TRANSCANADA HYDRO NORTHEAST INC.

ILP Study 25

Dragonfly and Damselfly Inventory and Assessment

Final Study Report

In support of Federal Energy Regulatory Commission Relicensing of:

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

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EXECUTIVE SUMMARY

The goals of this study were to conduct a survey and gather information about the distribution of river dependent odonate (dragonfly and damselfly) populations along the Connecticut River throughout the Wilder, Bellows Falls, and Vernon project-affected areas and to determine the effects of project operations on Vermont's seven dragonfly Species of Greatest Conservation Need, and an eighth species that may be rare.

This final study report includes additional analysis and discussion in response to stakeholder comments on the initial study report filed June 17, 2016.

The study was conducted in the summer of 2015 and included repeat surveys at eleven study sites. Biologists recorded 754 observations of pre-flight odonates and exuviae and documented eclosion behavior of riverine odonates. Six of the eight study focal species were located during surveys. *Gomphus vastus* and *Stylurus amnicola* were widespread throughout the study area. *Stylurus scudderi* was only found in the Bellows Falls and Wilder study areas, but was widespread within them. *Gomphus abbreviatus* was found in the Bellows Falls and Vernon study areas, most often in the impoundments. *Ophiogomphus rupinsulensis* was found only in the riverine reaches downstream of the Wilder and Vernon dams. *Gomphus quadricolor* was only found on one survey in the Wilder impoundment. *Gomphus ventricosus* and *Progomphus obscurus* were not located.

Project operations were evaluated through analysis of water level logger data and hydraulic and operations model (Studies 4 and 5) output. Project operations may have a small adverse effect on odonates; however, partial habitat inundation appears unlikely to adversely affect emerging odonates, since they are able to avoid, or compensate for such inundation. Rapid water level rises do have the potential to injure or kill odonates during the brief but vulnerable eclosion process. Rapid rates of rise that could affect eclosion were observed only at four study sites in the riverine sections below the dams and at one impoundment site close to a dam, and in all cases occurred less than 2% of the time during the critical emergence period (May 15 to August 31, 04:00 – 21:00) based on water level logger data. This level of potential mortality is unlikely to have a significant impact on odonate populations.

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List of Abbreviations and Definitions

Clubtail	A dragonfly of the family Gomphidae (Clubtails)
Critical Emergence Period	The timeframe spanning the dates of likely odonate eclosion
Eclosion	The process of leaving the larval exoskeleton to assume the adult form
Emergence	The time from which an odonate larva leaves the water until it takes flight
Exuvia(e)	The molted exoskeleton(s) of the larva that is cast off during eclosion
FERC	Federal Energy Regulatory Commission
Lotic	Associated with flowing water
RSP	Revised Study Plan
RTK	Real Time Kinematic Unit
SGCN	Species of Greatest Conservation Need
SSR	Site Selection Report
Teneral	Adult odonate not yet capable of sustained flight
TransCanada	TransCanada Hydro Northeast Inc.
USR	Updated Study Report
VANR	Vermont Agency of Natural Resources
VDEC	Vermont Department of Environmental Conservation
WSE	Water surface elevation

1.0 INTRODUCTION

This final study report presents the results of the 2015 Dragonfly and Damselfly Inventory and Assessment (ILP Study 25) conducted in support of Federal Energy Regulatory Commission (FERC) relicensing of the TransCanada Hydro Northeast Inc. (TransCanada) Wilder Hydroelectric Project (FERC Project No. 1892), Bellows Falls Hydroelectric Project (FERC No. 1855), and Vernon Hydroelectric Project (FERC No. 1904). TransCanada has initiated the Integrated Licensing Process (ILP) for these projects in order to renew their operating licenses beyond the current expiration date of April 30, 2019 for each project.

This final study report includes additional analysis and discussion in response to stakeholder comments on the initial study report filed June 17, 2016.

In its study request, Vermont Agency of Natural Resources (VANR) requested a baseline inventory of odonates and collection/synthesis of key life history, ecology, and habitat data to help assess the effects of current project operations on habitat and survival in the Wilder, Bellows Falls, and Vernon project-affected areas. The study request emphasized Species of Greatest Conservation Need (SGCN) but generally outlined objectives, methods, and analyses that would effectively target all odonate species that use riverine habitat for larval and eclosion life stages.

Seven of Vermont's SGCN dragonflies and damselflies (odonates) occur in the Wilder, Bellows Falls, and Vernon project-affected areas: *Gomphus abbreviatus* (spine-crowned clubtail), *Gomphus quadricolor* (rapids clubtail), *Gomphus ventricosus* (skillet clubtail), *Gomphus vastus* (cobra clubtail), *Ophiogomphus rupinsulensis* (rusty snaketail), *Stylurus amnicola* (riverine clubtail), and *Stylurus scudderi* (zebra clubtail). An eighth species, *Progomphus obscurus* (common sanddragon) which has not yet been recorded in Vermont may be rare. These eight species are all clubtails (members of the Gomphidae family). With the exception of *Stylurus scudderi,* these species reach the northern limit of their known range within the study area (Hunt 2010, Paulson 2011). However, the distribution of habitat of these (hereafter "focal species") and other odonate species is not well understood. Project operations may influence odonate assemblages in these areas, as well as their survival during emergence and eclosion.

Although dragonflies are most frequently observed as adults, they spend most of their life cycle as aquatic larvae. After growing for a year or more, larvae crawl from the water and metamorphose to adults. For the purposes of this study, emergence is defined as the time from which an odonate larva leaves the water until it takes flight. Eclosion occurs when the adult form exits the larval exoskeleton, or exuviae. After eclosion the teneral (adult not yet capable of sustained flight), dries and hardens before taking flight. During eclosion, odonates are unable to move until the process is complete, making it a particularly vulnerable part of their life cycle (Silsby, 2001; Paulson, 2011). Once the odonate has shed its exoskeleton, it is once again motile, and may continue to climb the bank or move in response to perceived threats (Wagner 1995, McMurray 2012).

One threat to odonates during eclosion is water level fluctuations (Martin, 2006; Martin, 2007). Any eclosing odonates that are immersed in rising water levels would likely be injured or die as a result. As project operations in the study area result in fluctuating water levels, the potential exists for eclosing odonates to become inundated.

The Revised Study Plan (RSP) for this study, as supported by stakeholders, was approved in FERC's February 21, 2014 Study Plan Determination with the following specific changes.

- Increase the survey frequency from once per month to twice per month from June through August.
- Deploy water level loggers at each study site throughout the entire study period.

This study documents the baseline distribution, relative abundance, habitat, and behavior of the river-dependent odonate assemblage, including the eight focal species; and assesses the potential effects of project operations, particularly water-level fluctuations, on these odonate species.

2.0 STUDY GOALS AND OBJECTIVES

This study had two related goals: 1) inventory the odonate assemblages dependent on large rivers in the project-affected areas, including life history, ecology, and behavior information for each species; and 2) assess the potential influence of project operations on river-dependent odonate larval emergence/eclosion and habitat. The four specific objectives were to:

1. conduct a baseline inventory and habitat assessment that builds on prior surveys in the project areas;
2. collect field data on the emergence and eclosion behavior of river-dependent odonates in the project areas;
3. review and synthesize available information on the life history, ecology, and behavior of river-dependent odonates that occur in the project areas; and
4. use information gathered in objectives 1–3, combined with data and analyses from other studies, to develop an overall assessment of the potential effects of project operations on odonate emergence/eclosion and habitat.

3.0 STUDY AREA

The study area encompassed the Wilder, Bellows Falls, and Vernon impoundments and riverine reaches below each dam. Eleven study sites were selected based on five criteria:

1. availability of larval habitat,
2. availability of eclosion habitat,
3. geographic breadth,
4. continuity with study sites from Hunt et al. (2010), and
5. accessibility.

Each study site extended for 100 meters along one bank of the river, parallel to the shoreline (Figure 3.1, Table 3.1). Note that Site 25-05 N and S are located along the bank of Hart Island which does not show on the topographic base map. These locations are not in water as depicted in Figure 3.1.

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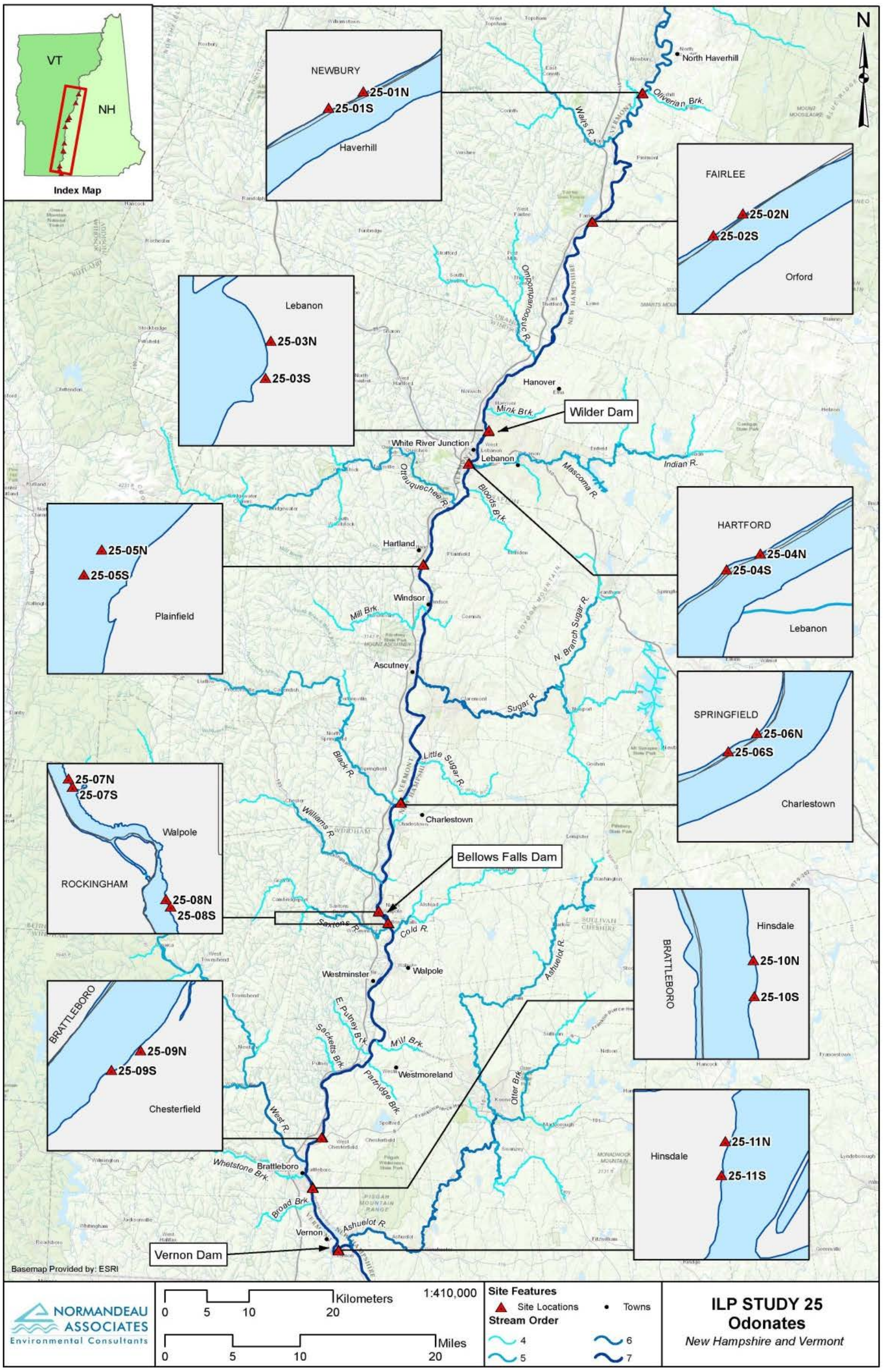

Note: Site 25-05 (N and S) are located along the bank of Hart Island which does not show on the topo base map. These locations are not in water as depicted above.

Figure 3.1. Study site locations. The northern and southern bounds of each 100-meter study site are identified by an “N” and an “S” respectively.

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Table 3.1. Study sites for dragonfly and damselfly inventory and assessment.

Site ID	Site Name	Study Reach	Previously Surveyed (Hunt, 2010)	Location[a] (WGS 1984)	
				Latitude	Longitude
25-01	Bedell Bridge	Wilder Impoundment	Yes	44.04611°	-72.07306°
25-02	Lyme	Wilder Impoundment	No	43.90444°	-72.14667°
25-03	Wilder Dam	Wilder Impoundment	Yes	43.67361°	-72.29750°
25-04	West Lebanon	Wilder-Riverine	Yes	43.63722°	-72.32583°
25-05	Plainfield/Cornish (Hart Island)	Wilder-Riverine	Yes	43.52556°	-72.39222°
25-06	North Charlestown	Bellows Falls Impoundment	Yes	43.26333°	-72.42167°
25-07	North Walpole	Bellows Falls Impoundment	Yes	43.14361°	-72.45306°
25-08	North Westminster	Bellows Falls-Riverine	No	43.13056°	-72.43889°
25-09	Chesterfield	Vernon Impoundment	Yes	42.89361°	-72.53194°
25-10	Broad Brook	Vernon Impoundment	Yes	42.83833°	-72.54500°
25-11	Stebbins Island	Vernon-Riverine	Yes	42.76889°	-72.50667°

a. Coordinates indicate the upstream terminus of the study site.

4.0 METHODS

4.1 Refinement of Study Plan

The RSP for this study proposed a total of three sample periods from June through August. During the site selection and permitting processes, the following modifications were made to the study plan:

- New Hampshire Fish and Game requested that the survey effort be increased from three surveys between June and August, to six surveys between June and August.
- All sampling events were conducted in June and July of 2015, to better match peak emergence (Table 4.1) of focal species. This modification was made in consultation with the terrestrial working group.

4.2 Site Selection

Appropriate habitat for odonates generally consists of fine aquatic bed substrates (sand and silt) for larvae, although some species have been reported to be associated with gravel substrate (*G. abbreviates*, *G. vastus*; McLain et al., 2004) with nearby steep, sparsely vegetated banks for eclosion. This habitat type appears to be widespread throughout the study area. ILP Study 7 – Aquatic Habitat

Mapping Study (Normandeau, 2015) mapped benthic substrates within the impoundments. Nearly all of the impoundments and many riverine sections had extensive sand/silt/clay components and the presence of sand substrates was confirmed prior to site placement.

The specific study site locations shown on Figures 3.1 were selected based on the aerial imagery, contours, and aquatic and terrestrial habitat maps generated during ILP Study 27 - Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study (Normandeau, 2016). Study sites were selected based on five criteria: availability of larval habitat, availability of eclosion habitat, geographic spread, continuity with Hunt et al. (2010), and accessibility. Hunt et al. (2010) qualitatively sampled ten sites within the study area. These sites included two in the Wilder impoundment, two in the riverine section below Wilder dam, three in the Bellows Falls impoundment, two in the Vernon impoundment, and one in the riverine section below Vernon dam. For continuity, nine of these study sites were retained for the current study (the third Bellow Falls impoundment site from the 2010 study was dropped). Two additional sites were selected, one in the Wilder impoundment, and one in the riverine section below the Bellows Falls impoundment.

When possible, east-facing banks were selected as odonates may eclose in the early morning (Silsby, 2001) and may select morning sunlight for rapid drying. For logistical reasons, when practicable, sample plots were placed in areas easily accessible from existing boat launches. In order to represent a broad range of operational effects, study sites were located at the northern and southern reaches of each impoundment, and in the riverine sections below the dams (Table 3.1).

A Site Selection Report (SSR) was prepared for stakeholder review and comment on April 28, 2015 (filed as part of the September 14, 2015 Updated Study Report). A working group consultation call on the SSR was held May 18, 2015 and the SSR was accepted without revision. A Scientific Collection Permit from VFWD and a Scientific License from NHFGD were issued in late May 2015. Site locations were GPS-located based on a preliminary field visit conducted in late May 2015 (locations are presented in Figure 3.1).

4.3 Literature Review

Although there are several previous studies of odonates within the study area, those studies focused primarily on species inventory. The earliest attempt at an inventory of riverine odonate species was conducted in 2005 and 2006 (Hunt, 2010). That study documented seven of the eight focal species, and identified three prior records of the remaining species, *Gomphus quadricolor*, from the study area. Additional inventory of the study area was conducted during the New Hampshire Dragonfly Survey between 2007 and 2011. This citizen-science based statewide study resulted in records of six of the eight focal species documented within the project area (Hunt, 2012).

The odonate populations along the Connecticut River in Massachusetts and Connecticut have been more extensively studied. Odonate studies in the vicinity of Turner's Falls dam, located downstream of the study area, focused primarily on

documenting the response of odonate populations to bank stabilization (McLain, 2008; McLain et al., 2006; Morrison et al., 2006). Beginning in 2006, mortality studies were conducted as well. Those studies found the most frequent causes of odonate mortality to be the result of boat wakes and predation. However, there were two observations of odonate mortality as the direct result of water level changes (Martin, 2006; Martin, 2008). In a Connecticut study, the only documented mortality was the result of predation (Wagner et al., 1995).

Those studies did not focus on eclosion behavior, but observations of eclosion behavior were made. At Turner's Falls, observers measured linear distance travelled (Martin, 2006; Martin, 2008); however, this measurement is not directly applicable to odonate eclosion height. No attempt was made to time emerging odonates. Wagner et al. (1995) estimated the total time from departure from the water to completion of eclosion to be 30 to 40 minutes.

4.4 Field Surveys

Six surveys were conducted between June 1 and July 30. Surveys were timed to the flight periods to maximize the probability of encountering emergence and eclosion of the focal species (Table 4.1). All data were recorded in the field on paper data sheets (Appendix A) and later transferred to an electronic database.

Table 4.1. Flight periods for focal species (Hunt, 2012).

Species	Early Date	Late Date[a]	Peak Flight Period[b]
Gomphus abbreviatus	5/20	7/27	5/21-6/20
Gomphus quadricolor	5/30	6/30	5/30-6/10
Gomphus vastus	5/28	7/22	6/1-6/30
Gomphus ventricosus	6/1	6/22	6/1-6/10
Ophiogomphus rupinsulensis	5/29	8/28	6/1-6/20
Stylurus amnicola	6/14	7/1	7/1-7/10
Stylurus scudderi	7/1	9/20	7/10-7/31
Progomphus obscurus	6/10	8/21	6/11-7/10

[a] Late dates only include observations of adults, as exuviae rarely linger for weeks or months after eclosion.

[b] Peak flight period was defined as the narrowest range of dates in which at least half of all observations (including exuviae) of a species were recorded. The peak flight period for *Stylurus amnicola* falls almost entirely after the late date for the species because only one adult was observed, and the remainder of observations relied on exuviae.

At each 100-meter long study site, five three-meter wide transects were subjectively established to sample representative habitats within the study site. Transects ran perpendicular to the shoreline from the estimated low water line or lower edge of vegetation to the top of bank or 1 meter into dense vegetation. During each survey, each transect was searched thoroughly for larvae, tenerals (pre-flight adults), and exuviae. Each individual was either identified in the field (if possible), or tagged and preserved for identification. Exuviae identified in the field were removed to ensure that individuals were not double counted on future visits. For each specimen identified, species, life stage (larva, eclosing, exuvia, or

teneral), surface the specimen was found on, and vertical and horizontal distance from the observed water line were collected.

Larval samples were collected by sweeping a D-net through bed substrate for a total of 2 minutes and placing the samples into a white pan in the field. Each site was sampled in a representative section of the habitat in shallow water. Larvae were identified in the field, and were removed from the pan to prevent double counting. Larval prey species collected in the sample were assessed using a rapid bioassessment protocol (Barbour et al., 1999). Individuals were identified to order and an abundance class assigned based on the number of individuals per order: Dominant (50+), Abundant (10-49), Common (4-9), Uncommon (1-3).

4.5 Habitat Assessment

Field staff conducted a detailed habitat assessment at each transect along each study site. For each transect, the following habitat characteristics were estimated: bank height, steepness, and relative stability; percentage of the bank consisting of bare substrate, vegetation, and other cover; and percent canopy cover. A real time kinematic unit (RTK) was used to determine the elevation of the toe-of-slope and top-of-bank for several representative transects at each study site. These data were compared with the odonate observations within and across study sites to evaluate the potential effects of project-related water level fluctuations during the critical emergence period.

4.6 Water Level Data

Project-related water level fluctuations were analyzed using on-site water level logger data. Water depths were recorded at fifteen minute intervals using HOBO® water level loggers deployed at each study site. Elevations of the loggers were determined using the RTK. Water surface elevations (WSE) were used in combination with bank elevations to evaluate the potential effects of water level fluctuations on odonate emergence. Considering the Wagner et al. (1995) estimate of 30-40 minutes for larvae to complete eclosion after emerging from the water, changes in water surface elevation at each study site were determined for 30-minute time periods by calculating the difference (positive=increasing, negative=decreasing) in WSE from the previous half hour. The rate of water level rise was calculated for each odonate eclosion point and the risk of inundation due to rising water was estimated.

5.0 RESULTS AND DISCUSSION

5.1 Species Inventory, Abundance, and Distribution

Twenty-eight species of odonate (Table 5.1) were found along the Connecticut River within the study area during surveys. Nineteen of these species were found during transect surveys; nine species were found incidentally elsewhere at the site as exuviae or flying adults. Of the species found as incidentals, seven were damselflies. A complete list of transect observations are included in Appendix B. Photo documentation was collected whenever feasible (Appendix C).

Overall species richness was generally uniform, with every study site recording between nine and 15 species. A total of 15 species were recorded at study sites associated with the Bellows Falls and Vernon projects, and 23 species were recorded at sites associated with the Wilder project. The higher richness in the Wilder study area is primarily the result of several species typically associated with lentic (stillwater) habitat. For instance Site 25-03 the site has odonates more associated with lentic habitats, even though the site is not truly lentic.

Table 5.1. Odonate species observed at each site (focal species bold). T = observed on one or more transects, B = observed during benthic sampling but not on transects, I = observed only as an incidental.

Species	**Site**										
	Wilder					**Bellows Falls**			**Vernon**		
	Impoundment			**Riverine**		**Impoundment**		**Riverine**	**Impoundment**		**Riverine**
	25-01	**25-02**	**25-03**	**25-04**	**25-05**	**25-06**	**25-07**	**25-08**	**25-09**	**25-10**	**25-11**
Total Species Richness	12	15	15	9	10	11	12	11	12	9	14
Species Richness (Transects only)	8	10	8	5	5	7	8	7	7	5	9
Aeshna umbrosa			I								
Argia apicalis											I
Argia moesta	I	I	I	I	I	I	I	I	I	I	I
Basiaeschna janata		I	T			I					
Boyeria vinosa			T	T	T	T		T	T		T
Chomagrion conditum					I						
Cordulegaster maculata		I	I		T						
Didymops transversa	T	T	T								
Dromogomphus spinosus	T	T	T			T	T	T	T	T	T
Enallagma ebrium	I	I									
Enallagma exulsans	I	I	I	I	I	I	I	I	I	I	I
Enallagma signatum			I				I				
Epitheca cynosura			T								
Epitheca princeps	I	T	T	I		I	T	I	I	I	I

Species	Site										
	Wilder					Bellows Falls			Vernon		
	Impoundment			Riverine		Impoundment		Riverine	Impoundment		Riverine
	25-01	25-02	25-03	25-04	25-05	25-06	25-07	25-08	25-09	25-10	25-11
Gomphus abbreviatus							T		T	T	T
Gomphus exilis			T								
Gomphus quadricolor		T									
Gomphus vastus	T	T			T	T	T	T	T	T	T
Hagenius brevistylus							T				
Heliocordulia uhleri			I								
Macromia illinoiensis	T	T	B/I	I	I	T	T	I	I	I	I
Nehalennia gracilis									I		
Neurocordulia yamaskanensis	T	T		T			I	T	T	T	T
Ophiogomphus rupinsulensis				T	T						T
Stylogomphus albistylus											T
Stylurus amnicola	T	T				T	T	T	T		T
Stylurus scudderi	T	T		T	B/I	T		T			
Stylurus spiniceps	T	T	T	T	T	T	T	T	T	T	T

A total of 754 observations of larvae, exuviae, and adults were made during transect searches (Table 5.2). The three sites with the fewest odonate observations were in riverine reaches. The two sites in the Wilder riverine reach (Sites 25-04 and 25-05) had the fewest observations, with each site recording nine individual odonates on transects. The site in the Bellows Falls riverine reach (Site 25-08) had 30 observations. The site in the Vernon riverine reach (Site 25-11) had 159 observations, more than any other site.

Species richness at the two Wilder riverine sites was also lower than at the other riverine sites, with five species recorded on each of the two Wilder transects and nine species on each of the single Bellows Falls and Vernon riverine transects. The site directly above Wilder dam (Site 25-03) was the only site that did not record any of Vermont's SGCN species.

Of the nineteen species found on transects, two species of clubtail, *Gomphus vastus* (a focal species) and *Stylurus spiniceps*, were each observed more than 200 times, and accounted for a total of 62% of all odonate observations on the transects (Table 5.2). *Stylurus spiniceps* was the only species observed on all transects. *Gomphus vastus* was nearly as widespread, with observations at nine of the eleven study sites. *Epitheca princeps* and *Dromogomphus spinosus* were each observed more than 50 times. Nine of the remaining species were each observed more than 10 times, and the remaining six species were observed fewer than 10 times.

Benthic surveys contributed minimal additional information on odonates or potential prey abundance. These surveys did not result in detection of species that were not observed otherwise. At two sites, a single species was identified during benthic sampling (not the same species at each site) and not on transect surveys; however, in both instances, exuviae of that same species were observed but only incidentally at the study site. Three species of clubtail were recorded during benthic surveys: *Stylurus spiniceps* (53), *Stylurus scudderi* (5; a focal species), and *Dromogomphus spinosus* (7). Species in the genus *Gomphus*, in particular, are known to burrow deep into the sediment, and D-net samples are unlikely to capture them. Most samples were characterized by low numbers of prey and clubtail larvae, with few samples with large numbers of either prey, larvae, or both. Odonate larval abundance appeared to be unrelated to both prey abundance and species richness.

Table 5.2. Number of observations of each species on transect surveys by site. Focal species are in bold.

	Site											
	Wilder					Bellows Falls			Vernon			
Species	**25-01**	**25-02**	**25-03**	**25-04**	**25-05**	**25-06**	**25-07**	**25-08**	**25-09**	**25-10**	**25-11**	**Total**
Basiaeschna janata			3									3
Boyeria vinosa			1	2	4	1		3	1		1	13
Cordulegaster maculata					1							1
Didymops transversa	1	1	3									5
Dromogomphus spinosus	3	12	11			6	6	1	9	17	3	68
Epitheca cynosura			21									21
Epitheca princeps		1	56				4					61
Gomphus abbreviatus							**2**		**2**	**5**	**1**	**10**
Gomphus exilis			1									1
Gomphus quadricolor		**1**										**1**
Gomphus vastus	**3**	**15**			**1**	**39**	**23**	**9**	**22**	**8**	**121**	**241**
Hagenius brevistylus							1					1
Macromia illinoiensis	7	1				2	2					12
Neurocordulia yamaskanensis	5	2		1				3	5	3	4	23
Ophiogomphus rupinsulensis				**1**	**2**						**7**	**10**
Stylogomphus albistylus											1	1
Stylurus amnicola	**2**	**2**				**21**	**3**	**2**	**6**		**3**	**39**
Stylurus scudderi	**4**	**1**		**3**		**3**		**1**				**12**
Stylurus spiniceps	23	13	20	2	1	60	34	11	36	13	18	231
Total	**48**	**49**	**116**	**9**	**9**	**132**	**75**	**30**	**81**	**46**	**159**	**754**

5.2 Focal Species

Six of the eight focal species were recorded on transects: *Gomphus abbreviatus, Gomphus quadricolor, Gomphus vastus, Ophiogomphus rupinsulensis, Stylurus amnicola,* and *Stylurus scudderi* (Table 5.3). The remaining two species, *Gomphus ventricosus* and *Progomphus obscurus*, were not expected to be recorded. *Gomphus ventricosus* has only been identified within the Vernon study area and was not recorded during the 2005-2006 study (Hunt et al., 2010) or subsequently (Hunt, 2012). *Progomphus obscurus* is only known from a single observation of a female in the Wilder riverine reach, and may not have an established population on the Connecticut River.

Gomphus abbreviatus was found at all three sites in the Vernon study area (Sites 25-09, 25-10, 25-11), but was also found at a single site in the Bellows Falls impoundment (Site 25-07). This species was previously only known to occur in the Vernon study area, so this represents an extension of the species' known range. Although it was found at four different sites, *Gomphus abbreviatus* was only observed ten times on transects. Nine of the ten observations came from sites in impoundments, and seven of those were in sites immediately upstream of the dams, suggesting that the species may be more likely to occur in impounded areas of the river.

Gomphus quadricolor was only located at a single site (Site 25-02) in the Wilder impoundment, where a single exuvia was found during transect surveys. Tenerals were noted at the site incidentally (i.e., not within study site transects) during the same survey. This represents a range extension over previous surveys, in which this species had been recorded only in the Vernon study area, and in extremely low densities (Hunt et al., 2010; Hunt, 2012). Failure to detect the species in the Vernon, and possibly Bellows Falls, study sites is likely a result of low densities, rather than extirpation.

Gomphus vastus was detected at nine study sites, and was the most frequently found species during transect surveys. However, it was not found at study sites immediately upstream and downstream of Wilder dam (Sites 25-03 and 25-04). This species was also not found in the vicinity of these sites during 2005-2006 field work (Hunt et al., 2010).

Ophiogomphus rupinsulensis was only recorded from riverine reaches (Sites 25-04, 25-05, 25-11). No site had high numbers of this species, although seven of the ten exuvia were collected from the same site (Site 25-11). This species has been previously found in the Bellows Falls and Vernon impoundments as well as the Bellows Falls riverine reach, and likely still occurs in these areas, but at low densities. Notably, this species was found at both study sites in the Wilder riverine reach despite those sites having the lowest odonate abundances on transects.

Stylurus amnicola was recorded from eight sites. It was notably absent from the Wilder riverine reach (Sites 5-04 and 25-05), but was found in the remaining impoundments and riverine reaches. It was also not found at the site above Wilder dam (Site 25-03). This is consistent with previous surveys (Hunt et al., 2010;

Hunt, 2012), where the species was not found in this stretch. Of special note was a teneral female observed on July 29 at Site 25-02 (Lyme, NH). This species had not previously been recorded as an adult after July 1 in New Hampshire, and is only previously known from Vermont from exuviae. As exuviae only rarely linger for weeks after emergence, this observation contributes to our understanding of the flight season of this rarely observed species.

Stylurus scudderi was observed in the Bellows Falls and Wilder study areas, and was widespread within them. This species was not observed at the sites immediately above either dam (Sites 25-03 and 25-07).

Table 5.3. Summary of distribution of focal species identified during transect surveys.

Species	Project	Location Type
Gomphus abbreviatus	Bellows Falls, Vernon	Impoundment
Gomphus quadricolor	Wilder	Impoundment
Gomphus vastus	Wilder, Bellows Falls, Vernon	Impoundment, Riverine
Ophiogomphus rupinsulensis	Wilder, Vernon	Riverine
Stylurus amnicola	Wilder, Bellows Falls, Vernon	Impoundment, Riverine
Stylurus scudderi	Wilder, Bellows Falls	Impoundment, Riverine

5.3 Habitat and Eclosion Behavior

Based on the presence of exuviae, odonate eclosion occurred on 53 of the 55 transects (96%) within the eleven study sites. Transects with few or no odonate observations were widely variable in all habitat characteristics and no consistent trends were found although 11 study sites is a small sample size. In this study, no specific habitat or substrate characteristics appeared to be directly associated with odonate abundance; however, transects with particularly high numbers of odonate observations (i.e., >30) all had generally low (30% or less) cover of exposed substrate, and generally high (50% or more) cover of coarse woody debris, exposed roots, and other non-vegetative cover. Canopy cover did not appear to be related to the occurrence of odonates at a site.

Eclosion substrate was found to be variable within species, and no patterns of preferential eclosion substrate were noted between species in this study (Table 5.4). Many exuviae had been dislodged from their eclosion substrate (for example, were laying upside down), and were therefore excluded from this analysis. Because eclosion substrate was identified for each individual, it was practical to classify substrates more narrowly than the three habitat classifications.

Excluding dislodged specimens, odonates and exuviae were most frequently found on soil (203 observations) and leafy vegetation (herbaceous vegetation and living leaves of woody plants, 177 observations). However, the high occurrence of these eclosion substrates does not necessarily mean that odonates preferentially eclose on these substrates. Most banks were dominated by herbaceous vegetation and

observers noted that exuviae were most conspicuous on exposed soil, and detection probability was likely biased towards exuviae on exposed soil. These observations suggest that patterns in eclosion substrate may actually be the result of site characteristics rather than selection by odonates. Quantitative habitat data is presented in Appendix E.

Species did not generally show any preference for eclosion substrate. However, two species, *Gomphus vastus* and *Ophiogomphus rupinsulensis*, were found more frequently on soil than on other eclosion substrates, but both of these species were also found more frequently than other species at a single site (25-11) which had above average proportion of exposed soil. Although this could be the result of a preference for banks with exposed soil, it could also be reflective of other factors including the timing of surveys and/or the location of the study site near the southern edge of the study area. When site 25-11 is excluded from the analysis, both species had a homogeneous distribution of eclosion substrates.

Table 5.4. Eclosion substrate associated with the number of exuviae found during transect surveys.

	Basiaeschna janata	*Boyera vinosa*	*Cordulegaster maculata*	*Didymops transversa*	*Dromogomphus spinosus*	*Epitheca cynosura*	*Epitheca princeps*	*Gomphus abbreviatus*		*Gomphus exilis*	*Gomphus quadricolor*	*Gomphus vastus*	*Hagenius brevistylus*	*Macromia illinoiensis*	*Neurocordulia yamaskanensis*	*Ophiogomphus rupinsulensis*	*Stylurus albistylus*	*Stylurus amnicola*	*Stylurus scudderi*	*Stylurus spiniceps*
Dislodged	0	4	0	2	7	3	8	2		0	0	33	0	6	5	1	0	4	1	42
Roots	3	2	1	0	6	0	1	2		0	0	30	0	2	8	1	0	10	1	27
Woody Vegetation	0	2	0	0	4	1	15	0		0	1	7	0	1	0	0	0	2	1	39
Leafy Vegetation	0	4	0	1	21	11	29	4		1	0	44	1	2	7	1	0	5	2	44
Soil	0	0	0	2	18	6	5	2		0	0	89	0	1	1	6	1	16	4	52
Cobble/Gravel	0	0	0	0	0	0	0	0		0	0	2	0	0	0	0	0	0	0	0
Boulder/Bedrock	0	0	0	0	1	0	0	0		0	0	0	0	0	0	0	0	0	0	5
Leaf Litter/Dead Vegetation	0	1	0	0	11	0	3	0		0	0	35	0	0	2	1	0	2	3	19
Other[a]	0	0	0	0	0	0	0	0		0	0	1	0	0	0	0	0	0	0	3

a. "Other" included human litter, and one occurrence of eclosion occurring on an observer's leg.

Odonate surveys were conducted between 07:00 and 20:00. Eclosion was observed on transects throughout the day with the earliest observation at 08:52 and the latest observations at 16:53. Odonates were observed incidentally eclosing prior to the start of surveys, and 25% of eclosion events occurred after 16:00. These observations suggest that odonate eclosion can occur across a wider period of the day than the time period during which it was observed on the transects. Odonates were observed eclosing during all conditions in which surveys were conducted, including temperatures as low as 55°F and as high as 80°F, clear and cloudy skies, dry and rain, and low and high water elevations.

Exuviae were found at vertical distances from 0 to 204 inches from the water surface (Figure 5.1). Five species were represented by a single observation on transects and are depicted in the figure by a circle with a line through the location of that observation.Many of these exuviae had obviously been dislodged from their eclosion substrate, and water level at the time of eclosion could not be determined. For this analysis, the vertical distance from the water surface at which an exuvia was found was assumed to be the vertical distance from the water surface at which the individual eclosed.

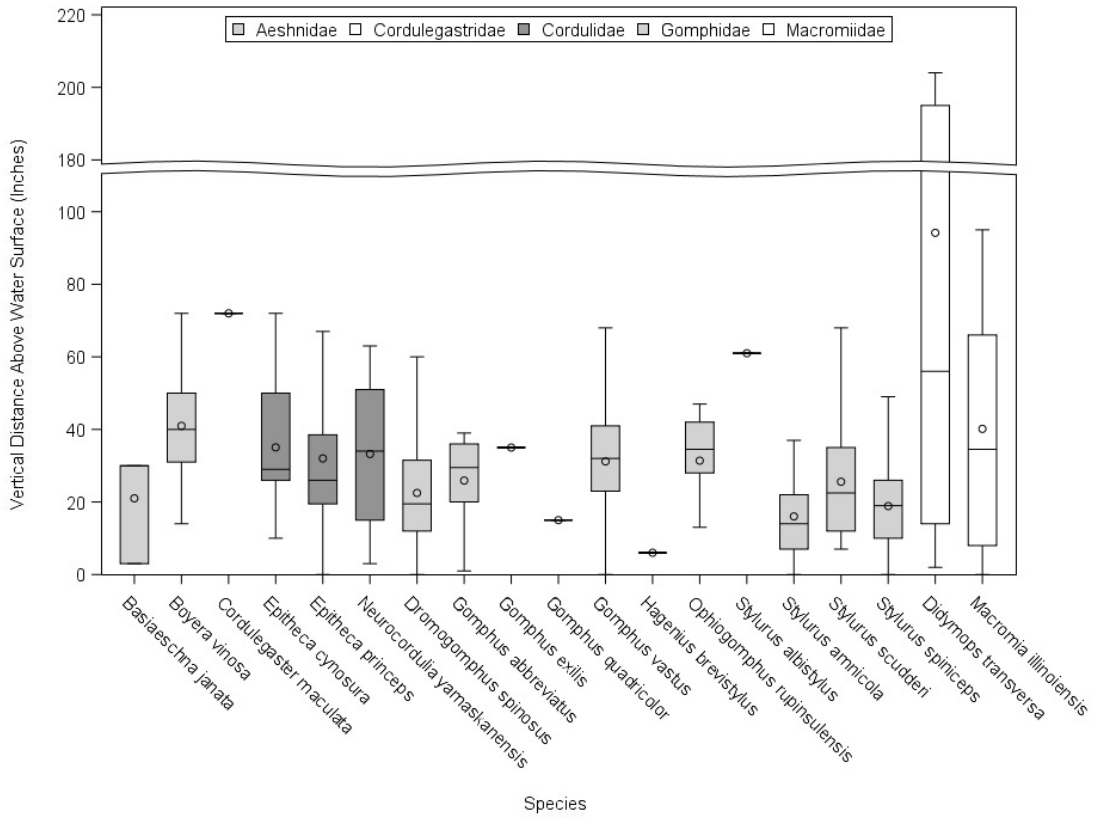

Figure 5.1. Distances from the water surface of odonate exuviae recorded during transect surveys. Maximum and minimum values are represented by the whiskers. The first and third quartiles are indicated by the bounds of the box. The median is represented by a horizontal line in

the interior of the box, and the mean is represented by a circle in the interior of the box.

Twenty-three larvae were observed in the process of eclosing during surveys. Eighteen of these observations were of *Stylurus spiniceps*, the remaining five observations were of *Didymops transversa, Dromogomphus spinosus, Gomphus vastus, Macromia illinoiensis,* and *Stylurus scudderi*. As *Stylurus spiniceps* was the only species for which multiple individuals were observed, discussion of eclosion behavior will focus on this species. Five *Stylurus spiniceps* were observed from the point at which they first left the water until they flew off as adults. The distance and amount of time that a larva spent on shore prior to eclosing varied, even within species. Several larvae eclosed almost immediately after leaving the water, but others walked for an hour or more before beginning to eclose. Several times, larvae were knocked loose of their substrate by waves or debris, and would right themselves or swim back to shore and resume climbing. Biologists were able to observe the full eclosion process of *Stylurus spiniceps* eight times, from when the exoskeleton first split until the teneral was able to either begin to fly, or climb higher on the bank. For each of these observations, the total time to complete eclosion ranged from 20-45 minutes, with an average 31 minutes. This is consistent with previous observations of eclosion of lotic species (Wagner et al., 1995). Although tenerals did not immediately take flight as adults after eclosing, they were mobile, and continued to climb upward. One teneral that fell from its perch was observed swimming to an overhanging branch, climbing away from the water and eventually taking flight.

The mean vertical distance from the water surface at which eclosing *Stylurus spiniceps* were observed was 12 inches (range of 8-16 inches). This differs significantly ($p=0.007$) from the mean vertical distance from water observed for exuviae of *Stylurus spiniceps* (20 inches) during the transect surveys. This variation is expected, as exuviae of individuals that eclosed during higher water elevations would be deposited higher than exuviae of individuals that eclosed during lower water elevations and those exuviae could have been inundated or swept from the bank when water levels rose again. The lower exuvia were more likely to have been swept from the bank when water levels rose again. The mean horizontal distance from the water surface at which eclosing *Stylurus spiniceps* were observed was 50 inches (range of 0-125 inches).

At the three sites with the smallest range of daily water surface elevation fluctuation (Sites 25-07, 25-09, and 25-10), the average vertical distance from the water surface for *Stylurus spinceps* exuviae was only 2 inches higher than for eclosing larvae and was not statistically different ($n=71$, mean=14 inches, $p=0.56$). These results suggest that the average distance of exuviae from the water surface can represent the eclosion distance from the water only when water level fluctuation is not large enough to remove the lower deposited exuviae.

Three of the six focal species were also recorded at the three sites listed above. *Gomphus abbreviatus* ($n=9$, mean=25 inches vertical distance from water surface) exuviae were found on average 11 inches higher than *Stylurus spiniceps* at the

same sites. *Gomphus vastus* (n=52, mean=31 inches) exuviae were found, on average, 17 inches higher than *Stylurus spiniceps* at these sites. *Stylurus amnicola* (n=9, mean=11 inches) exuviae were found on average 3 inches lower than *Stylurus spiniceps* at these sites. These data suggest that *Gomphus abbreviatus* and *Gomphus vastus* eclose farther from the water surface compared to *Stylurus spiniceps* and are less susceptible to water level rises. *Stylurus amnicola* ecloses closer to the water surface relative to *Stylurus spiniceps* and therefore may be more vulnerable.

Although *Stylurus scudderi* was not found at the three sites listed above, it was found elsewhere on average 7 inches higher (n=12, mean=26 inches vertical distance from water surface) than *Stylurus spiniceps*, suggesting it usually ecloses higher along the bank. Vertical measurements of the remaining two focal species do not provide insight into eclosion height. Only one *Gomphus quadricolor* exuvia was located (18 inches vertical distance from the water surface), so no analysis can be performed. *Ophiogomphus rupinsulensis* was found only in riverine reaches, and most exuviae were found during June, when water levels in 2015 were most variable (mean=31 inches vertical distance from the water surface, n=10).

Although horizontal distance of exuviae from the water surface was measured in the field, it was found to be of limited use. Because of variable water levels, the non-uniform nature of the bank profiles and the non-linear path frequently observed for emerging larvae, the actual horizontal distance travelled could not be determined unless the individual was tracked from emergence from the water to its eclosion location.

5.4 Observed Water Level Fluctuation

The on-site water level loggers showed a range of water level fluctuation between 2.7 and 11.0 feet at the sites over the water level logger periods of record which varied by study site but generally spanned mid-May to late July (Table 5.5, Appendix D). In general, the sites with the widest fluctuation ranges were in riverine reaches, and the sites with the smallest ranges were in the impoundments close to the dam. However, Bedell Bridge (Site 25-01) at the upper end of the Wilder impoundment had a large water level fluctuation, being influenced primarily by upstream inflow rather than by Wilder project operations. The study period and water level logger data encompassed periods of sustained spill at all three projects due to high water events that occurred on several occasions in June and into early July (Figure 5.1).

Table 5.5. Recorded maximum, minimum, and range of water surface elevations[1] (in feet) for water level logger periods of record at each odonate site, 2015.

Site	Location		Max WSE (ft) NAVD88	Min WSE (ft) NAVD88	Recorded Range (ft)[a]	Logger Period of Record
25-01	Wilder	Impoundment	392.6	383.4	9.2	05/21 – 07/13
25-02			386.5	382.4	4.1	05/21 – 07/29
25-03			385.0	381.1	3.9	05/20 – 07/29
25-04		Riverine	334.1	324.5	9.6	05/20 – 07/29
25-05			310.2	299.2	11.0	05/21 – 07/30
25-06	Bellows Falls	Impoundment	292.0	289.3	2.7	05/20 - 07/28
25-07			291.2	288.4	2.8	05/20 – 07/28
25-08		Riverine	235.8	225.5	10.3	05/19 – 07/28
25-09	Vernon	Impoundment	221.4	217.0	4.4	05/19 – 07/27
25-10			220.0	216.6	3.4	05/18 – 07/27
25-11		Riverine	189.8	181.7	8.1	05/20 – 07/27

a. Logger data includes periods outside of normal project operations, including spill.

[1] All WSE values from water level loggers and model output are reported in the North American Vertical Datum of 1988 (NAVD 88).

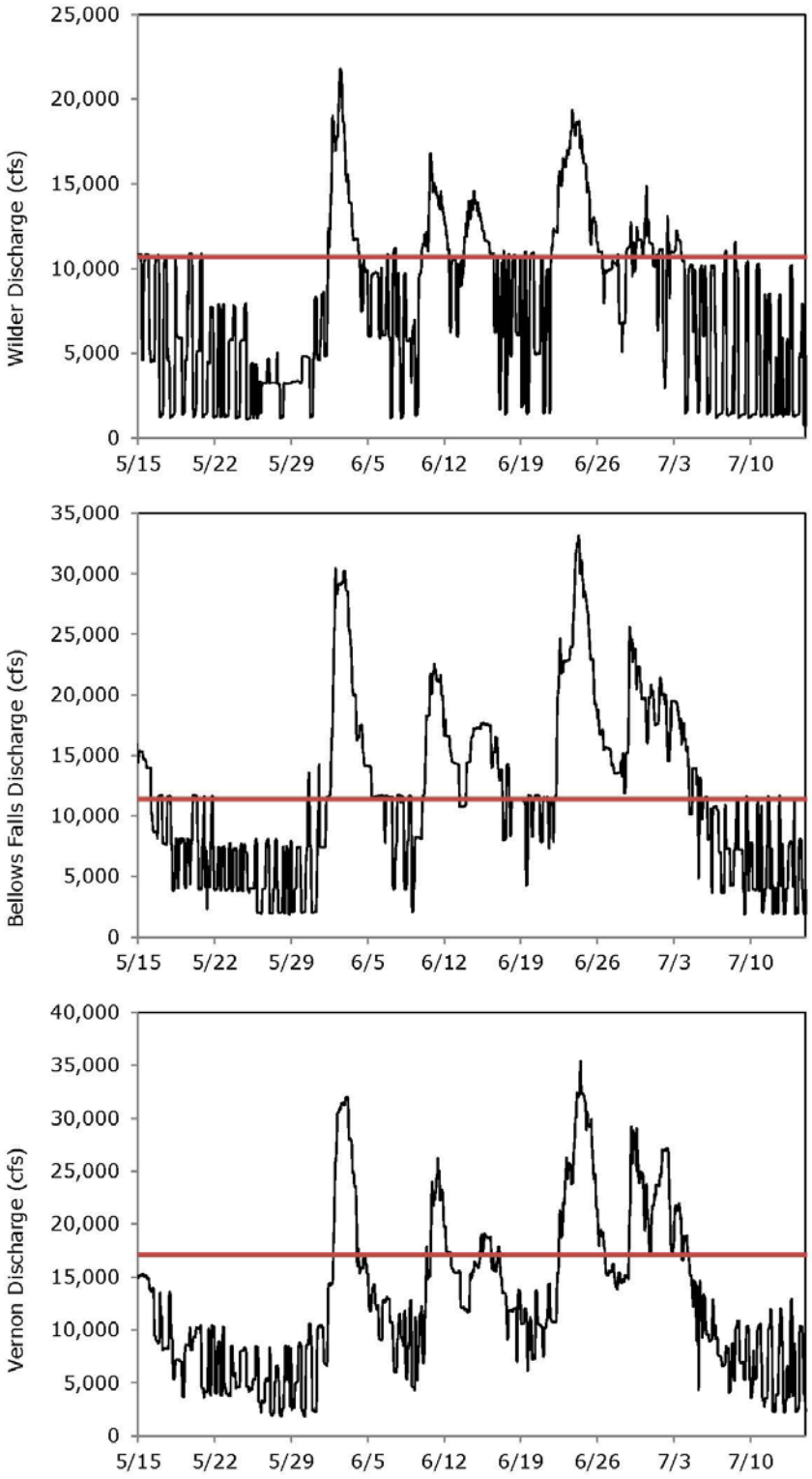

Figure 5.1. Hourly average total project discharge (cfs) for: Wilder (top panel), Bellows Falls (center panel), and Vernon (bottom panel) during the study period. The horizontal line indicates full station generating capacity.

6.0 ASSESSMENT OF PROJECT EFFECTS

Project operations have the potential to cause direct adverse effects on odonate populations. There are two potential types of adverse effects: 1) loss of habitat when the entire bank height becomes inundated; and 2) direct mortality due to rising water levels at the time of eclosion if the water rises enough to submerge the individual. These effects are discussed separately in the sections below.

6.1 Habitat Inundation

As discussed in Section 5.3, no consistent trends were found in substrate or habitat preferences based on observed odonates or abundance. However, steep banks may be beneficial to odonate larvae, as odonates are able to distance themselves further from the water with the same total distance travelled. For purposes of this discussion, it is assumed that availability of steep riverbank habitat is beneficial and inundation of this habitat may result in increased mortality. There is potential for habitat needed during the critical emergence period to be unavailable when the entire bank height becomes inundated. For purposes of assessing project effects on habitat, hourly WSE data from the hydraulic and operations models (ILP Study 4, GEI 2016; and ILP Study 5, Hatch, 2016) was analyzed during the critical period for emergence, defined as the season and times of day during which odonates are most likely to eclose. For this study, the critical period for emergence was defined as May 15 to August 31, between 04:00 and 21:00 (Hunt, 2012; Paulson, 2011). This period is broader than the field survey period. For safety reasons and the ability to visually observe odonates, the field surveys were conducted between 07:00 and 20:00. Odonates were observed on transects only from 09:00 and 17:00; but were observed eclosing incidentally (not at transects) prior to the start of surveys and 25% of eclosion events occurred between 16:00 and 17:00. It is reasonable to assume that some eclosion also occurs outside of the field survey window.

Hydraulic model cross sections were identified at, or nearest to, the study sites. Rating curves at those locations were analyzed to determine if the range of measured habitat elevations (from toe-of-slope to top-of-bank along representative transects at each study site) fell within the modeled range of normal project operations WSEs at each study site in order to screen each site for potential project effects. In all cases, the maximum habitat elevation was determined to never be inundated under normal project operations so that at least some portion of the suitable habitat range is always available for larvae to emerge and initiate eclosion (Table 6.1).

Table 6.1. Hydraulic model screening of project effects on habitat elevation ranges.

Site ID#	Location	Project Area	Model Node#	Model Max. WSE (ft)[a] NAVD88	Min. Habitat Elev. (ft) NAVD88	Max Habitat Elev. (ft) NAVD88	Available Habitat Height at Max WSE (ft)[b] NAVD88	Habitat Inundation Under Normal Project Operations Based on Hydraulic Model Output
25-01S	Bedell Bridge	Wilder Impound.	1166	388.6	385.2	394.7	6.1	Max Habitat Elev never inundated. Min Habitat Elev inundated at project-controlled flows >~4,000 cfs at low dam WSE to > ~7,000 cfs at high Wilder dam WSE.
25-02N	Lyme	Wilder Impound.	1051	385.5	382.5	394.3	8.8	Max Habitat Elev never inundated. Min Habitat Elev inundated at at all project-controlled flows, at Wilder dam WSE >382.5 ft.
25-03N	Wilder Dam	Wilder Impound.	878	384.1	383.3	388.3	4.2	Max Habitat Elev never inundated. Min Habitat Elev inundated at all project-controlled flows, at Wilder dam WSE >383.3 ft.
25-04N	West Lebanon	Wilder Riverine	845	328.0	324.4	330.3	2.3	Max Habitat Elev never inundated. Min Habitat Elev inundated at all project-controlled flows.
25-05S	Plainfield/ Cornish (Hart Island)	Wilder Riverine	750	304.6	300.8	310.9	6.3	Max Habitat Elev never inundated. Min Habitat Elev inundated at project-controlled flows >~4,000 cfs.
25-06S	North Charlestown	Bellows Falls Impound.	575	291.3	288.7	296.9	5.6	Max Habitat Elev never inundated. Min Habitat Elev inundated at project-controlled flows and at all Bellows Falls dam WSEs.
25-07S	North Walpole	Bellows Falls Impound.	517	291.0	288.8	298.8	7.8	Max Habitat Elev never inundated. Min Habitat Elev inundated at project-controlled flows and at all Bellows Falls dam WSEs.
25-08S	North Westminster	Bellows Falls Riverine	495	229.7	227.8	231.2	1.5	Max Habitat Elev never inundated. Min Habitat Elev inundated at project-controlled flows >~7,500 cfs.
25-09S	Brattleboro/ Chesterfield	Vernon Impound.	238	220.0	218.2	224.1	4.1	Max Habitat Elev never inundated. Min Habitat Elev inundated at project-controlled flows and at all Vernon dam WSEs.
25-10S	Broad Brook	Vernon Impound.	133	219.6	218.1	225.1	5.5	Max Habitat Elev never inundated. Min Habitat Elev inundated at project-controlled flows and at all Vernon dam WSEs.

Site ID#	Location	Project Area	Model Node#	Model Max. WSE (ft)[a] NAVD88	Min. Habitat Elev. (ft) NAVD88	Max Habitat Elev. (ft) NAVD88	Available Habitat Height at Max WSE (ft)[b] NAVD88	Habitat Inundation Under Normal Project Operations Based on Hydraulic Model Output
25-11N	Stebbins Island	Vernon Riverine	125-VR	186.0	181.6	188.5	2.5	Max Habitat Elev never inundated. Min Habitat Elev inundated at project-controlled flows from minimum flow at high Turners Falls dam operating WSE, to >~4,300 cfs or less including minimum flow, within Turners Falls dam normal operational WSE (179.9 – 181.6 ft NAVD88).

a. Approximate hydraulic model maximum WSE elevation at the site under normal project operations.
b. Available habitat height under normal project operations.

Operations model data was used to evaluate the frequency and duration of inundation at the study sites. Figures 6.1-6.11 illustrate hourly site-specific WSE values from transect locations and results from the operations model, including high flows exceeding station capacities. Figures 6.4, 6.5, 6.8, and 6.11 illustrate that at the four riverine sites (25-04, 25-05, 25-08, 25-11) typical habitat may be inundated under high flow conditions that cause abnormally high WSEs. Using the same inflow hydrologies and project operating conditions, the operations model indicates at the impoundment sites (25-01, 25-02, 25-03, 25-06, 25-07, 25-09, 25-10), that typical habitat is not inundated. Since exuvia were observed well above the bank at riverine sites (25-04, 25-05, 25-08, 25-11) during, and immediately after, storm-related high water events in June 2015, such events do not preclude odonate emergence. Normal project operations in the summer typically result in WSE peaks in response to energy demands that last only several hours at a time, while the broader and higher WSE peaks shown in the figures are the result of high flow events rather than normal project operations. Thus it can be concluded that normal project operations are not likely to adversely affect typical habitat for odonate larval emergence/eclosion.

It should be noted that for riverine Site 25-11 located downstream of Vernon dam, the Operations Model output was based on FirstLight's typical operating range of Turners Falls WSEs, so the frequency of inundation illustrated in Figure 6.11 may not fully reflect inundation due to Turners Falls project operations.

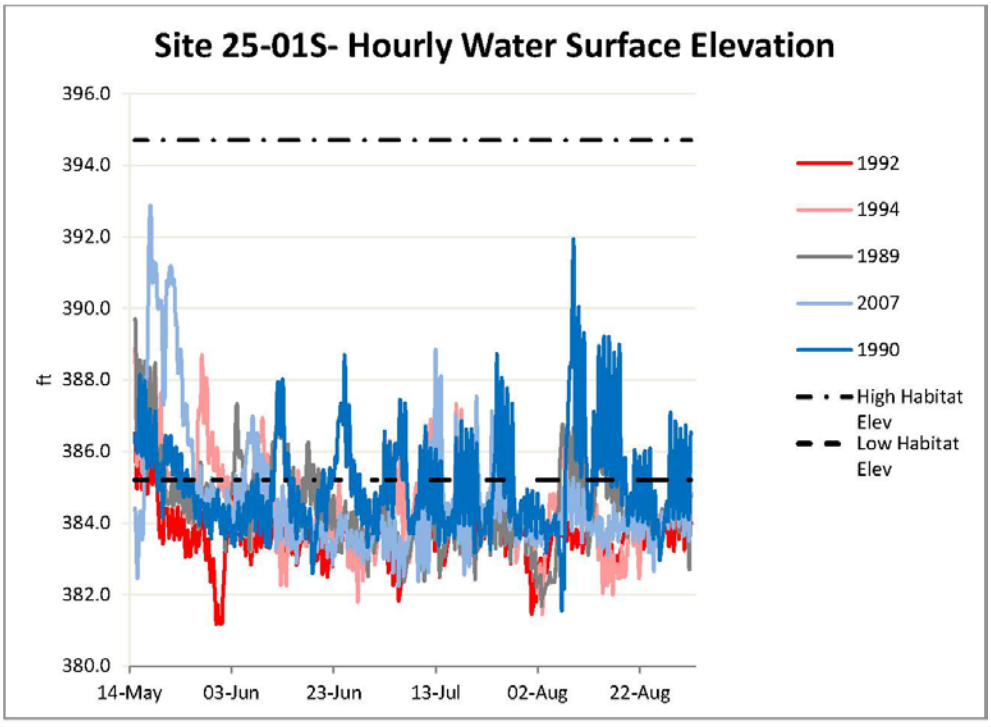

Figure 6.1. Habitat elevations and hourly WSEs from operations model at Site 25-01, Bedell Bridge, Wilder impoundment.

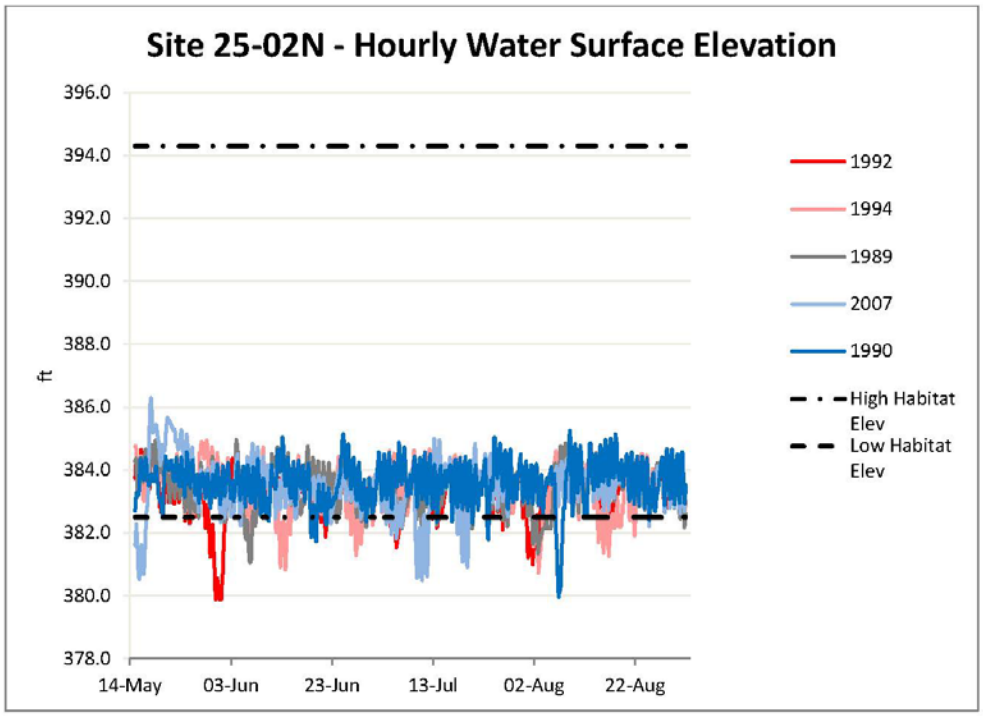

Figure 6.2. Habitat elevations and hourly WSEs from operations model at Site 25-02, Lyme NH, Wilder impoundment.

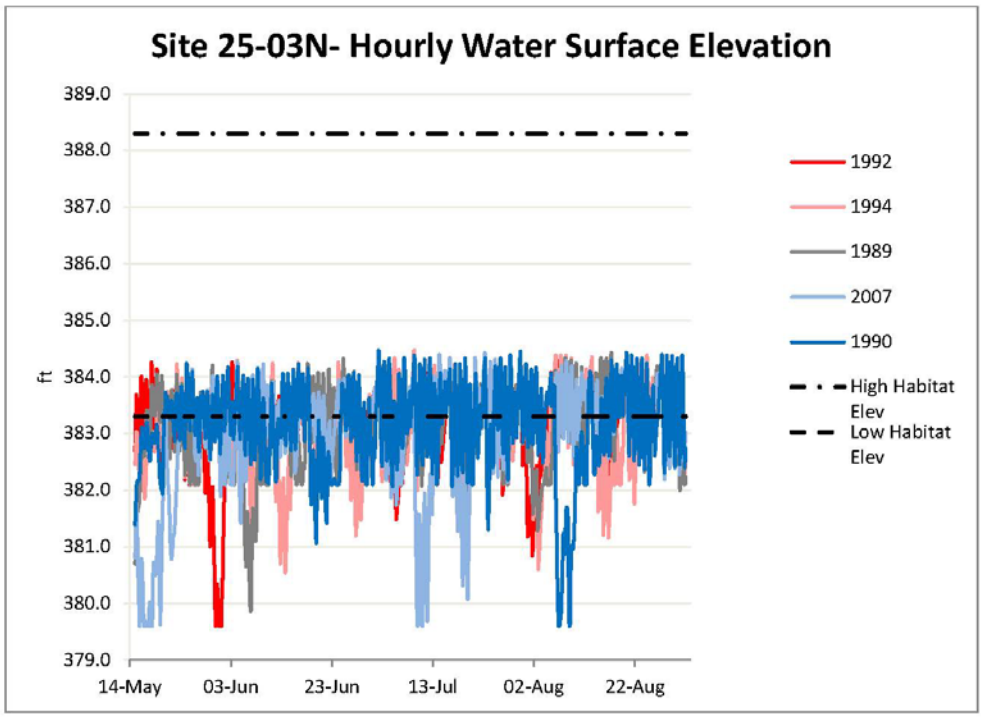

Figure 6.3. Habitat elevations and hourly WSEs from operations model at Site 25-03, Wilder dam, Wilder impoundment.

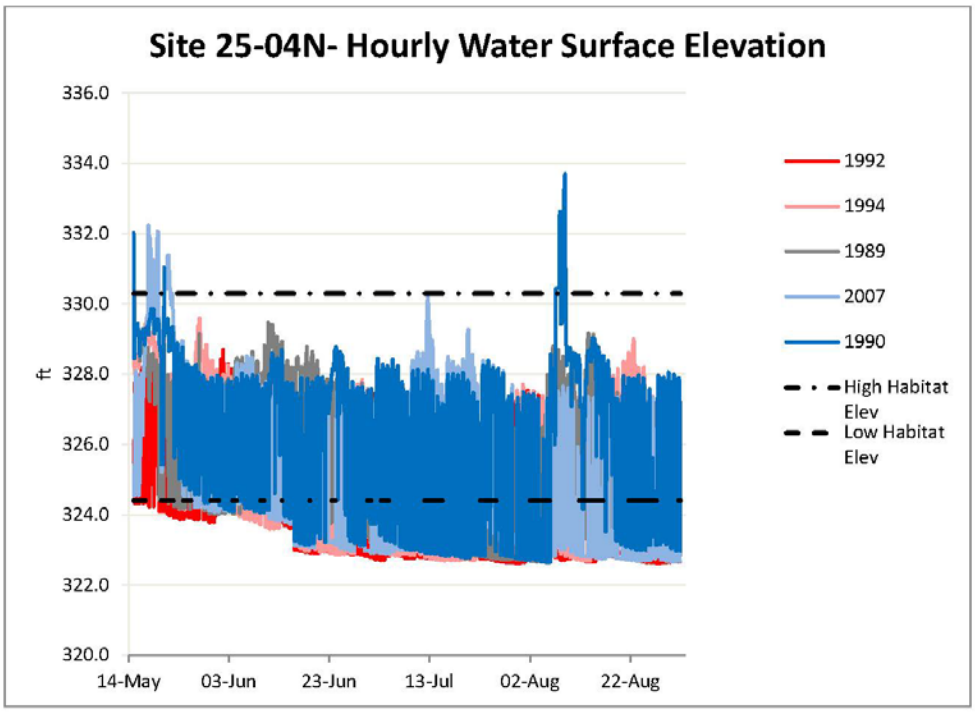

Figure 6.4. Habitat elevations and hourly WSEs from operations model at Site 25-04, West Lebanon, Wilder riverine reach.

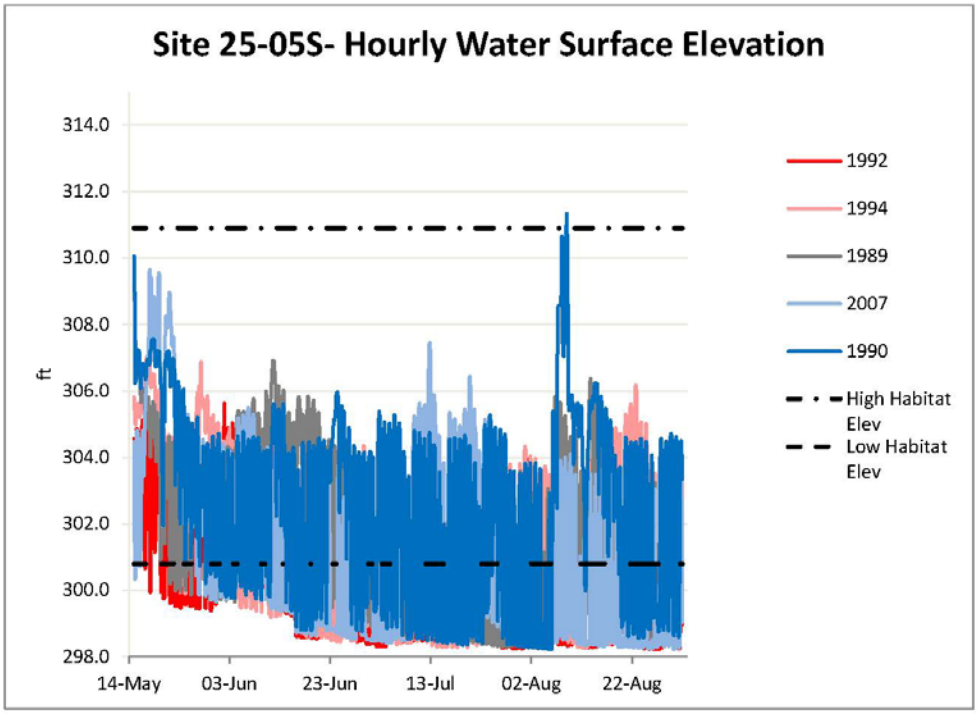

Figure 6.5. Habitat elevations and hourly WSEs from operations model at Site 25-05, Hart Island, Wilder riverine reach.

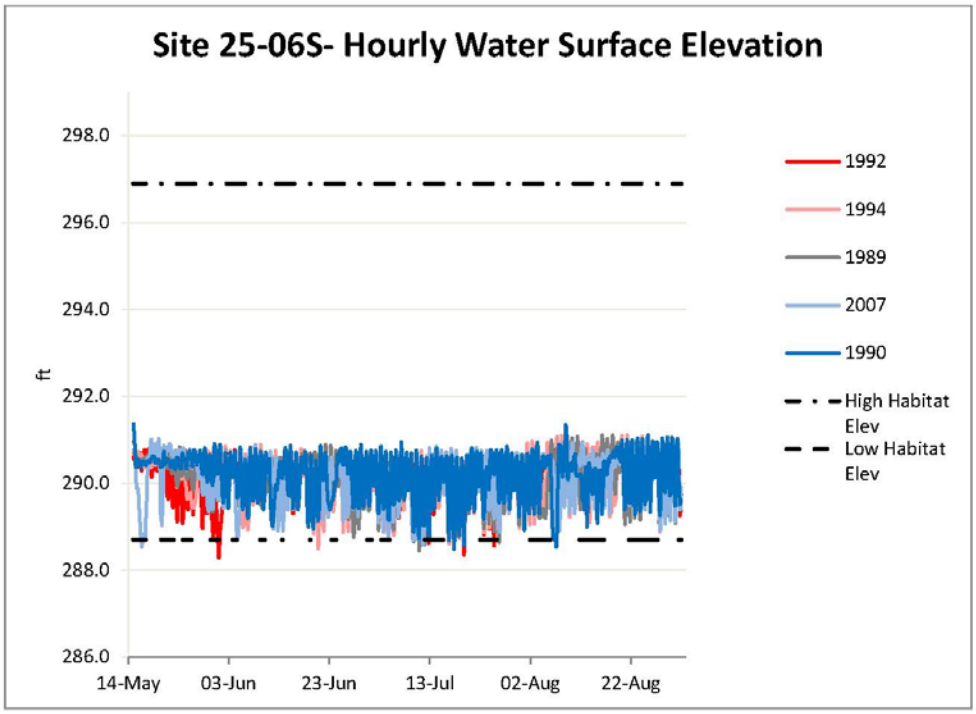

Figure 6.6. Habitat elevations and hourly WSEs from operations model at Site 25-06, N. Charlestown, Bellows Falls impoundment.

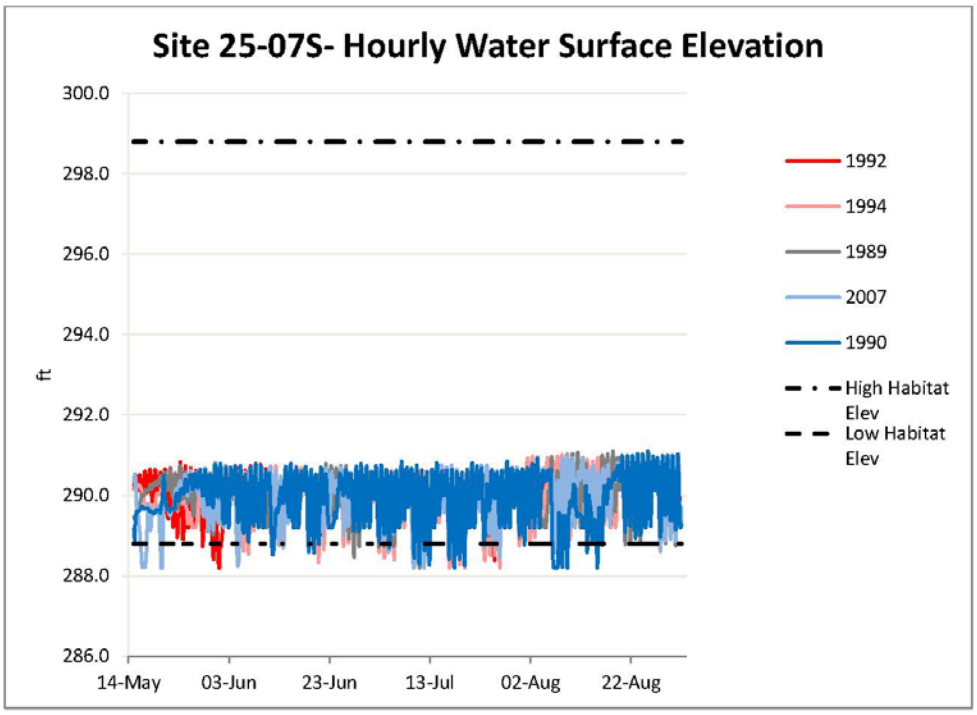

Figure 6.7. Habitat elevations and weekly WSEs from operations model at Site 25-07, N. Walpole, Bellows Falls impoundment.

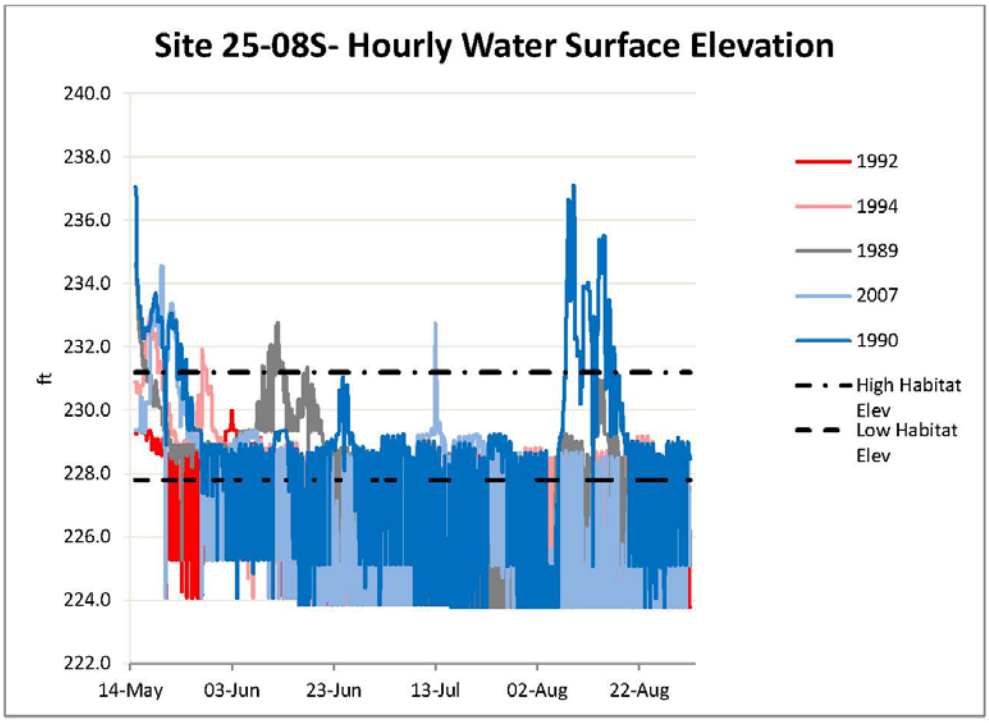

Figure 6.8. Habitat elevations and hourly WSEs from operations model at Site 25-08, N. Westminster, Bellows Falls riverine reach.

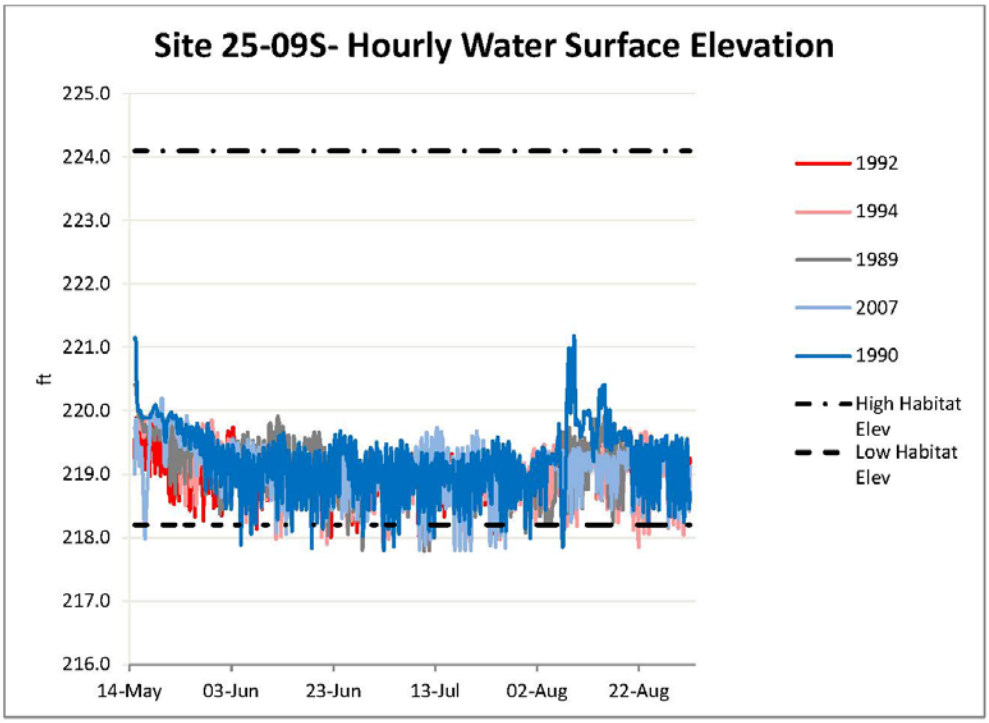

Figure 6.9. Habitat elevations and hourly WSEs from operations model at Site 25-09, Chesterfield, Vernon impoundment.

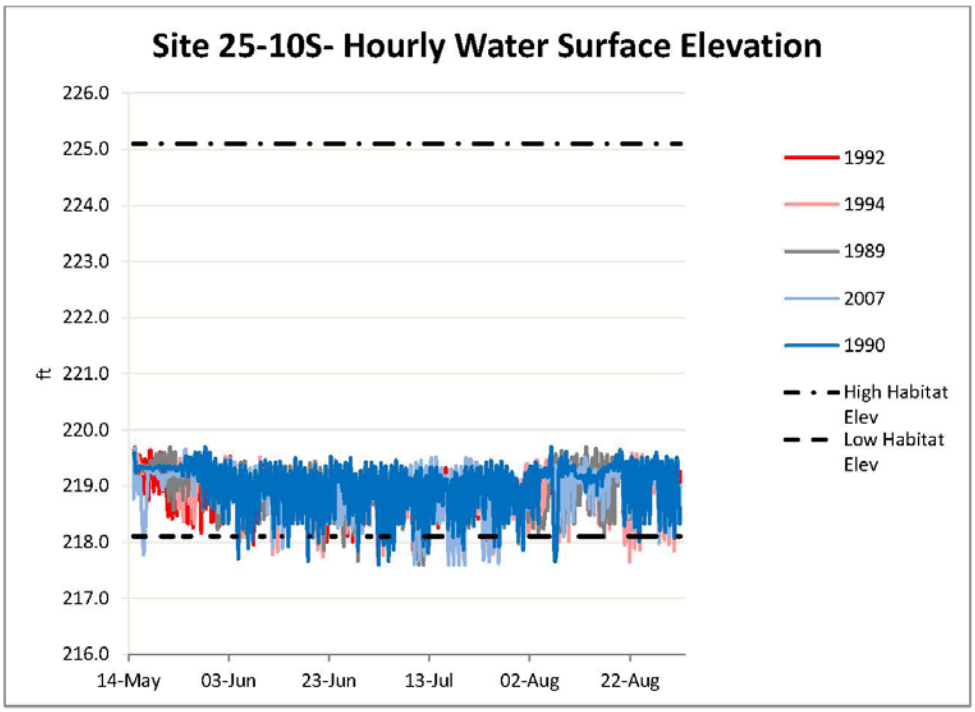

Figure 6.10. Habitat elevations and hourly WSEs from operations model at Site 25-10, Broad Brook Vernon impoundment.

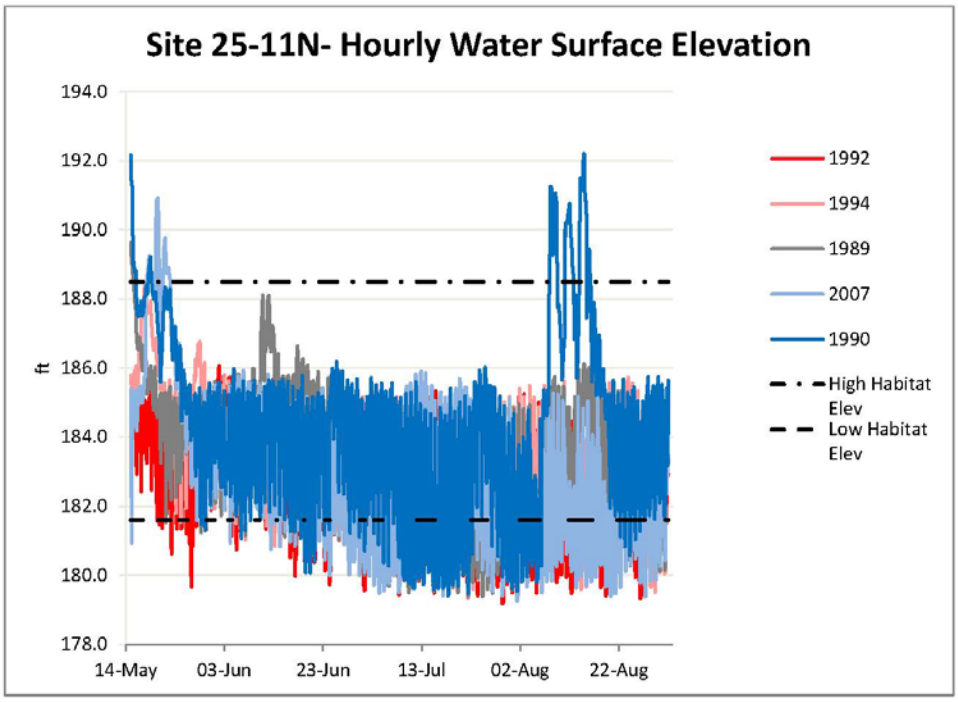

Figure 6.11. Habitat elevations and hourly WSEs from operations model at Site 25-11, Stebbins Island, Vernon riverine reach (based on median Turners Falls dam WSE).

6.2 Direct Mortality

To more fully evaluate project effects, the analysis must take into account the rate of water level rise at each site during the critical emergence period. Based on observations of emergence behavior, the most sensitive stage for odonate emergence is the actual eclosion period, when odonates have started to shed their exoskeleton but are not yet capable of climbing or flight.

In the case of *Stylurus spiniceps*, most individuals observed during field surveys were eclosing 8-16 inches above the water surface. As discussed in Section 5.4, the entire eclosion process takes approximately 30 minutes. Water level logger data at each site were used to evaluate water level rises since the operations model operates on a one-hour time step, while loggers recorded at 15-minute intervals. During normal project operations, the rate of water level rise typically was considerably slower than 8 inches in 30 minutes, and therefore unlikely to cause mortality to odonates. However, 8-inch rises in water elevation per half-hour were recorded at very low frequency (less than 2% frequency) by water level loggers at five of the eleven study sites, including all four riverine sites (Sites 25-04, 25-05, 25-08, 25-11), most frequently at Site 25-08, and at the lower Wilder impoundment site (Site 25-03), (Figure 6.12). There was no statistical difference in this very low frequency between periods of normal project operations and periods of storm events.

Depending on their specific eclosion behavior, odonates other than *Stylurus spiniceps* may be differently affected by rising water levels. Based on the data collected in this study, three of the focal species, *Gomphus vastus*, *Gomphus abbreviatus,* and *Stylurus scudderi*, are less susceptible to water level rises because they typically eclose farther from the water surface than *Stylurus spiniceps*. The only focal species that is potentially more susceptible to water level rise is *Stylurus amnicola*, as the species was found 3 inches lower in average vertical distance from the water surface compared with *Stylurus spiniceps.* Data on *Gomphus quadricolor* and *Ophiogomphus rupinsulensis* are insufficient to draw conclusions about the relative likelihood of project effects from rapidly rising water on direct mortality to these species.

Within the impoundments, direct mortality of odonates due to project operations is unlikely. The only impoundment site to record water level changes that pose a potential threat to eclosing odonates was Site 25-03 (Wilder dam). However, these occurrences were exceptionally rare (less than 0.05% frequency, Figure 6.12). These rare events are unlikely to cause substantial mortality of focal species in the impoundments.

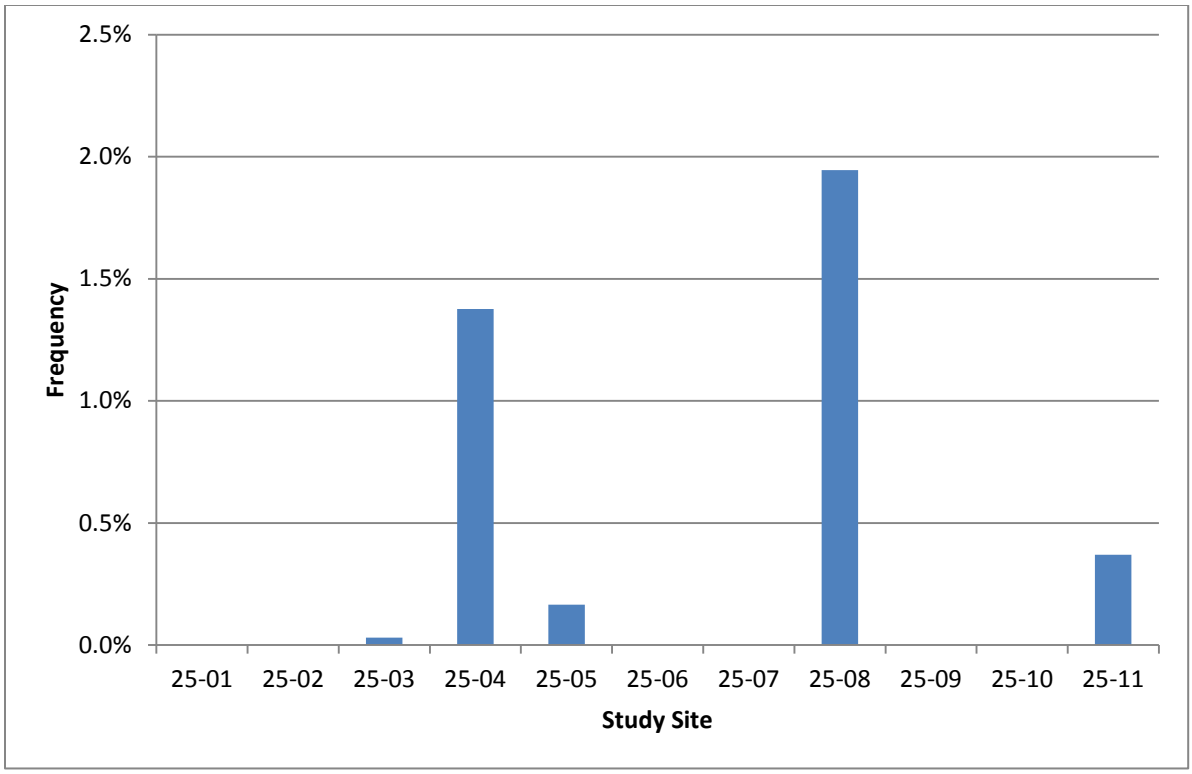

Figure 6.12. Frequency of occurrence of water levels rising at a rate of 8 inches per half-hour or more during the critical emergence period (04:00 – 21:00), based on 2015 water level logger data.

6.3 Additional Potential Effects

Additional variables were screened for potential effects of project operations. Although a previous study (Morrison et al., 2006) found potential effects of water level changes on eclosion, that study was conducted for purposes of evaluating the effects of bank stabilization on odonates and in an area with extensive anthropogenically stabilized banks that are not common in this study's study sites. Although no causationwas identified, Morrison et al. (2006) found that some species travelled shorter distances on banks stabilized with rip-rap than on natural banks, and may have been more likely to eclose on rip-rap during periods of low water because a greater amount of rip rap at the base of the bank was exposed under those conditions. Those species tend to eclose on the first vertical surface encountered.

The same study suggested that at low water levels at the studied sites, odonates may need to travel a greater horizontal distance to reach a suitable eclosion site, which may also impact the vertical distance travelled. However, that may be a function of the type of exposed substrate at the water surface interface at the time of eclosion (i.e., large or small sized rip-rap, sandy beach, natural bank). Horizontal distance was not found to be a good predictor of vertical distance

travelled in this study (β=0.07, r^2=0.045, F(1,748)=35.46), so there is no reason to expect low water levels alone to result in a shorter horizontal or vertical distance travelled.

6.4 Study Conclusions

Biologists were able to record vertical distances from water surface of 754 pre-flight odonates and exuviae and document eclosion behavior of lotic odonates. Six of the eight focal species were located during study surveys. *Gomphus vastus* and *Stylurus amnicola* were widespread throughout the project areas. *Stylurus scudderi* was only found in the Bellows Falls and Wilder project-affected areas, but was widespread within them. *Gomphus abbreviatus* was found in the Bellows Falls and Vernon project-affected areas, most often in impoundments. *Ophiogomphus rupinsulensis* was found only in the riverine sections downstream of Wilder and Vernon dams. *Gomphus quadricolor* was only found at one study site located in the Wilder impoundment. *Gomphus ventricosus* and *Progomphus obscurus* were not located.

Normal project operations appear to have a very limited adverse effect on emerging odonate larvae based on water level logger data, direct observation, and modeling of project operations. Habitat inundation associated with normal project operations (as opposed to high water events) appears unlikely to adversely affect odonate larval emergence/eclosion. Observations during this study suggest that odonate emergence does not occur (or fail to occur) in response to water levels. Rates of change in WSE based on in-situ observations typically provide adequate time for emergence and eclosion without inundation. However, rapid water level rises greater than 8 inches in 30 minutes have the potential to injure or kill odonates during the brief but vulnerable eclosion process. Rapid rates of rise were observed only in the riverine sections below the dams and at one site directly above Wilder dam, and less than 2% of the time. Any associated mortality is unlikely to have a significant impact on odonate populations.

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Appendix A

Field Data Forms

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TC Odonate Study – Survey Site Data Sheet

-Date:	Time Begin:	Time End:
Survey Location:		Surveyors:

Water Level: High ☐	Med. ☐	Low ☐	Water Level Change:
Weather Conditions:			

HOBO Data Retrieved? Yes ☐ No ☐

Water Temperature_____ °F / °C

Comments:_____

_____

Habitat Assessment During this Visit? Yes ☐ No ☐

If Yes, Attach Habitat Assessment Data Sheet

Odonate Larvae from Benthic Samples(Collect from Representative Habitats)

Number Collected in Jar _____ Jar Number _____

Total Number ID'd in Field _____

Species	Number/Tally	Comments
Dromogomphus spinosus		
Gomphus abbreviatus		
Gomphus descriptus		
Gomphus quadricolor		
Gomphus vastus		
Gomphus ventricosus		
Hagenius brevistylus		
Lanthus sp.		
Ophiogomphus rupinsulensis		
Progomphus obscurus		
Stylurus amnicola		
Stylurus scudderi		
Stylurus spiniceps		
Other:		

Larval Prey from Benthic Samples

Abundance Class: Absent=0, Uncommon= 1-3, Common=3-9, Abundant=10-50, Dominant= >50

Order	Abundance Class	Comments

Incidental Species (e.g., Adults, Non-Gomphid Larvae)

Number Collected in Jar _____ Jar Number _____

Total Number ID'd in Field _____

Species	Number/Tally	Comments

TC Odonate Survey – Transect Data Sheet

Date:	Time Begin:	Time End:
Survey Site:	**Transect Number:**	

Evidence of Recent Water Level Change on Transect:_____

_____

Photos Taken? Yes ☐ No ☐ Photo Number(s):_____

Transect Comments:

*Examples of Surfaces: Vegetation, woody debris, cobble, exposed substrate, rock

Species	Horizontal/Vertical Distance from Water (inches)	Type (e.g., Larva, Exuvia, Teneral)	Surface Where Found*	Jar # (if applicable)
	/			
	/			
	/			
	/			
	/			
	/			
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	/			
	/			
	/			
	/			
	/			
	/			

TC Odonate Survey – Transect Data Sheet

Species	Horizontal/Vertical Distance from Water (include units)	Type (e.g. Larva, Exuvia, Teneral)	Surface Where Found*	Jar # (if applicable)
	/			
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TC Odonate Study – Habitat Assessment Data Sheet

Survey Site:	Date:

Riverbank Height (Ft)

Tran 1_____Tran 2_____Tran 3_____Tran 4_____Tran 5_____

Slope: Shallow, Medium, Steep, Undercut (use combinations if helpful)

Tran 1_____Tran 2_____Tran 3_____Tran 4_____Tran 5_____

Stability (write in transect # in each category**)**:

Severely Eroded_____ Moderately Eroded_____ Stable _____

Aquatic Habitat – Draw profile of Transects on back of data sheet

Trans	**Soil/Substrate**	**Vegetation** (% cover, list species or generalized taxa)	**Cover** (% woody debris, roots, ledge, etc.)	**% Canopy**
1				
2				
3				
4				
5				

Bank Habitat

Trans	**Soil/Substrate**	**Vegetation** (% cover, list species or generalized taxa)	**Cover** (% woody debris, roots, ledge, etc.)	**% Canopy**
1				
2				
3				
4				
5				

Above-Bank Habitat

Trans	**Soil/Substrate**	**Vegetation** (% cover, list species or generalized taxa)	**Cover** (% woody debris, roots, ledge, etc.)	**% Canopy**
1				
2				
3				
4				
5				

Other Comments: Wildlife, fish, groundwater seepage, etc

Appendix B

Survey Data

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Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
6/3/2015	25-01	5	11:49	11:53	No odonates observed			
6/3/2015	25-01	4	11:57	12:02	*Didymops transversa*	0	2	Exuvia
6/3/2015	25-01	3	12:03	12:07	No odonates observed			
6/3/2015	25-01	2	12:10	12:14	No odonates observed			
6/3/2015	25-01	1	12:15	12:17	No odonates observed			
6/11/2015	25-01	1	14:09	14:14	No odonates observed			
6/11/2015	25-01	2	14:19	14:21	No odonates observed			
6/11/2015	25-01	3	14:42	14:46	No odonates observed			
6/11/2015	25-01	4	14:24	14:27	No odonates observed			
6/11/2015	25-01	5	14:29	14:34	No odonates observed			
6/24/2015	25-01	1	14:27	14:41	No odonates observed			
6/24/2015	25-01	2	14:42	14:50	No odonates observed			
6/24/2015	25-01	3	15:11	15:23	No odonates observed			
6/24/2015	25-01	4	15:01	15:09	No odonates observed			
6/24/2015	25-01	5	15:25	15:34	No odonates observed			
7/8/2015	25-01	1	12:20	12:37	*Macromia illinoiensis*	55	68	Exuvia
7/8/2015	25-01	2	12:51	13:05	*Neurocordulia yamaskanensis*	16	18	Exuvia
7/8/2015	25-01	3	11:52	12:17	*Neurocordulia yamaskanensis*	0	40	Exuvia
7/8/2015	25-01	3	11:52	12:17	*Neurocordulia yamaskanensis*	20	51	Exuvia
7/8/2015	25-01	3	11:52	12:17	*Gomphus vastus*	32	76	Exuvia
7/8/2015	25-01	3	11:52	12:17	*Neurocordulia yamaskanensis*	30	54	Exuvia
7/8/2015	25-01	3	11:52	12:17	*Macromia illinoiensis*	42	92	Exuvia
7/8/2015	25-01	3	11:52	12:17	*Neurocordulia yamaskanensis*	0	48	Exuvia
7/8/2015	25-01	3	11:52	12:17	*Macromia illinoiensis*	40	95	Exuvia
7/8/2015	25-01	4	11:35	11:48	*Macromia illinoiensis*	7	0	Exuvia
7/8/2015	25-01	5	11:07	11:30	*Dromogomphus spinosus*	3	14	Emerging
7/13/2015	25-01	1	14:13	14:20	No odonates observed			
7/13/2015	25-01	2	14:24	14:31	*Macromia illinoiensis*	40	45	Exuvia
7/13/2015	25-01	3	14:33	14:38	No odonates observed			
7/13/2015	25-01	4	14:42	14:51	*Gomphus vastus*	82	34	Exuvia
7/13/2015	25-01	5	14:53	14:59	No odonates observed			
7/29/2015	25-01	1	9:27	9:54	*Stylurus spiniceps*	88	4	Exuvia
7/29/2015	25-01	1	9:27	9:54	*Stylurus amnicola*	112	20	Exuvia
7/29/2015	25-01	1	9:27	9:54	*Stylurus spiniceps*	105	13	Exuvia
7/29/2015	25-01	2	9:58	10:15	*Stylurus amnicola*	40	6	Exuvia
7/29/2015	25-01	2	9:58	10:15	*Stylurus spiniceps*	84	26	Exuvia
7/29/2015	25-01	2	9:58	10:15	*Stylurus spiniceps*	67	8	Exuvia
7/29/2015	25-01	2	9:58	10:15	*Stylurus spiniceps*	98	19	Exuvia
7/29/2015	25-01	3	10:28	10:56	*Stylurus spiniceps*	58	4	Exuvia
7/29/2015	25-01	3	10:28	10:56	*Stylurus spiniceps*	51	7	Exuvia
7/29/2015	25-01	3	10:28	10:56	*Stylurus scudderi*	62	13	Exuvia
7/29/2015	25-01	3	10:28	10:56	*Stylurus spiniceps*	91	44	Exuvia
7/29/2015	25-01	3	10:28	10:56	*Macromia illinoiensis*	91	64	Exuvia
7/29/2015	25-01	3	10:28	10:56	*Macromia illinoiensis*	89	54	Exuvia
7/29/2015	25-01	3	10:28	10:56	*Dromogomphus spinosus*	51	66	Exuvia
7/29/2015	25-01	3	10:28	10:56	*Gomphus vastus*	52	64	Exuvia
7/29/2015	25-01	4	11:05	11:16	*Stylurus spiniceps*	113	19	Exuvia
7/29/2015	25-01	4	11:05	11:16	*Stylurus spiniceps*	128	37	Exuvia
7/29/2015	25-01	4	11:05	11:16	*Stylurus spiniceps*	127	40	Exuvia
7/29/2015	25-01	4	11:05	11:16	*Stylurus spiniceps*	102	14	Exuvia
7/29/2015	25-01	4	11:05	11:16	*Stylurus spiniceps*	103	14	Exuvia
7/29/2015	25-01	4	11:05	11:16	*Stylurus spiniceps*	92	11	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	62	6	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus scudderi*	62	10	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	79	10	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	72	13	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	76	14	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	73	12	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	73	10	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	71	10	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	91	20	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus spiniceps*	59	8	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus scudderi*	106	24	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Stylurus scudderi*	113	21	Exuvia
7/29/2015	25-01	5	11:30	11:53	*Dromogomphus spinosus*	104	27	Exuvia
6/3/2015	25-02	1	9:15	9:21	No odonates observed			
6/3/2015	25-02	2	9:23	9:33	No odonates observed			
6/3/2015	25-02	3	10:08	10:15	No odonates observed			
6/3/2015	25-02	4	9:56	10:04	No odonates observed			
6/3/2015	25-02	5	9:46	9:53	No odonates observed			
6/10/2015	25-02	1	17:57	18:01	No odonates observed			
6/10/2015	25-02	2	17:40	17:48	*Gomphus quadricolor*	1	15	Exuvia
6/10/2015	25-02	3	17:31	17:35	No odonates observed			
6/10/2015	25-02	4	17:25	17:28	No odonates observed			
6/10/2015	25-02	5	17:09	17:12	No odonates observed			
6/24/2015	25-02	1	12:55	13:17	*Didymops transversa*	5	14	Exuvia
6/24/2015	25-02	1	12:55	13:17	*Gomphus vastus*	0	27	Exuvia
6/24/2015	25-02	1	12:55	13:17	*Gomphus vastus*	0	27	Exuvia
6/24/2015	25-02	1	12:55	13:17	*Gomphus vastus*	0	5	Exuvia
6/24/2015	25-02	1	12:55	13:17	*Gomphus vastus*	0	14	Teneral
6/24/2015	25-02	2	12:42	12:53	*Gomphus vastus*	0	5	Exuvia
6/24/2015	25-02	2	12:42	12:53	*Gomphus vastus*	0	12	Exuvia
6/24/2015	25-02	3	12:26	12:34	No odonates observed			
6/24/2015	25-02	4	12:01	12:22	*Gomphus vastus*	0	17	Exuvia
6/24/2015	25-02	4	12:01	12:22	*Gomphus vastus*	3	25	Exuvia
6/24/2015	25-02	4	12:01	12:22	*Neurocordulia yamaskanensis*	0	8	Exuvia
6/24/2015	25-02	4	12:01	12:22	*Gomphus vastus*	0	8	Exuvia
6/24/2015	25-02	4	12:01	12:22	*Gomphus vastus*	13	53	Exuvia
6/24/2015	25-02	4	12:01	12:22	*Gomphus vastus*	7	53	Exuvia
6/24/2015	25-02	5	11:40	11:59	*Gomphus vastus*	0	0	Exuvia
7/8/2015	25-02	1	16:02	16:08	No odonates observed			
7/8/2015	25-02	2	15:49	15:59	*Dromogomphus spinosus*	16	19	Exuvia
7/8/2015	25-02	2	15:49	15:59	*Epitheca princeps*	19	15	Exuvia
7/8/2015	25-02	2	15:49	15:59	*Gomphus vastus*	10	27	Exuvia
7/8/2015	25-02	3	15:38	15:45	*Dromogomphus spinosus*	0	10	Exuvia
7/8/2015	25-02	4	15:16	15:32	*Gomphus vastus*	3	50	Exuvia
7/8/2015	25-02	5	14:57	15:15	*Macromia illinoiensis*	0	12	Exuvia
7/8/2015	25-02	5	14:57	15:15	*Dromogomphus spinosus*	0	12	Exuvia
7/8/2015	25-02	5	14:57	15:15	*Gomphus vastus*	0	4	Exuvia
7/13/2015	25-02	1	16:24	16:33	No odonates observed			
7/13/2015	25-02	2	16:34	16:42	*Dromogomphus spinosus*	49	17	Exuvia
7/13/2015	25-02	2	16:34	16:42	*Dromogomphus spinosus*	51	8	Exuvia
7/13/2015	25-02	3	16:43	16:49	No odonates observed			
7/13/2015	25-02	4	16:51	16:58	No odonates observed			
7/13/2015	25-02	5	16:59	17:07	*Dromogomphus spinosus*	10	20	Exuvia
7/29/2015	25-02	1	13:12	13:28	*Dromogomphus spinosus*	0	16	Exuvia
7/29/2015	25-02	1	13:12	13:28	*Stylurus scudderi*	0	11	Exuvia
7/29/2015	25-02	1	13:12	13:28	*Stylurus spiniceps*	0	23	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Stylurus spiniceps*	8	40	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Stylurus spiniceps*	19	8	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Dromogomphus spinosus*	18	12	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Stylurus spiniceps*	0	16	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Stylurus spiniceps*	13	10	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Dromogomphus spinosus*	16	10	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Stylurus amnicola*	0	14	Teneral
7/29/2015	25-02	2	13:29	13:47	*Dromogomphus spinosus*	17	23	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/29/2015	25-02	2	13:29	13:47	*Dromogomphus spinosus*	18	0	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Stylurus spiniceps*	8	25	Exuvia
7/29/2015	25-02	2	13:29	13:47	*Stylurus spiniceps*	11	1	Exuvia
7/29/2015	25-02	3	14:22	14:32	*Stylurus spiniceps*	0	4	Exuvia
7/29/2015	25-02	3	14:22	14:32	*Stylurus spiniceps*	1	10	Exuvia
7/29/2015	25-02	3	14:22	14:32	*Stylurus spiniceps*	0	13	Exuvia
7/29/2015	25-02	4	14:38	14:47	*Dromogomphus spinosus*	0	14	Exuvia
7/29/2015	25-02	4	14:38	14:47	*Stylurus spiniceps*	3	23	Exuvia
7/29/2015	25-02	4	14:38	14:47	*Neurocordulia yamaskanensis*	0	11	Exuvia
7/29/2015	25-02	5	14:49	15:04	*Stylurus spiniceps*	24	20	Exuvia
7/29/2015	25-02	5	14:49	15:04	*Stylurus amnicola*	26	21	Exuvia
7/29/2015	25-02	5	14:49	15:04	*Stylurus spiniceps*	20	9	Exuvia
6/2/2015	25-03	5	14:46	15:35	*Didymops transversa*	79	204	Emerging
6/2/2015	25-03	5	14:46	15:35	*Epitheca princeps*	32	201	Exuvia
6/2/2015	25-03	5	14:46	15:35	*Didymops transversa*	143	195	Exuvia
6/2/2015	25-03	4	15:39	15:52	*Basaeshna janata*	126	30	Exuvia
6/2/2015	25-03	4	15:39	15:52	*Basaeshna janata*	129	30	Exuvia
6/2/2015	25-03	3	15:55	16:07	*Basaeshna janata*	129	3	Exuvia
6/2/2015	25-03	2	16:29	16:36	No odonates observed			
6/10/2015	25-03	1	15:01	15:06	No odonates observed			
6/10/2015	25-03	2	15:08	15:13	No odonates observed			
6/10/2015	25-03	3	15:03	15:06	No odonates observed			
6/10/2015	25-03	4	14:38	14:40	No odonates observed			
6/10/2015	25-03	5	14:06	14:23	*Didymops transversa*	96	56	Exuvia
6/10/2015	25-03	5	14:06	14:23	*Epitheca cynosura*	105	10	Exuvia
6/10/2015	25-03	5	14:06	14:23	*Epitheca cynosura*	100	57	Exuvia
6/10/2015	25-03	5	14:06	14:23	*Epitheca cynosura*	100	72	Exuvia
6/23/2015	25-03	1	15:25	15:33	*Epitheca cynosura*	313	30	Exuvia
6/23/2015	25-03	2	15:17	15:24	*Epitheca princeps*	263	26	Exuvia
6/23/2015	25-03	2	15:17	15:24	*Epitheca princeps*	263	26	Exuvia
6/23/2015	25-03	2	15:17	15:24	*Epitheca princeps*	263	26	Exuvia
6/23/2015	25-03	2	15:17	15:24	*Epitheca cynosura*	263	26	Exuvia
6/23/2015	25-03	3	15:07	15:16	*Epitheca princeps*	204	65	Exuvia
6/23/2015	25-03	3	15:07	15:16	*Epitheca princeps*	204	53	Exuvia
6/23/2015	25-03	3	15:07	15:16	*Epitheca princeps*	230	26	Exuvia
6/23/2015	25-03	3	15:07	15:16	*Epitheca princeps*	235	23	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Epitheca princeps*	180	67	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Epitheca princeps*	180	67	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Epitheca princeps*	180	67	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Epitheca cynosura*	216	60	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Epitheca cynosura*	216	60	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Epitheca princeps*	216	35	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Gomphus exilis*	216	35	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Epitheca princeps*	216	42	Exuvia
6/23/2015	25-03	4	14:50	15:05	*Epitheca cynosura*	216	42	Exuvia
6/23/2015	25-03	5	14:34	14:49	*Epitheca cynosura*	319	40	Exuvia
6/23/2015	25-03	5	14:34	14:49	*Epitheca cynosura*	279	40	Exuvia
6/23/2015	25-03	5	14:34	14:49	*Epitheca princeps*	264	40	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Epitheca cynosura*	22	20	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Epitheca princeps*	5	15	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Epitheca princeps*	5	15	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Epitheca princeps*	26	37	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Epitheca princeps*	67	25	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Epitheca princeps*	67	36	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Dromogomphus spinosus*	74	60	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Epitheca princeps*	66	50	Exuvia
7/8/2015	25-03	1	18:37	18:52	*Epitheca princeps*	66	50	Exuvia
7/8/2015	25-03	2	18:23	18:32	*Epitheca princeps*	10	20	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/8/2015	25-03	2	18:23	18:32	*Epitheca princeps*	8	19	Exuvia
7/8/2015	25-03	2	18:23	18:32	*Epitheca cynosura*	31	20	Exuvia
7/8/2015	25-03	2	18:23	18:32	*Epitheca princeps*	31	15	Exuvia
7/8/2015	25-03	2	18:23	18:32	*Epitheca princeps*	17	19	Exuvia
7/8/2015	25-03	2	18:23	18:32	*Epitheca princeps*	20	8	Exuvia
7/8/2015	25-03	3	18:11	18:18	*Epitheca princeps*	0	38	Exuvia
7/8/2015	25-03	3	18:11	18:18	*Dromogomphus spinosus*	0	36	Exuvia
7/8/2015	25-03	3	18:11	18:18	*Epitheca princeps*	0	32	Exuvia
7/8/2015	25-03	3	18:11	18:18	*Epitheca princeps*	0	20	Exuvia
7/8/2015	25-03	3	18:11	18:18	*Epitheca princeps*	0	25	Exuvia
7/8/2015	25-03	3	18:11	18:18	*Epitheca princeps*	0	24	Exuvia
7/8/2015	25-03	3	18:11	18:18	*Epitheca cynosura*	0	26	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	0	39	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Boyeria vinosa*	0	39	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	4	16	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Dromogomphus spinosus*	4	24	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	0	32	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	0	25	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca cynosura*	2	29	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca cynosura*	2	29	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	2	16	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	0	20	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca cynosura*	3	31	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca cynosura*	3	31	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca cynosura*	2	26	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	2	29	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	0	22	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	2	26	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca cynosura*	2	29	Exuvia
7/8/2015	25-03	4	17:42	18:08	*Epitheca princeps*	1	22	Exuvia
7/8/2015	25-03	5	17:18	17:38	*Epitheca princeps*	42	40	Exuvia
7/8/2015	25-03	5	17:18	17:38	*Dromogomphus spinosus*	53	44	Exuvia
7/8/2015	25-03	5	17:18	17:38	*Dromogomphus spinosus*	55	22	Exuvia
7/8/2015	25-03	5	17:18	17:38	*Dromogomphus spinosus*	55	20	Exuvia
7/8/2015	25-03	5	17:18	17:38	*Epitheca princeps*	45	18	Exuvia
7/8/2015	25-03	5	17:18	17:38	*Epitheca cynosura*	45	18	Exuvia
7/8/2015	25-03	5	17:18	17:38	*Epitheca princeps*	61	24	Exuvia
7/8/2015	25-03	5	17:18	17:38	*Epitheca princeps*	58	32	Exuvia
7/14/2015	25-03	1	9:19	9:26	*Epitheca princeps*	7	6	Exuvia
7/14/2015	25-03	1	9:19	9:26	*Dromogomphus spinosus*	14	17	Exuvia
7/14/2015	25-03	1	9:19	9:26	*Epitheca princeps*	16	44	Exuvia
7/14/2015	25-03	2	9:08	9:12	*Dromogomphus spinosus*	4	21	Exuvia
7/14/2015	25-03	3	8:54	9:01	*Epitheca princeps*	0	22	Exuvia
7/14/2015	25-03	4	8:41	8:52	*Stylurus spiniceps*	4	13	Exuvia
7/14/2015	25-03	4	8:41	8:52	*Dromogomphus spinosus*	0	4	Exuvia
7/14/2015	25-03	5	8:25	8:37	*Epitheca princeps*	0	0	Exuvia
7/29/2015	25-03	1	17:24	17:35	*Stylurus spiniceps*	62	23	Exuvia
7/29/2015	25-03	1	17:24	17:35	*Stylurus spiniceps*	62	23	Exuvia
7/29/2015	25-03	1	17:24	17:35	*Dromogomphus spinosus*	74	22	Exuvia
7/29/2015	25-03	1	17:24	17:35	*Epitheca princeps*	90	38	Exuvia
7/29/2015	25-03	1	17:24	17:35	*Stylurus spiniceps*	84	7	Exuvia
7/29/2015	25-03	2	17:12	17:22	*Epitheca princeps*	27	2	Exuvia
7/29/2015	25-03	2	17:12	17:22	*Stylurus spiniceps*	31	24	Exuvia
7/29/2015	25-03	2	17:12	17:22	*Stylurus spiniceps*	26	3	Exuvia
7/29/2015	25-03	2	17:12	17:22	*Stylurus spiniceps*	33	23	Exuvia
7/29/2015	25-03	2	17:12	17:22	*Stylurus spiniceps*	36	3	Exuvia
7/29/2015	25-03	2	17:12	17:22	*Stylurus spiniceps*	43	10	Exuvia
7/29/2015	25-03	2	17:12	17:22	*Stylurus spiniceps*	34	22	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/29/2015	25-03	3	17:01	17:08	*Stylurus spiniceps*	0	21	Exuvia
7/29/2015	25-03	3	17:01	17:08	*Epitheca princeps*	2	47	Exuvia
7/29/2015	25-03	3	17:01	17:08	*Stylurus spiniceps*	14	10	Exuvia
7/29/2015	25-03	3	17:01	17:08	*Stylurus spiniceps*	3	5	Exuvia
7/29/2015	25-03	4	16:47	16:59	*Stylurus spiniceps*	0	33	Exuvia
7/29/2015	25-03	4	16:47	16:59	*Stylurus spiniceps*	0	30	Exuvia
7/29/2015	25-03	4	16:47	16:59	*Stylurus spiniceps*	0	29	Exuvia
7/29/2015	25-03	4	16:47	16:59	*Stylurus spiniceps*	0	38	Exuvia
7/29/2015	25-03	4	16:47	16:59	*Epitheca princeps*	21	47	Exuvia
7/29/2015	25-03	4	16:47	16:59	*Dromogomphus spinosus*	24	53	Exuvia
7/29/2015	25-03	4	16:47	16:59	*Epitheca princeps*	22	2	Exuvia
7/29/2015	25-03	4	16:47	16:59	*Stylurus spiniceps*	27	24	Exuvia
7/29/2015	25-03	5	16:30	16:45	*Epitheca princeps*	87	56	Exuvia
7/29/2015	25-03	5	16:30	16:45	*Epitheca cynosura*	77	50	Exuvia
7/29/2015	25-03	5	16:30	16:45	*Epitheca princeps*	72	27	Exuvia
7/29/2015	25-03	5	16:30	16:45	*Stylurus spiniceps*	76	25	Exuvia
7/29/2015	25-03	5	16:30	16:45	*Stylurus spiniceps*	75	16	Exuvia
6/4/2015	25-04	4	8:53	9:00	No odonates observed			
6/4/2015	25-04	5	8:45	8:50	No odonates observed			
6/4/2015	25-04	3	9:10	9:06	No odonates observed			
6/4/2015	25-04	2	9:09	9:14	No odonates observed			
6/4/2015	25-04	1	9:15	9:20	No odonates observed			
6/11/2015	25-04	1	17:06	17:09	No odonates observed			
6/11/2015	25-04	2	16:58	17:03	No odonates observed			
6/11/2015	25-04	3	16:52	16:57	*Ophiogomphus rupinsulensis*	1	1	Exuvia
6/11/2015	25-04	4	16:45	16:50	No odonates observed			
6/11/2015	25-04	5	16:35	16:41	*Neurocordulia yamaskanensis*	24	28	Exuvia
6/25/2015	25-04	1	8:16	8:27	No odonates observed			
6/25/2015	25-04	2	8:28	8:35	No odonates observed			
6/25/2015	25-04	3	8:39	8:47	No odonates observed			
6/25/2015	25-04	4	8:49	8:59	No odonates observed			
6/25/2015	25-04	5	9:01	9:10	No odonates observed			
7/9/2015	25-04	1	12:42	12:55	*Stylurus scudderi*	36	30	Exuvia
7/9/2015	25-04	1	12:42	12:55	*Boyeria vinosa*	35	40	Exuvia
7/9/2015	25-04	2	12:26	12:36	No odonates observed			
7/9/2015	25-04	3	12:59	13:14	*Boyeria vinosa*	79	29	Exuvia
7/9/2015	25-04	4	11:54	12:22	No odonates observed			
7/9/2015	25-04	5	11:29	11:46	*Stylurus scudderi*	102	68	Exuvia
7/14/2015	25-04	1	11:17	11:21	No odonates observed			
7/14/2015	25-04	2	11:09	11:15	No odonates observed			
7/14/2015	25-04	3	11:01	11:05	No odonates observed			
7/14/2015	25-04	4	10:53	11:00	No odonates observed			
7/14/2015	25-04	5	10:45	10:53	No odonates observed			
7/29/2015	25-04	1	19:31	19:36	*Stylurus spiniceps*	0	6	Exuvia
7/29/2015	25-04	2	19:23	19:28	No odonates observed			
7/29/2015	25-04	3	19:13	19:18	No odonates observed			
7/29/2015	25-04	4	19:06	19:11	No odonates observed			
7/29/2015	25-04	5	18:56	19:03	*Stylurus scudderi*	8	7	Exuvia
7/29/2015	25-04	5	18:56	19:03	*Stylurus spiniceps*	10	7	Exuvia
6/8/2015	25-05	2	10:03	10:13	*Ophiogomphus rupinsulensis*	20	41	Exuvia
6/8/2015	25-05	1	10:07	10:15	No odonates observed			
6/8/2015	25-05	3	9:49	9:54	No odonates observed			
6/8/2015	25-05	4	9:44	9:49	No odonates observed			
6/8/2015	25-05	5	9:24	9:33	No odonates observed			
6/11/2015	25-05	1	10:06	10:11	No odonates observed			
6/11/2015	25-05	2	10:13	10:17	No odonates observed			
6/11/2015	25-05	3	10:20	10:25	No odonates observed			
6/11/2015	25-05	4	10:27	10:32	No odonates observed			

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
6/11/2015	25-05	5	10:32	10:41	*Ophiogomphus rupinsulensis*	21	13	Exuvia
6/24/2015	25-05	1	8:47	8:51	No odonates observed			
6/24/2015	25-05	2	8:52	8:56	No odonates observed			
6/24/2015	25-05	3	8:58	9:04	No odonates observed			
6/24/2015	25-05	4	9:13	9:17	No odonates observed			
6/24/2015	25-05	5	9:07	9:10	No odonates observed			
7/9/2015	25-05	1	9:01	9:07	No odonates observed			
7/9/2015	25-05	2	8:47	8:58	No odonates observed			
7/9/2015	25-05	3	9:10	9:27	*Boyeria vinosa*	122	72	Exuvia
7/9/2015	25-05	4	9:29	9:45	*Cordulegaster maculata*	95	72	Exuvia
7/9/2015	25-05	4	9:29	9:45	*Gomphus vastus*	78	45	Exuvia
7/9/2015	25-05	5	9:49	10:02	No odonates observed			
7/13/2015	25-05	1	11:22	11:28	No odonates observed			
7/13/2015	25-05	2	11:30	11:37	*Boyeria vinosa*	103	50	Exuvia
7/13/2015	25-05	3	11:39	11:44	*Boyeria vinosa*	41	31	Exuvia
7/13/2015	25-05	4	11:42	11:52	No odonates observed			
7/13/2015	25-05	5	11:56	12:02	No odonates observed			
7/30/2015	25-05	1	8:59	9:07	No odonates observed			
7/30/2015	25-05	2	7:55	8:15	No odonates observed			
7/30/2015	25-05	3	8:30	8:41	*Boyeria vinosa*	94	48	Exuvia
7/30/2015	25-05	4	8:19	8:29	No odonates observed			
7/30/2015	25-05	5	8:47	8:57	*Stylurus spiniceps*	72	39	Exuvia
6/3/2015	25-06	4	15:31	15:35	No odonates observed			
6/3/2015	25-06	3	15:38	15:44	No odonates observed			
6/3/2015	25-06	2	15:48	15:55	No odonates observed			
6/3/2015	25-06	1	15:59	16:05	No odonates observed			
6/9/2015	25-06	1	16:25	16:35	*Gomphus vastus*	36	8	Exuvia
6/9/2015	25-06	1	16:25	16:35	*Gomphus vastus*	48	15	Exuvia
6/9/2015	25-06	1	16:25	16:35	*Gomphus vastus*	29	8	Exuvia
6/9/2015	25-06	2	16:18	16:24	No odonates observed			
6/9/2015	25-06	3	16:10	16:17	*Gomphus vastus*	31	31	Exuvia
6/9/2015	25-06	3	16:10	16:17	*Gomphus vastus*	28	32	Exuvia
6/9/2015	25-06	4	16:05	16:09	No odonates observed			
6/9/2015	25-06	5	15:56	16:04	*Gomphus vastus*	6	43	Exuvia
6/9/2015	25-06	5	15:56	16:04	*Gomphus vastus*	6	46	Exuvia
6/9/2015	25-06	5	15:56	16:04	*Gomphus vastus*	6	36	Exuvia
6/23/2015	25-06	1	11:44	11:48	No odonates observed			
6/23/2015	25-06	2	11:51	12:14	*Gomphus vastus*	33	42	Exuvia
6/23/2015	25-06	2	11:51	12:14	*Gomphus vastus*	33	47	Exuvia
6/23/2015	25-06	2	11:51	12:14	*Gomphus vastus*	35	48	Exuvia
6/23/2015	25-06	2	11:51	12:14	*Gomphus vastus*	36	42	Exuvia
6/23/2015	25-06	3	12:11	12:20	*Gomphus vastus*	15	31	Exuvia
6/23/2015	25-06	3	12:11	12:20	*Gomphus vastus*	0	72	Exuvia
6/23/2015	25-06	3	12:11	12:20	*Gomphus vastus*	37	70	Exuvia
6/23/2015	25-06	4	12:21	12:30	*Gomphus vastus*	26	46	Exuvia
6/23/2015	25-06	4	12:21	12:30	*Gomphus vastus*	0	20	Exuvia
6/23/2015	25-06	4	12:21	12:30	*Gomphus vastus*	0	15	Exuvia
6/23/2015	25-06	4	12:21	12:30	*Gomphus vastus*	0	14	Exuvia
6/23/2015	25-06	4	12:21	12:30	*Gomphus vastus*	5	17	Exuvia
6/23/2015	25-06	5	12:30	12:41	*Gomphus vastus*	31	28	Exuvia
6/23/2015	25-06	5	12:30	12:41	*Gomphus vastus*	46	33	Exuvia
6/23/2015	25-06	5	12:30	12:41	*Gomphus vastus*	24	6	Exuvia
6/23/2015	25-06	5	12:30	12:41	*Gomphus vastus*	72	58	Exuvia
7/7/2015	25-06	1	17:49	17:57	*Dromogomphus spinosus*	107	18	Exuvia
7/7/2015	25-06	1	17:49	17:57	*Dromogomphus spinosus*	112	37	Exuvia
7/7/2015	25-06	2	17:44	17:48	No odonates observed			
7/7/2015	25-06	3	17:30	17:42	*Stylurus amnicola*	122	7	Exuvia
7/7/2015	25-06	3	17:30	17:42	*Gomphus vastus*	122	54	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/7/2015	25-06	3	17:30	17:42	*Gomphus vastus*	154	78	Exuvia
7/7/2015	25-06	3	17:30	17:42	*Gomphus vastus*	128	25	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Stylurus amnicola*	78	6	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Stylurus amnicola*	93	7	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Stylurus amnicola*	104	17	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Stylurus amnicola*	109	12	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Stylurus amnicola*	92	19	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Gomphus vastus*	105	38	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Dromogomphus spinosus*	104	42	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Gomphus vastus*	108	42	Exuvia
7/7/2015	25-06	4	17:13	17:29	*Gomphus vastus*	104	36	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Stylurus amnicola*	72	6	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Stylurus amnicola*	82	8	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Stylurus amnicola*	82	8	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Stylurus amnicola*	64	6	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Stylurus amnicola*	86	8	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Stylurus amnicola*	125	27	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Stylurus amnicola*	127	27	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Gomphus vastus*	126	27	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Stylurus amnicola*	120	32	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Gomphus vastus*	134	43	Exuvia
7/7/2015	25-06	5	16:36	17:12	*Gomphus vastus*	130	45	Exuvia
7/14/2015	25-06	1	13:11	13:32	*Boyeria vinosa*	61	16	Exuvia
7/14/2015	25-06	1	13:11	13:32	*Stylurus spiniceps*	55	15	Emerging
7/14/2015	25-06	1	13:11	13:32	*Gomphus vastus*	87	28	Exuvia
7/14/2015	25-06	1	13:11	13:32	*Gomphus vastus*	87	28	Exuvia
7/14/2015	25-06	1	13:11	13:32	*Stylurus spiniceps*	78	24	Exuvia
7/14/2015	25-06	1	13:11	13:32	*Macromia illinoiensis*	76	24	Emerging
7/14/2015	25-06	1	13:11	13:32	*Stylurus spiniceps*	71	24	Exuvia
7/14/2015	25-06	2	14:29	14:42	*Stylurus spiniceps*	125	29	Larva
7/14/2015	25-06	2	14:29	14:42	*Macromia illinoiensis*	115	22	Exuvia
7/14/2015	25-06	2	14:29	14:42	*Stylurus spiniceps*	103	14	Exuvia
7/14/2015	25-06	2	14:29	14:42	*Stylurus spiniceps*	106	15	Exuvia
7/14/2015	25-06	2	14:29	14:42	*Gomphus vastus*	105	14	Exuvia
7/14/2015	25-06	3	13:35	13:43	*Stylurus amnicola*	84	18	Exuvia
7/14/2015	25-06	3	13:35	13:43	*Stylurus amnicola*	92	34	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	83	38	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Dromogomphus spinosus*	87	41	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	80	44	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	79	36	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	81	3	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus amnicola*	81	3	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	77	20	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus amnicola*	77	20	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	83	41	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	82	20	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	83	23	Exuvia
7/14/2015	25-06	4	13:45	14:01	*Stylurus spiniceps*	85	36	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Stylurus amnicola*	116	13	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Stylurus spiniceps*	122	12	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Stylurus spiniceps*	121	12	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Stylurus spiniceps*	124	26	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Stylurus scudderi*	100	37	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Gomphus vastus*	104	38	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Stylurus spiniceps*	120	33	Emerging
7/14/2015	25-06	5	14:03	14:10	*Stylurus amnicola*	104	15	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Stylurus spiniceps*	135	32	Exuvia
7/14/2015	25-06	5	14:03	14:10	*Stylurus spiniceps*	125	42	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/14/2015	25-06	5	14:03	14:10	*Stylurus scudderi*	123	40	Exuvia
7/28/2015	25-06	1	14:47	15:09	*Stylurus spiniceps*	38	7	Exuvia
7/28/2015	25-06	1	14:47	15:09	*Stylurus spiniceps*	17	2	Exuvia
7/28/2015	25-06	1	14:47	15:09	*Stylurus spiniceps*	50	5	Exuvia
7/28/2015	25-06	1	14:47	15:09	*Stylurus spiniceps*	70	24	Exuvia
7/28/2015	25-06	1	14:47	15:09	*Stylurus spiniceps*	0	0	Larva
7/28/2015	25-06	1	14:47	15:09	*Stylurus spiniceps*	72	23	Exuvia
7/28/2015	25-06	1	14:47	15:09	*Stylurus spiniceps*	72	23	Exuvia
7/28/2015	25-06	2	15:10	15:24	*Stylurus spiniceps*	55	12	Exuvia
7/28/2015	25-06	2	15:10	15:24	*Stylurus spiniceps*	67	9	Exuvia
7/28/2015	25-06	2	15:10	15:24	*Stylurus spiniceps*	84	35	Exuvia
7/28/2015	25-06	3	15:27	15:44	*Stylurus spiniceps*	78	14	Exuvia
7/28/2015	25-06	3	15:27	15:44	*Stylurus spiniceps*	104	46	Exuvia
7/28/2015	25-06	3	15:27	15:44	*Stylurus spiniceps*	97	30	Exuvia
7/28/2015	25-06	3	15:27	15:44	*Stylurus spiniceps*	94	24	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Stylurus spiniceps*	82	23	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Stylurus spiniceps*	82	25	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Stylurus spiniceps*	81	16	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Stylurus spiniceps*	98	36	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Stylurus spiniceps*	98	36	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Gomphus vastus*	89	33	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Stylurus spiniceps*	92	32	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Dromogomphus spinosus*	115	41	Exuvia
7/28/2015	25-06	4	15:45	16:04	*Gomphus vastus*	88	35	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	120	22	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	131	25	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	132	27	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	135	27	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	134	27	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	109	15	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	120	19	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	119	19	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	133	32	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	133	26	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	114	15	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus amnicola*	121	25	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	132	26	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Dromogomphus spinosus*	137	26	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	147	29	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	145	34	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	149	33	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	138	33	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus scudderi*	138	33	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	145	32	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	162	36	Exuvia
7/28/2015	25-06	5	16:05	16:37	*Stylurus spiniceps*	158	32	Exuvia
6/4/2015	25-07	1	11:15	11:21	No odonates observed			
6/4/2015	25-07	5	11:49	12:09	*Gomphus abbreviatus*	0	20	Exuvia
6/4/2015	25-07	4	11:49	12:09	*Gomphus abbreviatus*	2	31	Exuvia
6/4/2015	25-07	2	11:24	11:30	No odonates observed			
6/4/2015	25-07	3	11:42	11:47	No odonates observed			
6/9/2015	25-07	1	15:05	15:07	No odonates observed			
6/9/2015	25-07	2	14:50	15:03	*Gomphus vastus*	0	20	Exuvia
6/9/2015	25-07	2	14:50	15:03	*Gomphus vastus*	0	12	Exuvia
6/9/2015	25-07	2	14:50	15:03	*Gomphus vastus*	0	12	Exuvia
6/9/2015	25-07	3	14:49	14:52	*Gomphus vastus*	14	6	Exuvia
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	40	Exuvia
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	42	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	32	Exuvia
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	29	Exuvia
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	29	Exuvia
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	29	Exuvia
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	29	Exuvia
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	32	Exuvia
6/9/2015	25-07	4	14:35	14:47	*Gomphus vastus*	0	12	Exuvia
6/9/2015	25-07	5	14:14	14:30	*Gomphus vastus*	0	28	Exuvia
6/9/2015	25-07	5	14:14	14:30	*Gomphus vastus*	0	28	Exuvia
6/9/2015	25-07	5	14:14	14:30	*Gomphus vastus*	0	32	Exuvia
6/9/2015	25-07	5	14:14	14:30	*Gomphus vastus*	0	38	Exuvia
6/9/2015	25-07	5	14:14	14:30	*Gomphus vastus*	0	38	Exuvia
6/9/2015	25-07	5	14:14	14:30	*Gomphus vastus*	0	18	Exuvia
6/23/2015	25-07	1	8:47	8:57	*Epitheca princeps*	52	36	Exuvia
6/23/2015	25-07	2	8:58	9:05	*Gomphus vastus*	52	11	Exuvia
6/23/2015	25-07	3	9:07	9:16	*Gomphus vastus*	72	22	Exuvia
6/23/2015	25-07	3	9:07	9:16	*Epitheca princeps*	59	20	Exuvia
6/23/2015	25-07	3	9:07	9:16	*Hagenius brevirostris*	55	6	Exuvia
6/23/2015	25-07	4	9:28	9:32	No odonates observed			
6/23/2015	25-07	5	9:18	9:27	*Epitheca princeps*	41	24	Exuvia
6/23/2015	25-07	5	9:18	9:27	*Gomphus vastus*	41	18	Exuvia
6/23/2015	25-07	5	9:18	9:27	*Gomphus vastus*	51	43	Exuvia
7/7/2015	25-07	1	15:33	15:37	No odonates observed			
7/7/2015	25-07	2	15:25	15:31	*Stylurus spiniceps*	44	3	Exuvia
7/7/2015	25-07	2	15:25	15:31	*Stylurus spiniceps*	13	1	Exuvia
7/7/2015	25-07	3	15:05	15:23	*Stylurus amnicola*	43	4	Exuvia
7/7/2015	25-07	3	15:05	15:23	*Stylurus spiniceps*	47	40	Exuvia
7/7/2015	25-07	3	15:05	15:23	*Stylurus spiniceps*	56	14	Exuvia
7/7/2015	25-07	4	14:55	15:02	*Macromia illinoiensis*	42	2	Exuvia
7/7/2015	25-07	4	14:55	15:02	*Dromogomphus spinosus*	42	2	Exuvia
7/7/2015	25-07	4	14:55	15:02	*Epitheca princeps*	42	2	Exuvia
7/7/2015	25-07	5	14:00	14:53	*Dromogomphus spinosus*	17	17	Exuvia
7/7/2015	25-07	5	14:00	14:53	*Stylurus spiniceps*	17	1	Exuvia
7/7/2015	25-07	5	14:00	14:53	*Stylurus spiniceps*	16	1	Larva
7/7/2015	25-07	5	14:00	14:53	*Stylurus spiniceps*	11	2	Larva
7/7/2015	25-07	5	14:00	14:53	*Stylurus amnicola*	0	0	Exuvia
7/7/2015	25-07	5	14:00	14:53	*Stylurus spiniceps*	0	0	Exuvia
7/7/2015	25-07	5	14:00	14:53	*Dromogomphus spinosus*	18	23	Exuvia
7/7/2015	25-07	5	14:00	14:53	*Stylurus spiniceps*	0	0	Larva
7/14/2015	25-07	1	16:05	16:19	*Stylurus spiniceps*	0	7	Emerging
7/14/2015	25-07	1	16:05	16:19	*Stylurus spiniceps*	0	6	Emerging
7/14/2015	25-07	1	16:05	16:19	*Stylurus spiniceps*	0	4	Emerging
7/14/2015	25-07	1	16:05	16:19	*Stylurus spiniceps*	0	5	Emerging
7/14/2015	25-07	1	16:05	16:19	*Dromogomphus spinosus*	110	6	Exuvia
7/14/2015	25-07	2	16:22	16:27	*Dromogomphus spinosus*	114	13	Exuvia
7/14/2015	25-07	2	16:22	16:27	*Stylurus spiniceps*	114	13	Exuvia
7/14/2015	25-07	2	16:22	16:27	*Stylurus spiniceps*	74	2	Exuvia
7/14/2015	25-07	3	16:29	16:37	*Stylurus spiniceps*	132	21	Exuvia
7/14/2015	25-07	3	16:29	16:37	*Stylurus spiniceps*	130	24	Exuvia
7/14/2015	25-07	3	16:29	16:37	*Stylurus spiniceps*	122	20	Exuvia
7/14/2015	25-07	3	16:29	16:37	*Stylurus spiniceps*	122	20	Exuvia
7/14/2015	25-07	4	16:39	16:52	*Dromogomphus spinosus*	127	12	Exuvia
7/14/2015	25-07	4	16:39	16:52	*Stylurus spiniceps*	99	17	Emerging
7/14/2015	25-07	4	16:39	16:52	*Stylurus spiniceps*	99	17	Emerging
7/14/2015	25-07	4	16:39	16:52	*Stylurus spiniceps*	104	14	Emerging
7/14/2015	25-07	5	16:53	17:15	*Stylurus spiniceps*	86	10	Exuvia
7/14/2015	25-07	5	16:53	17:15	*Stylurus spiniceps*	95	4	Exuvia
7/14/2015	25-07	5	16:53	17:15	*Stylurus spiniceps*	104	6	Emerging

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/14/2015	25-07	5	16:53	17:15	*Stylurus spiniceps*	104	5	Exuvia
7/14/2015	25-07	5	16:53	17:15	*Stylurus spiniceps*	118	12	Exuvia
7/14/2015	25-07	5	16:53	17:15	*Stylurus spiniceps*	118	12	Exuvia
7/14/2015	25-07	5	16:53	17:15	*Stylurus spiniceps*	114	11	Emerging
7/28/2015	25-07	1	11:42	11:55	No odonates observed			
7/28/2015	25-07	2	11:35	11:41	No odonates observed			
7/28/2015	25-07	3	11:22	11:32	No odonates observed			
7/28/2015	25-07	4	11:13	11:21	*Stylurus spiniceps*	1	0	Exuvia
7/28/2015	25-07	4	11:13	11:21	*Stylurus spiniceps*	1	0	Exuvia
7/28/2015	25-07	5	10:53	11:11	*Stylurus spiniceps*	0	6	Exuvia
7/28/2015	25-07	5	10:53	11:11	*Stylurus spiniceps*	1	3	Exuvia
7/28/2015	25-07	5	10:53	11:11	*Stylurus spiniceps*	1	13	Exuvia
7/28/2015	25-07	5	10:53	11:11	*Macromia illinoiensis*	4	4	Exuvia
7/28/2015	25-07	5	10:53	11:11	*Stylurus amnicola*	0	0	Exuvia
6/8/2015	25-08	2	12:30	12:47	*Neurocordulia yamaskanensis*	124	63	Exuvia
6/8/2015	25-08	5	13:22	13:33	*Neurocordulia yamaskanensis*	61	55	Exuvia
6/8/2015	25-08	3	12:49	12:55	No odonates observed			
6/8/2015	25-08	4	12:59	13:20	*Gomphus vastus*	40	0	Exuvia
6/8/2015	25-08	1	12:10	12:28	No odonates observed			
6/11/2015	25-08	1	14:05	14:15	No odonates observed			
6/11/2015	25-08	2	19:17	19:27	*Gomphus vastus*	53	6	Exuvia
6/11/2015	25-08	2	19:17	19:27	*Gomphus vastus*	53	6	Exuvia
6/11/2015	25-08	2	19:17	19:27	*Gomphus vastus*	53	6	Exuvia
6/11/2015	25-08	2	19:17	19:27	*Gomphus vastus*	56	7	Exuvia
6/11/2015	25-08	2	19:17	19:27	*Gomphus vastus*	50	6	Exuvia
6/11/2015	25-08	2	19:17	19:27	*Gomphus vastus*	50	6	Exuvia
6/11/2015	25-08	2	19:17	19:27	*Neurocordulia yamaskanensis*	47	6	Exuvia
6/11/2015	25-08	2	19:17	19:27	*Gomphus vastus*	46	6	Exuvia
6/11/2015	25-08	2	19:17	19:27	*Gomphus vastus*	43	6	Exuvia
6/11/2015	25-08	3	19:10	19:15	No odonates observed			
6/11/2015	25-08	4	19:15	19:45	No odonates observed			
6/11/2015	25-08	5	19:44	19:52	No odonates observed			
6/23/2015	25-08	1	10:20	10:27	No odonates observed			
6/23/2015	25-08	2	10:30	10:35	No odonates observed			
6/23/2015	25-08	3	10:36	10:39	No odonates observed			
6/23/2015	25-08	4	10:40	10:43	No odonates observed			
6/23/2015	25-08	5	10:44	10:47	No odonates observed			
6/25/2015	25-08	1	11:01	11:10	No odonates observed			
6/25/2015	25-08	2	11:11	11:17	*Dromogomphus spinosus*	6	1	Exuvia
6/25/2015	25-08	3	11:19	11:25	No odonates observed			
6/25/2015	25-08	4	11:26	11:30	No odonates observed			
6/25/2015	25-08	5	11:31	11:39	No odonates observed			
7/7/2015	25-08	1	12:02	12:06	No odonates observed			
7/7/2015	25-08	2	12:06	12:12	No odonates observed			
7/7/2015	25-08	3	12:14	12:18	No odonates observed			
7/7/2015	25-08	4	12:23	12:35	No odonates observed			
7/7/2015	25-08	5	12:40	12:45	No odonates observed			
7/13/2015	25-08	1	8:52	9:01	*Stylurus spiniceps*	0	29	Exuvia
7/13/2015	25-08	1	8:52	9:01	*Stylurus spiniceps*	19	15	Emerging
7/13/2015	25-08	2	9:07	9:11	*Stylurus amnicola*	37	35	Exuvia
7/13/2015	25-08	2	9:07	9:11	*Stylurus scudderi*	21	13	Larva
7/13/2015	25-08	3	9:19	9:25	*Stylurus amnicola*	0	11	Exuvia
7/13/2015	25-08	3	9:19	9:25	*Stylurus spiniceps*	28	39	Exuvia
7/13/2015	25-08	3	9:19	9:25	*Stylurus spiniceps*	34	43	Exuvia
7/13/2015	25-08	3	9:19	9:25	*Stylurus spiniceps*	9	38	Exuvia
7/13/2015	25-08	4	9:29	9:36	*Stylurus spiniceps*	32	45	Exuvia
7/13/2015	25-08	4	9:29	9:36	*Boyeria vinosa*	45	61	Exuvia
7/13/2015	25-08	5	9:43	9:47	No odonates observed			

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/28/2015	25-08	1	8:58	9:16	*Boyeria vinosa*	26	14	Exuvia
7/28/2015	25-08	1	8:58	9:16	*Stylurus spiniceps*	35	12	Emerging
7/28/2015	25-08	2	9:17	9:27	*Stylurus spiniceps*	100	47	Exuvia
7/28/2015	25-08	3	9:29	9:35	*Stylurus spiniceps*	45	22	Exuvia
7/28/2015	25-08	3	9:29	9:35	*Stylurus spiniceps*	39	15	Exuvia
7/28/2015	25-08	4	9:37	9:44	*Boyeria vinosa*	94	46	Exuvia
7/28/2015	25-08	5	9:51	9:59	*Stylurus spiniceps*	110	37	Exuvia
6/4/2015	25-09	1	15:12	15:15	No odonates observed			
6/4/2015	25-09	2	14:58	15:06	No odonates observed			
6/4/2015	25-09	3	14:51	14:56	No odonates observed			
6/4/2015	25-09	4	14:49	14:54	No odonates observed			
6/4/2015	25-09	5	14:30	14:39	No odonates observed			
6/9/2015	25-09	1	12:03	12:22	*Gomphus vastus*	105	30	Exuvia
6/9/2015	25-09	1	12:03	12:22	*Gomphus vastus*	104	34	Exuvia
6/9/2015	25-09	1	12:03	12:22	*Neurocordulia yamaskanensis*	104	34	Exuvia
6/9/2015	25-09	2	11:49	12:00	*Gomphus vastus*	94	28	Exuvia
6/9/2015	25-09	3	11:27	11:46	*Gomphus vastus*	34	17	Exuvia
6/9/2015	25-09	3	11:27	11:46	*Neurocordulia yamaskanensis*	33	17	Exuvia
6/9/2015	25-09	3	11:27	11:46	*Gomphus vastus*	47	44	Exuvia
6/9/2015	25-09	3	11:27	11:46	*Gomphus vastus*	53	29	Exuvia
6/9/2015	25-09	3	11:27	11:46	*Gomphus abbreviatus*	60	28	Exuvia
6/9/2015	25-09	3	11:27	11:46	*Gomphus abbreviatus*	52	24	Exuvia
6/9/2015	25-09	3	11:27	11:46	*Gomphus vastus*	44	31	Emerging
6/9/2015	25-09	3	11:27	11:46	*Gomphus vastus*	59	47	Exuvia
6/9/2015	25-09	4	11:20	11:35	No odonates observed			
6/9/2015	25-09	5	11:11	11:18	*Neurocordulia yamaskanensis*	16	58	Exuvia
6/22/2015	25-09	1	14:05	14:13	*Dromogomphus spinosus*	48	6	Exuvia
6/22/2015	25-09	1	14:05	14:13	*Dromogomphus spinosus*	50	6	Exuvia
6/22/2015	25-09	2	16:16	16:37	*Gomphus vastus*	46	36	Exuvia
6/22/2015	25-09	2	16:16	16:37	*Gomphus vastus*	55	16	Exuvia
6/22/2015	25-09	2	16:16	16:37	*Gomphus vastus*	65	42	Exuvia
6/22/2015	25-09	2	16:16	16:37	*Neurocordulia yamaskanensis*	83	60	Exuvia
6/22/2015	25-09	2	16:16	16:37	*Gomphus vastus*	76	42	Exuvia
6/22/2015	25-09	2	16:16	16:37	*Gomphus vastus*	84	44	Exuvia
6/22/2015	25-09	2	16:16	16:37	*Gomphus vastus*	84	44	Exuvia
6/22/2015	25-09	2	16:16	16:37	*Gomphus vastus*	120	84	Exuvia
6/22/2015	25-09	3	16:39	16:45	*Gomphus vastus*	39	27	Exuvia
6/22/2015	25-09	4	16:59	17:07	No odonates observed			
6/22/2015	25-09	5	16:49	16:58	*Gomphus vastus*	0	24	Exuvia
6/22/2015	25-09	5	16:49	16:58	*Gomphus vastus*	9	22	Exuvia
6/22/2015	25-09	5	16:49	16:58	*Gomphus vastus*	50	40	Exuvia
7/6/2015	25-09	1	12:38	12:46	*Dromogomphus spinosus*	150	31	Exuvia
7/6/2015	25-09	2	12:18	12:36	*Dromogomphus spinosus*	82	45	Exuvia
7/6/2015	25-09	3	12:02	12:16	*Gomphus vastus*	75	28	Exuvia
7/6/2015	25-09	3	12:02	12:16	*Gomphus vastus*	72	37	Exuvia
7/6/2015	25-09	4	11:18	11:45	*Stylurus amnicola*	82	14	Exuvia
7/6/2015	25-09	4	11:18	11:45	*Gomphus vastus*	122	23	Exuvia
7/6/2015	25-09	5	10:51	11:10	No odonates observed			
7/15/2015	25-09	1	8:01	8:12	*Stylurus spiniceps*	164	19	Exuvia
7/15/2015	25-09	1	8:01	8:12	*Stylurus amnicola*	165	19	Exuvia
7/15/2015	25-09	1	8:01	8:12	*Stylurus spiniceps*	166	20	Exuvia
7/15/2015	25-09	1	8:01	8:12	*Dromogomphus spinosus*	180	28	Exuvia
7/15/2015	25-09	1	8:01	8:12	*Dromogomphus spinosus*	186	33	Exuvia
7/15/2015	25-09	2	8:13	8:23	*Stylurus spiniceps*	113	26	Exuvia
7/15/2015	25-09	2	8:13	8:23	*Stylurus spiniceps*	113	26	Exuvia
7/15/2015	25-09	2	8:13	8:23	*Stylurus spiniceps*	99	20	Exuvia
7/15/2015	25-09	2	8:13	8:23	*Stylurus spiniceps*	104	13	Exuvia
7/15/2015	25-09	3	8:24	8:34	*Dromogomphus spinosus*	78	14	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/15/2015	25-09	3	8:24	8:34	*Stylurus spiniceps*	80	19	Exuvia
7/15/2015	25-09	3	8:24	8:34	*Neurocordulia yamaskanensis*	91	26	Exuvia
7/15/2015	25-09	3	8:24	8:34	*Stylurus spiniceps*	66	23	Exuvia
7/15/2015	25-09	4	8:35	8:44	*Stylurus spiniceps*	117	13	Exuvia
7/15/2015	25-09	4	8:35	8:44	*Dromogomphus spinosus*	136	19	Exuvia
7/15/2015	25-09	4	8:35	8:44	*Stylurus spiniceps*	108	6	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	0	3	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	0	7	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	0	11	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	0	8	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	0	8	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	0	2	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus amnicola*	7	7	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	91	24	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	96	20	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	96	5	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	68	15	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Stylurus spiniceps*	68	27	Exuvia
7/15/2015	25-09	5	8:46	9:03	*Boyeria vinosa*	140	56	Exuvia
7/27/2015	25-09	1	15:11	15:27	*Stylurus spiniceps*	129	23	Exuvia
7/27/2015	25-09	1	15:11	15:27	*Stylurus spiniceps*	118	23	Exuvia
7/27/2015	25-09	2	15:29	15:42	*Stylurus spiniceps*	78	12	Exuvia
7/27/2015	25-09	2	15:29	15:42	*Stylurus amnicola*	78	14	Exuvia
7/27/2015	25-09	2	15:29	15:42	*Stylurus amnicola*	108	22	Exuvia
7/27/2015	25-09	3	15:42	15:51	*Stylurus spiniceps*	59	17	Exuvia
7/27/2015	25-09	4	15:53	16:13	*Stylurus spiniceps*	94	22	Exuvia
7/27/2015	25-09	4	15:53	16:13	*Stylurus spiniceps*	114	30	Exuvia
7/27/2015	25-09	4	15:53	16:13	*Stylurus spiniceps*	112	22	Exuvia
7/27/2015	25-09	4	15:53	16:13	*Stylurus spiniceps*	102	20	Exuvia
7/27/2015	25-09	4	15:53	16:13	*Stylurus spiniceps*	86	16	Exuvia
7/27/2015	25-09	4	15:53	16:13	*Stylurus spiniceps*	94	30	Exuvia
7/27/2015	25-09	5	16:16	16:34	*Stylurus spiniceps*	0	3	Exuvia
7/27/2015	25-09	5	16:16	16:34	*Stylurus amnicola*	70	6	Exuvia
7/27/2015	25-09	5	16:16	16:34	*Stylurus spiniceps*	97	26	Exuvia
7/27/2015	25-09	5	16:16	16:34	*Stylurus spiniceps*	56	8	Exuvia
7/27/2015	25-09	5	16:16	16:34	*Stylurus spiniceps*	65	17	Exuvia
7/27/2015	25-09	5	16:16	16:34	*Dromogomphus spinosus*	123	42	Exuvia
7/27/2015	25-09	5	16:16	16:34	*Stylurus spiniceps*	0	3	Exuvia
6/4/2015	25-10	5	17:35	17:37	No odonates observed			
6/4/2015	25-10	4	17:39	17:44	No odonates observed			
6/4/2015	25-10	3	17:54	17:59	No odonates observed			
6/4/2015	25-10	2	18:11	18:14	No odonates observed			
6/4/2015	25-10	1	18:03	18:07	No odonates observed			
6/9/2015	25-10	1	8:54	8:58	*Neurocordulia yamaskanensis*	15	15	Exuvia
6/9/2015	25-10	2	9:28	9:30	No odonates observed			
6/9/2015	25-10	3	9:08	9:12	No odonates observed			
6/9/2015	25-10	4	9:21	9:24	No odonates observed			
6/9/2015	25-10	5	9:15	9:19	No odonates observed			
6/22/2015	25-10	1	13:51	13:59	No odonates observed			
6/22/2015	25-10	2	14:01	14:12	*Dromogomphus spinosus*	132	2	Exuvia
6/22/2015	25-10	2	14:01	14:12	*Dromogomphus spinosus*	144	27	Exuvia
6/22/2015	25-10	3	14:12	14:23	*Neurocordulia yamaskanensis*	168	3	Exuvia
6/22/2015	25-10	4	14:46	14:52	*Dromogomphus spinosus*	16	25	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Neurocordulia yamaskanensis*	37	40	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Gomphus abbreviatus*	38	36	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Gomphus abbreviatus*	25	36	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Gomphus abbreviatus*	37	39	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Gomphus vastus*	33	37	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
6/22/2015	25-10	5	14:27	14:44	*Gomphus vastus*	28	32	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Gomphus vastus*	34	45	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Gomphus abbreviatus*	19	1	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Gomphus vastus*	34	34	Exuvia
6/22/2015	25-10	5	14:27	14:44	*Gomphus vastus*	33	44	Exuvia
7/7/2015	25-10	1	9:29	9:39	No odonates observed			
7/7/2015	25-10	2	9:40	9:46	No odonates observed			
7/7/2015	25-10	3	9:53	9:58	No odonates observed			
7/7/2015	25-10	4	10:02	10:26	*Dromogomphus spinosus*	1	12	Exuvia
7/7/2015	25-10	4	10:02	10:26	*Gomphus abbreviatus*	0	11	Exuvia
7/7/2015	25-10	4	10:02	10:26	*Dromogomphus spinosus*	0	11	Exuvia
7/7/2015	25-10	4	10:02	10:26	*Gomphus vastus*	8	24	Exuvia
7/7/2015	25-10	5	10:28	10:41	*Gomphus vastus*	8	23	Exuvia
7/7/2015	25-10	5	10:28	10:41	*Dromogomphus spinosus*	10	32	Exuvia
7/7/2015	25-10	5	10:28	10:41	*Dromogomphus spinosus*	20	10	Exuvia
7/7/2015	25-10	5	10:28	10:41	*Dromogomphus spinosus*	2	11	Exuvia
7/7/2015	25-10	5	10:28	10:41	*Dromogomphus spinosus*	6	23	Exuvia
7/15/2015	25-10	1	10:48	10:54	*Stylurus spiniceps*	21	2	Exuvia
7/15/2015	25-10	1	10:48	10:54	*Dromogomphus spinosus*	16	27	Exuvia
7/15/2015	25-10	1	10:48	10:54	*Stylurus spiniceps*	18	11	Exuvia
7/15/2015	25-10	2	10:40	10:47	*Dromogomphus spinosus*	58	11	Exuvia
7/15/2015	25-10	2	10:40	10:47	*Dromogomphus spinosus*	31	55	Exuvia
7/15/2015	25-10	3	10:32	10:38	*Stylurus spiniceps*	45	3	Exuvia
7/15/2015	25-10	4	10:20	10:29	*Stylurus spiniceps*	2	5	Exuvia
7/15/2015	25-10	4	10:20	10:29	*Dromogomphus spinosus*	6	15	Exuvia
7/15/2015	25-10	4	10:20	10:29	*Dromogomphus spinosus*	28	33	Exuvia
7/15/2015	25-10	4	10:20	10:29	*Stylurus spiniceps*	25	25	Exuvia
7/15/2015	25-10	4	10:20	10:29	*Gomphus vastus*	18	27	Exuvia
7/15/2015	25-10	5	10:05	10:15	*Dromogomphus spinosus*	5	19	Exuvia
7/15/2015	25-10	5	10:05	10:15	*Stylurus spiniceps*	15	15	Exuvia
7/15/2015	25-10	5	10:05	10:15	*Stylurus spiniceps*	12	15	Exuvia
7/15/2015	25-10	5	10:05	10:15	*Stylurus spiniceps*	5	15	Exuvia
7/15/2015	25-10	5	10:05	10:15	*Dromogomphus spinosus*	20	17	Exuvia
7/15/2015	25-10	5	10:05	10:15	*Dromogomphus spinosus*	12	4	Exuvia
7/27/2015	25-10	1	18:04	18:14	*Stylurus spiniceps*	0	11	Exuvia
7/27/2015	25-10	2	18:15	18:23	No odonates observed			
7/27/2015	25-10	3	18:25	18:36	*Stylurus spiniceps*	173	4	Exuvia
7/27/2015	25-10	3	18:25	18:36	*Stylurus spiniceps*	173	19	Exuvia
7/27/2015	25-10	4	18:38	18:49	*Stylurus spiniceps*	0	5	Exuvia
7/27/2015	25-10	5	18:50	18:59	*Stylurus spiniceps*	8	22	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	144	41	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	126	18	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	158	25	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	173	38	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	152	30	Teneral
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	163	42	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	163	42	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	163	42	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	163	42	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	165	46	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Gomphus vastus*	180	48	Exuvia
6/8/2015	25-11	5	18:09	18:37	*Neurocordulia yamaskanensis*	180	48	Exuvia
6/8/2015	25-11	4	17:50	18:08	*Gomphus vastus*	310	45	Exuvia
6/8/2015	25-11	4	17:50	18:08	*Gomphus vastus*	274	27	Exuvia
6/8/2015	25-11	4	17:50	18:08	*Gomphus vastus*	268	36	Exuvia
6/8/2015	25-11	4	17:50	18:08	*Gomphus vastus*	274	27	Exuvia
6/8/2015	25-11	3	17:20	17:38	*Neurocordulia yamaskanensis*	125	12	Exuvia
6/8/2015	25-11	3	17:20	17:38	*Gomphus abbreviatus*	125	33	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
6/8/2015	25-11	3	17:20	17:38	*Gomphus vastus*	131	12	Exuvia
6/8/2015	25-11	3	17:20	17:38	*Gomphus vastus*	144	39	Exuvia
6/8/2015	25-11	2	16:52	17:17	*Ophiogomphus rupinsulensis*	81	42	Exuvia
6/8/2015	25-11	2	16:52	17:17	*Ophiogomphus rupinsulensis*	100	47	Exuvia
6/8/2015	25-11	2	16:52	17:17	*Gomphus vastus*	124	61	Exuvia
6/8/2015	25-11	1	16:22	16:36	*Gomphus vastus*	180	26	Exuvia
6/10/2015	25-11	1	10:00	10:10	*Gomphus vastus*	30	38	Exuvia
6/10/2015	25-11	1	10:00	10:10	*Gomphus vastus*	16	34	Exuvia
6/10/2015	25-11	1	10:00	10:10	*Gomphus vastus*	18	34	Exuvia
6/10/2015	25-11	2	9:58	10:03	No odonates observed			
6/10/2015	25-11	3	9:50	9:55	*Gomphus vastus*	0	14	Exuvia
6/10/2015	25-11	4	9:42	9:47	*Gomphus vastus*	62	36	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Gomphus vastus*	66	34	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Gomphus vastus*	57	34	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Gomphus vastus*	51	28	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Gomphus vastus*	57	44	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Gomphus vastus*	62	36	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Gomphus vastus*	64	36	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Gomphus vastus*	54	28	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Ophiogomphus rupinsulensis*	54	28	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Ophiogomphus rupinsulensis*	57	34	Exuvia
6/10/2015	25-11	5	9:11	9:38	*Gomphus vastus*	60	34	Exuvia
6/22/2015	25-11	1	12:29	12:38	*Gomphus vastus*	19	32	Exuvia
6/22/2015	25-11	1	12:29	12:38	*Gomphus vastus*	20	2	Exuvia
6/22/2015	25-11	1	12:29	12:38	*Gomphus vastus*	5	20	Exuvia
6/22/2015	25-11	1	12:29	12:38	*Gomphus vastus*	2	22	Exuvia
6/22/2015	25-11	1	12:29	12:38	*Gomphus vastus*	8	25	Exuvia
6/22/2015	25-11	2	10:28	10:50	*Gomphus vastus*	20	32	Exuvia
6/22/2015	25-11	2	10:28	10:50	*Gomphus vastus*	15	13	Exuvia
6/22/2015	25-11	2	10:28	10:50	*Gomphus vastus*	11	31	Exuvia
6/22/2015	25-11	2	10:28	10:50	*Gomphus vastus*	11	31	Exuvia
6/22/2015	25-11	2	10:28	10:50	*Dromogomphus spinosus*	19	42	Exuvia
6/22/2015	25-11	2	10:28	10:50	*Gomphus vastus*	8	14	Exuvia
6/22/2015	25-11	2	10:28	10:50	*Gomphus vastus*	12	28	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	5	25	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	29	22	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	29	16	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	31	16	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	26	23	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	22	20	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	24	18	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	9	26	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	8	26	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	16	38	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	16	36	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	13	34	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	13	34	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	8	25	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	7	25	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	33	33	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	24	40	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	25	44	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	16	37	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	10	31	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	19	43	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	31	68	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	15	36	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	20	32	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	18	41	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	18	38	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	22	44	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	24	21	Exuvia
6/22/2015	25-11	3	10:51	11:24	*Gomphus vastus*	15	38	Exuvia
6/22/2015	25-11	4	11:27	11:37	*Gomphus vastus*	33	24	Exuvia
6/22/2015	25-11	4	11:27	11:37	*Gomphus vastus*	76	34	Exuvia
6/22/2015	25-11	4	11:27	11:37	*Gomphus vastus*	26	19	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Ophiogomphus rupinsulensis*	58	35	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	61	44	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	65	45	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	61	36	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	32	5	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	41	11	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	68	41	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	68	41	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	57	26	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	62	34	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	68	41	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	49	29	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	52	30	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	60	33	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	61	34	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	48	30	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	64	46	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	59	41	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	55	39	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	56	50	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	48	24	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	50	24	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	49	35	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	55	45	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	57	46	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	55	32	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	54	32	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	55	32	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	54	32	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	55	32	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	46	21	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	48	25	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	47	25	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	64	46	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	64	46	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	51	38	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	51	38	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	48	20	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	46	20	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	51	20	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	57	41	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	60	37	Exuvia
6/22/2015	25-11	5	11:44	12:18	*Gomphus vastus*	64	39	Exuvia
7/6/2015	25-11	1	16:04	16:24	*Stylurus amnicola*	0	45	Exuvia
7/6/2015	25-11	1	16:04	16:24	*Stylurus amnicola*	0	32	Exuvia
7/6/2015	25-11	2	16:26	16:33	*Stylurus amnicola*	0	37	Exuvia
7/6/2015	25-11	3	16:37	17:08	*Gomphus vastus*	0	42	Exuvia
7/6/2015	25-11	3	16:37	17:08	*Neurocordulia yamaskanensis*	20	35	Exuvia
7/6/2015	25-11	3	16:37	17:08	*Stylurus spiniceps*	42	13	Exuvia
7/6/2015	25-11	3	16:37	17:08	*Gomphus vastus*	35	41	Exuvia

Date	Site	Transect	Start Time	End Time	Species	Horizontal	Vertical	Type
7/6/2015	25-11	3	16:37	17:08	*Ophiogomphus rupinsulensis*	22	31	Exuvia
7/6/2015	25-11	3	16:37	17:08	*Stylurus spiniceps*	13	34	Exuvia
7/6/2015	25-11	4	17:10	17:17	No odonates observed			
7/6/2015	25-11	5	17:22	17:48	*Dromogomphus spinosus*	59	25	Exuvia
7/6/2015	25-11	5	17:22	17:48	*Dromogomphus spinosus*	60	35	Exuvia
7/6/2015	25-11	5	17:22	17:48	*Stylurus spiniceps*	56	23	Exuvia
7/6/2015	25-11	5	17:22	17:48	*Gomphus vastus*	72	30	Exuvia
7/6/2015	25-11	5	17:22	17:48	*Stylogomphus albistylus*	36	61	Exuvia
7/6/2015	25-11	5	17:22	17:48	*Neurocordulia yamaskanensis*	68	34	Exuvia
7/6/2015	25-11	5	17:22	17:48	*Gomphus vastus*	72	20	Exuvia
7/6/2015	25-11	5	17:22	17:48	*Ophiogomphus rupinsulensis*	80	42	Exuvia
7/15/2015	25-11	1	13:03	13:20	*Stylurus spiniceps*	115	22	Exuvia
7/15/2015	25-11	2	12:51	12:56	*Boyeria vinosa*	48	31	Exuvia
7/15/2015	25-11	3	12:46	12:50	No odonates observed			
7/15/2015	25-11	4	12:37	12:45	*Stylurus spiniceps*	164	20	Exuvia
7/15/2015	25-11	5	12:29	12:36	*Stylurus spiniceps*	30	11	Exuvia
7/27/2015	25-11	1	12:18	12:24	*Stylurus spiniceps*	102	19	Exuvia
7/27/2015	25-11	1	12:18	12:24	*Stylurus spiniceps*	212	28	Exuvia
7/27/2015	25-11	2	12:05	12:13	*Stylurus spiniceps*	114	20	Exuvia
7/27/2015	25-11	2	12:05	12:13	*Stylurus spiniceps*	126	28	Exuvia
7/27/2015	25-11	2	12:05	12:13	*Stylurus spiniceps*	126	28	Exuvia
7/27/2015	25-11	2	12:05	12:13	*Stylurus spiniceps*	110	16	Exuvia
7/27/2015	25-11	2	12:05	12:13	*Stylurus spiniceps*	96	18	Exuvia
7/27/2015	25-11	3	11:56	12:03	*Stylurus spiniceps*	343	42	Exuvia
7/27/2015	25-11	4	11:48	11:55	*Stylurus spiniceps*	329	49	Exuvia
7/27/2015	25-11	5	11:30	11:47	*Stylurus spiniceps*	234	44	Exuvia
7/27/2015	25-11	5	11:30	11:47	*Stylurus spiniceps*	180	36	Exuvia
7/27/2015	25-11	5	11:30	11:47	*Stylurus spiniceps*	180	36	Exuvia

Appendix C

Photos

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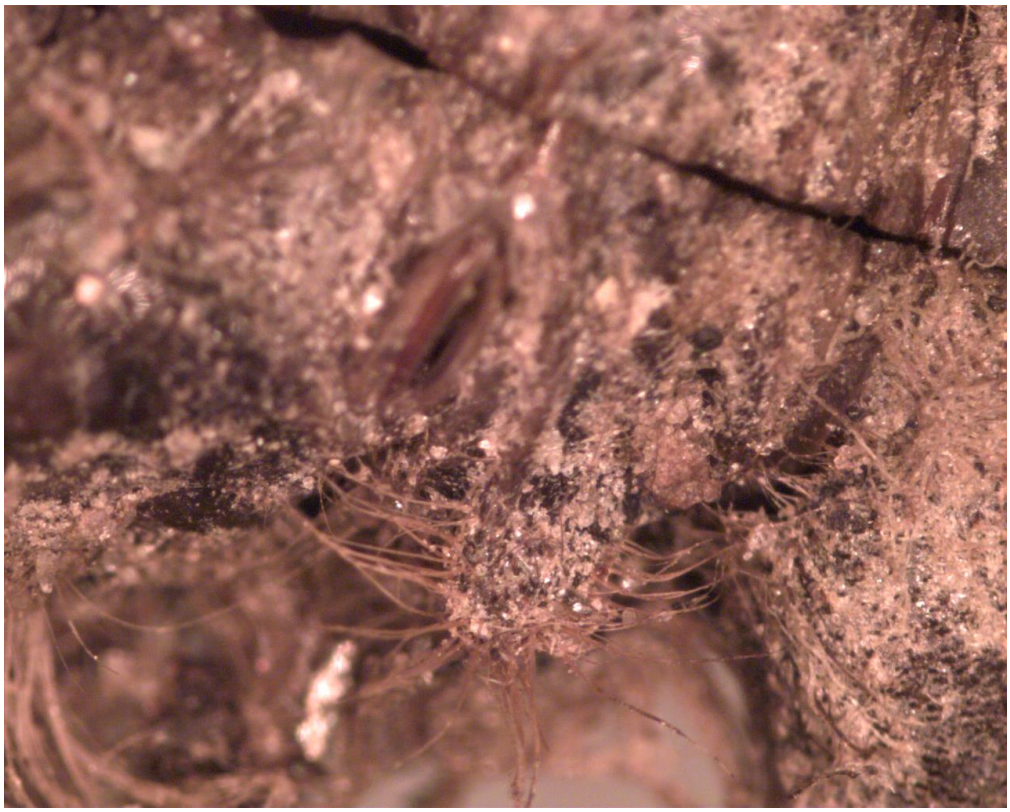
Exuviae

Boyeria vinosa (dorsolateral view) from 25-08

Cordulegaster maculata exuvia (ventral view) collected from 25-05



Cordulegaster maculata exuvia (epaulet detail, 1.25x) collected from 25-05

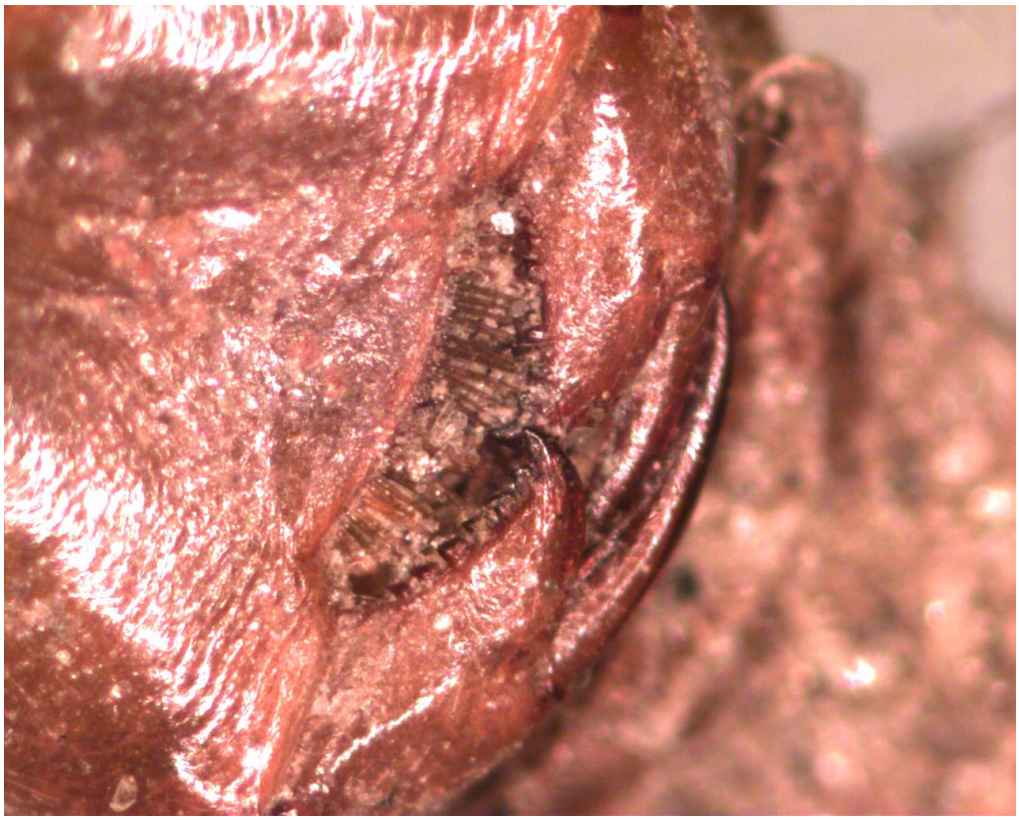
Didymops transvera exuvia (dorsal view) collected from 25-03

*Dromogomphus spinosus (*dorsal view) exuvia collected at 25-10

Dromogomphus spinosus exuvia (lateral view) collected at 25-10

Gomphus abbreviatus exuvia (lateral view) collected from 25-07

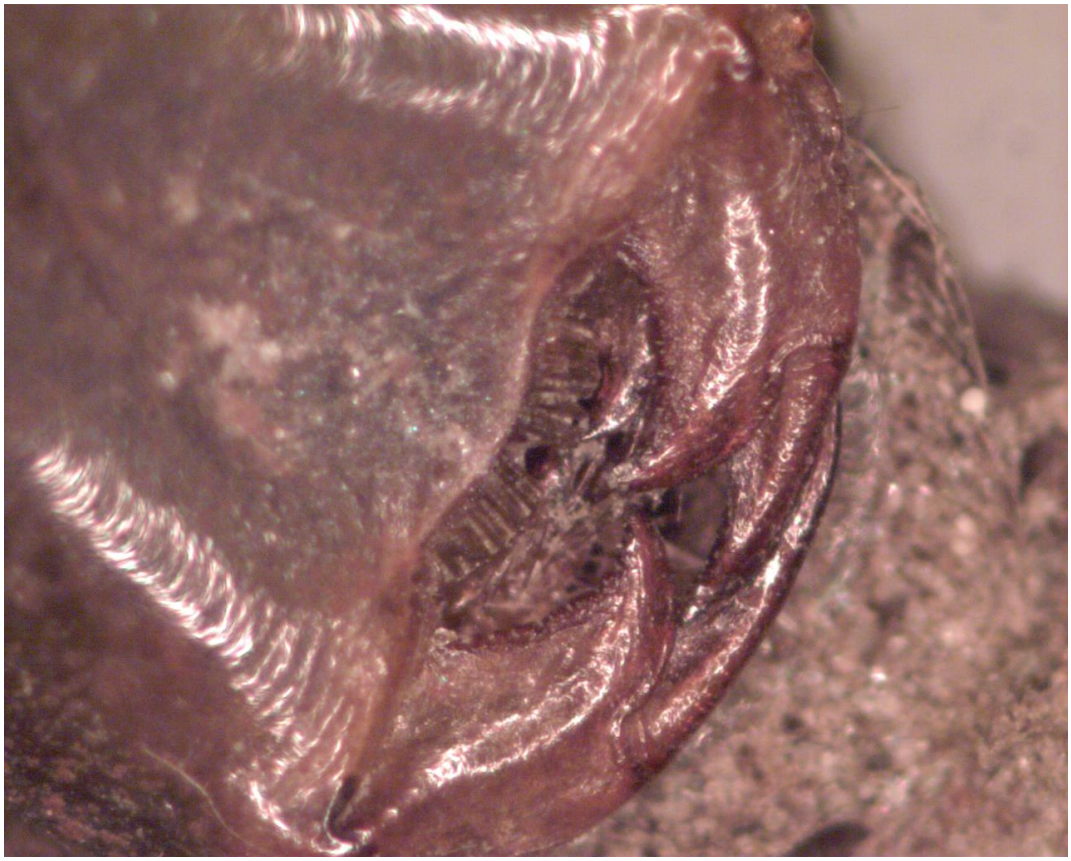
Gomphus abbreviatus exuvia (dorsal view) collected from 25-07



Gomphus abbreviatus exuvia (lateral lobe detail, 4x) collected from 25-07

Gomphus quadricolor exuvia (dorsal view) collected from 25-02

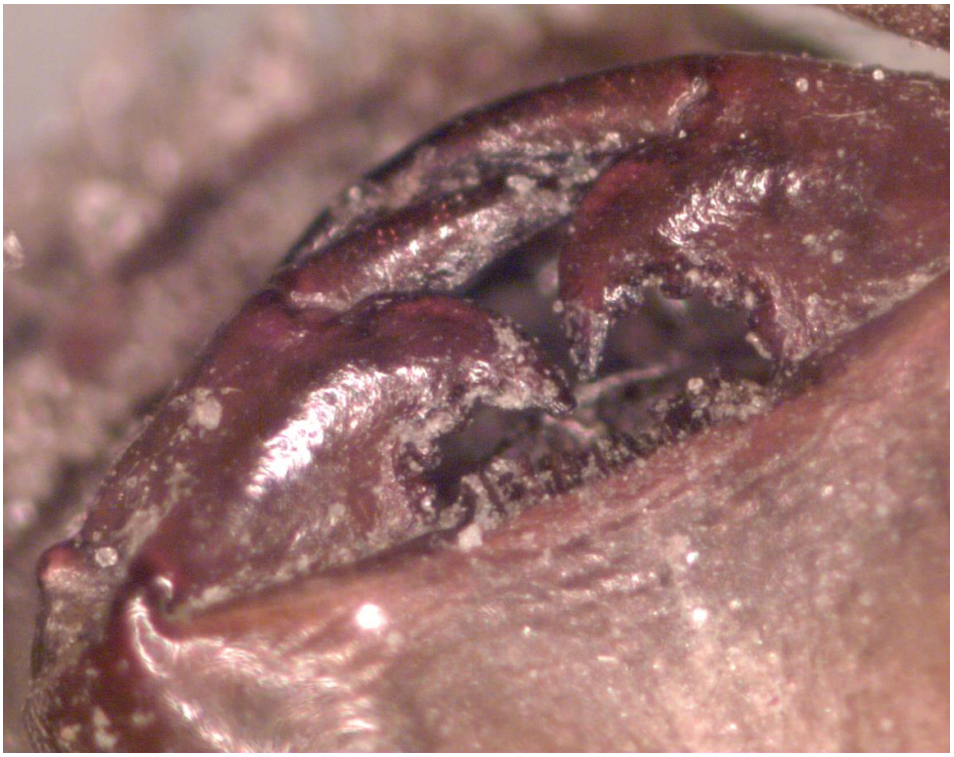
Gomphus quadricolor exuvia (lateral view) collected from 25-02



Gomphus quadricolor exuvia (lateral lobe detail, 3.2x)

Gomphus vastus exuvia (dorsal view) collected from 25-11

Gomphus vastus exuvia (lateral view) collected from 25-11



Gomphus vastus exuvia (lateral lobe detail, 3.2x) collected from 25-11

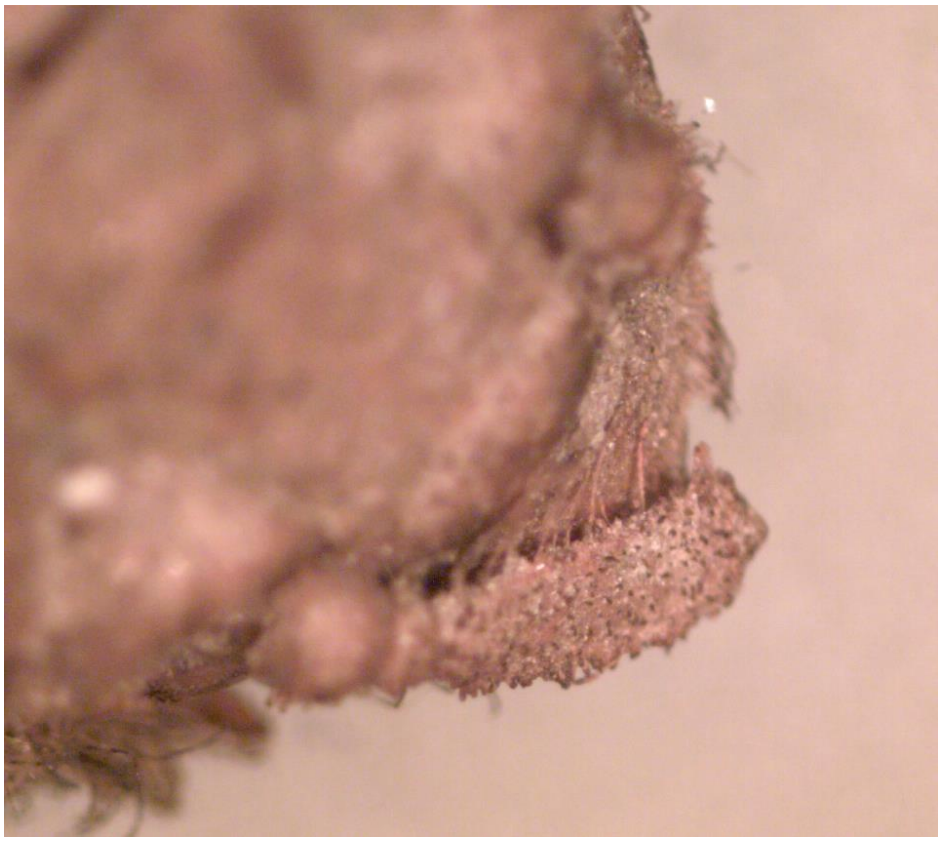
Hagenius brevistylus exuvia (dorsal view) collected from 25-07

Macromia illinoiensis (dorsal view) collected from 25-01

Neurocordulia yamaskanensis exuvia (dorsal view) collected from 25-11

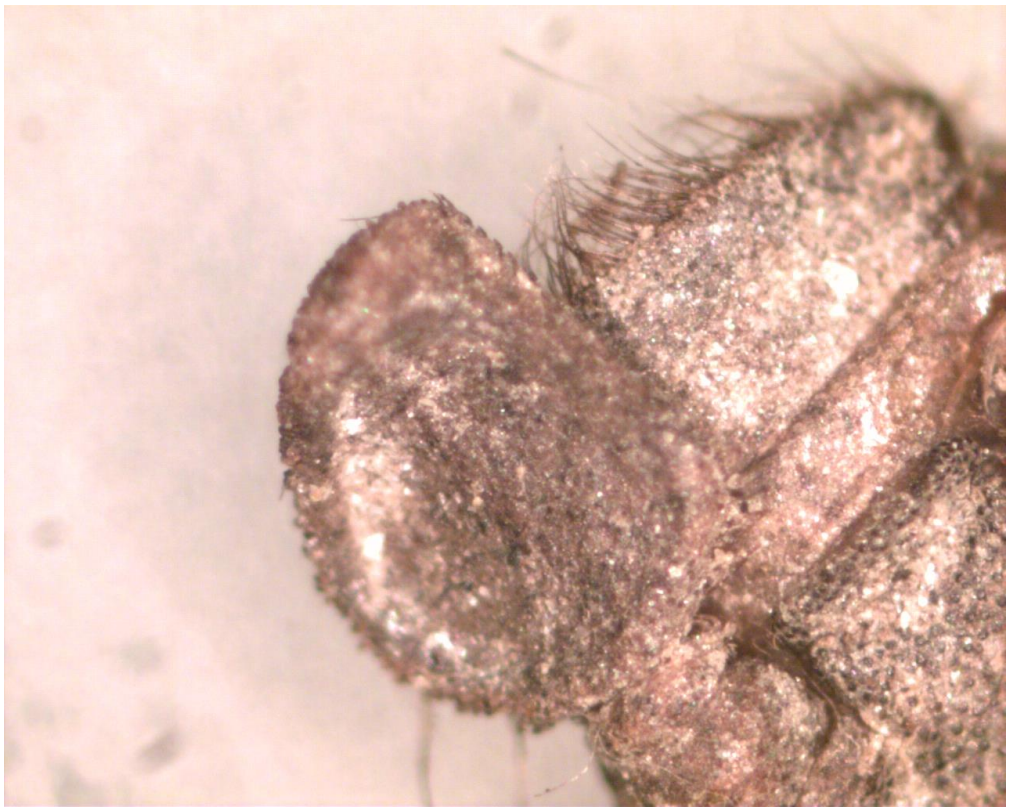
Ophiogomphus rupinsulensis exuvia (lateral view) collected from 25-11

Ophiogomphus rupinsulensis exuvia (dorsal view) collected from 25-11



Ophiogomphus rupinsulensis exuvia (antenna detail, 1.6x) collected from 25-11

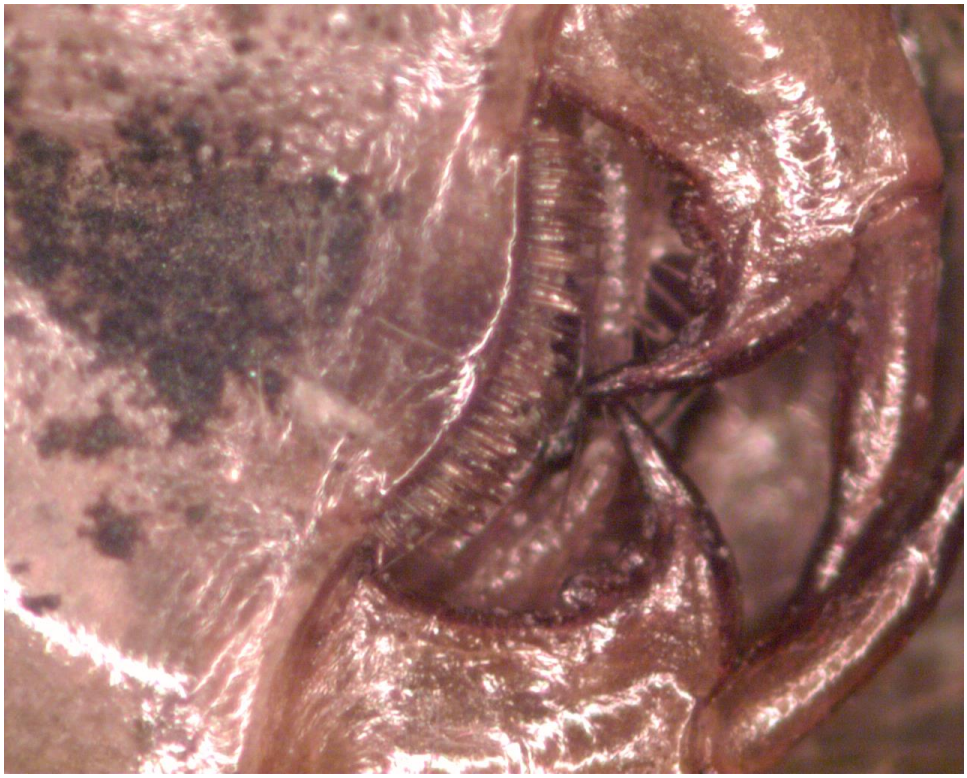
Stylogomphus albistylus exuvia (dorsal view) collected from 25-11



Stylogomphus albistylus exuvia (antenna detail, 3.2x) collected from 25-11

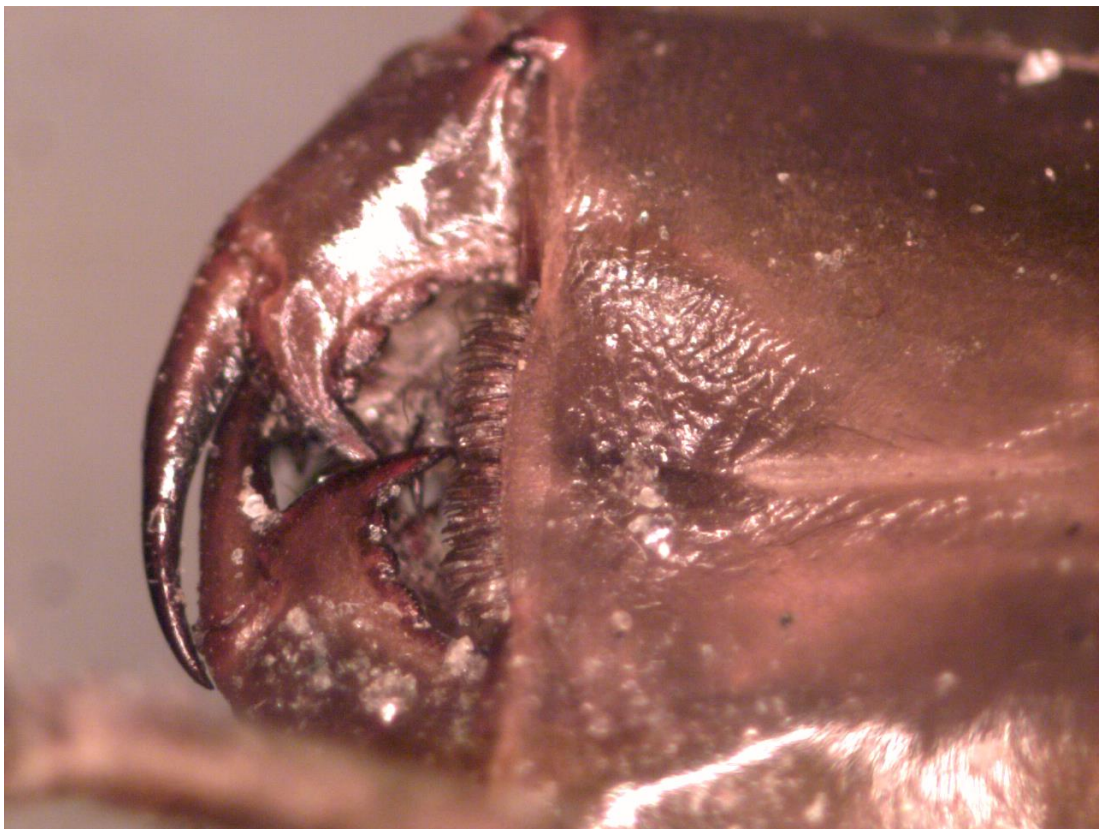
Stylurus amnicola exuvia (dorsal view) collected from 25-06

Stylurus amnicola exuvia (lateral view) collected from 25-06



Stylurus amnicola exuvia (lateral lobe detail, 4x) collected from 25-06

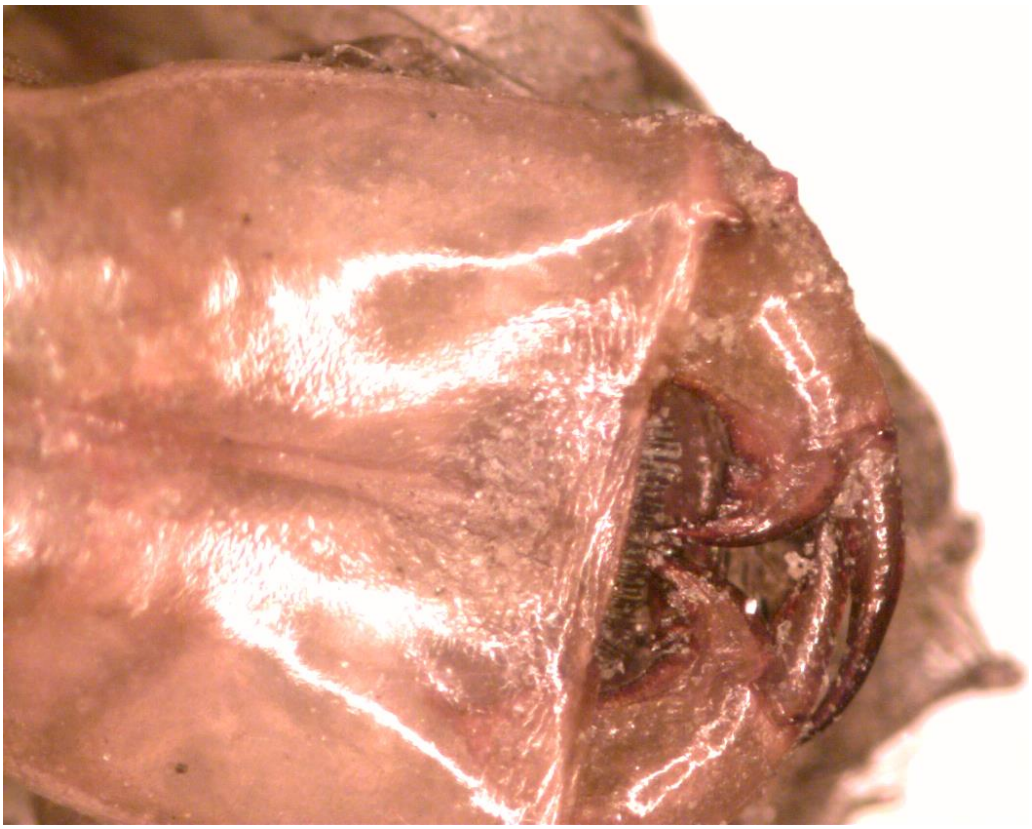
Stylurus scudderi exuvia (dorsolateral view) collected from 25-06



Stylurus scudderi exuvia (lateral lobe detail, 2x) collected from 25-06

Stylurus spiniceps exuvia (dorsal view) from 25-11

Stylurus spiniceps exuvia (lateral view) from 25-11



Stylurus spiniceps exuvia (lateral lobe detail, 1.6x) from 25-11

Field Photos

Teneral *Gomphus vastus* with eclosure-related wing injury at 25-11 on June 8, 2015.

Emerging *Gomphus vastus* at 25-09 on June 9, 2015

Teneral *Gomphus quadricolor* (lateral view) at 25-02 on June 10, 2015

Teneral *Gomphus quadricolor* (dorsal view) at 25-02 on June 10, 2015

Teneral *Dromogomphus spinosus* at 25-10 on June 22, 2015

Early and terminal instars of *Stylurus spiniceps* from 25-09 on June 22, 2015

Teneral *Gomphus vastus* from 25-02 on June 24, 2015

Emerging *Dromogomphus spinosus* larva from 25-10 on July 7, 2015

Stylurus spiniceps larva in the process of leaving the water at 25-08 on July 7, 2015

Eclosing *Stylurus spiniceps* from 25-07 on July 7, 2015

Stylurus scudderi larvae from 25-05 benthic sample on July 9, 2015

Macromia illinoiensis eclosing near 25-03 on July 14, 2015

Stylurus spiniceps injured as a result of a boat wake near 25-06 on July 14, 2015

Stylurus scudderi eclosing at 25-01, July 29, 2015

Teneral *Stylurus amnicola* from 25-02 on July 29, 2015

Teneral *Stylurus spiniceps* at 25-02 on July 29, 2015

Appendix D

Water Level Logger Data

(filed separately in Excel format with initial study report on June 17, 2016)

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Appendix E

Habitat Data

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		% Cover									
		Aquatic			Bank			Top of Bank			
Site	Transect	Soil (Bed Substrate)	Vegetation	Non-Vegetative Cover	Soil	Vegetation	Non-Vegetative Cover	Soil	Vegetation	Non-Vegetative Cover	Canopy
25-01	1	95 (sand/silt)	5	0	30	50	20	0	100	0	25
	2	100 (sand/silt)	0	0	10	80	10	0	100	0	60
	3	100 (sand/silt)	0	0	20	5	75	20	80	0	80
	4	100 (sand/silt)	0	0	40	0	60	20	80	0	60
	5	100 (sand/silt)	0	0	30	70	0	0	100	0	5
25-02	1	100 (sand)	0	0	5	80	15	0	70	30	60
	2	100 (sand)	0	0	10	60	30	0	80	20	80
	3	100 (sand)	0	0	10	50	40	10	50	40	90
	4	100 (sand)	0	0	10	35	50	10	75	15	90
	5	100 (sand)	0	0	15	70	15	0	90	10	70
25-03	1	40 (sand/silt)	0	60	50	25	25	20	50	30	-
	2	0 (sand/silt)	0	100	15	60	25	0	90	10	-
	3	60 (sand/silt)	0	40	10	60	30	0	70	30	-
	4	5 (sand/silt)	0	95	10	70	20	0	70	30	-
	5	0 (sand/silt)	0	100	30	60	10	0	70	30	-
25-04	1	100 (sand/silt)	0	0	60	40	0	0	100	0	50
	2	100 (sand/silt)	0	0	60	40	0	0	100	0	20
	3	100 (silt)	0	0	70	30	0	0	100	0	40
	4	100 (silt)	0	0	65	25	10	0	100	0	80
	5	100 (sand/silt)	0	0	85	10	5	0	100	0	60
25-05	1	100 (sand/silt)	0	0	30	70	0	0	100	0	15
	2	100 (sand/silt)	0	0	20	40	40	0	100	0	40
	3	100 (sand/silt)	0	0	20	50	30	0	100	0	40
	4	100 (sand/silt)	0	0	50	45	5	0	100	0	30
	5	100 (sand/silt)	0	0	30	70	0	0	100	0	30
25-06	1	100 (cobble/silt)	0	0	0	80	20	0	90	10	70
	2	100 (cobble)	0	0	0	90	10	0	70	30	60
	3	100 (silt/sand)	0	0	50	40	10	0	40	60	80
	4	100 (silt/sand)	0	0	10	50	40	0	40	60	90
	5	100 (silt/sand)	0	0	10	60	30	0	80	20	80
25-07	1	50 (sand)	0	50	65	20	15	0	100	0	90
	2	80 (sand)	0	20	0	100	0	0	100	0	35
	3	65 (sand)	15	20	10	80	10	0	100	0	40
	4	80 (sand)	0	20	75	5	20	5	75	20	90
	5	85 (sand)	5	10	25	70	5	0	90	10	60
25-08	1	100 (sand/silt)	0	0	0	50	50	0	100	0	-
	2	100 (sand/silt)	0	0	38	10	50	83	7	10	-
	3	100 (sand/silt)	0	0	20	50	30	60	30	10	-
	4	100 (cobble/gravel)	0	5	15	10	75	0	100	0	-
	5	100 (cobble/gravel)	0	0	30	35	35	0	100	0	-

		% Cover									
		Aquatic			Bank			Top of Bank			
Site	Transect	Soil (Bed Substrate)	Vegetation	Non-Vegetative Cover	Soil	Vegetation	Non-Vegetative Cover	Soil	Vegetation	Non-Vegetative Cover	Canopy
25-09	1	100 (sand/silt)	0	0	55	20	25	20	80	0	70
	2	100 (sand/silt)	0	0	20	60	20	20	80	0	70
	3	100 (sand/silt)	0	0	20	50	30	20	80	0	75
	4	100 (sand/silt)	0	0	20	60	20	30	70	0	75
	5	90 (sand/silt)	0	10	30	30	40	50	50	0	60
25-10	1	90 (sand/silt)	0	10	70	0	30	0	40	60	70
	2	90 (sand/silt)	0	10	70	10	30	0	50	50	60
	3	85 (sand/silt)	0	15	50	0	80	0	50	50	20
	4	10 (silt)	0	90	70	0	60	30	50	20	40
	5	60 (silt)	0	40	60	0	80	0	90	10	20
25-11	1	100 (silt)	0	0	30	40	30	0	100	0	-
	2	100 (silt)	0	0	50	30	20	0	100	0	-
	3	100 (silt)	0	0	25	65	20	0	100	0	-
	4	100 (silt)	0	0	60	40	0	50	50	0	-
	5	100 (silt)	0	0	20	80	0	0	100	0	-