

Reed Canarygrass Monitoring Program 2020 Findings and Results: Irely Creek

Overview

The goals of the Reed Canarygrass Monitoring Program (RCMP) are to collect physiochemical and biological measurements indicative of water quality, substrate composition, and vegetative plant community in response to the invasion and subsequent removal of *Phalaris arundinacea* (PHARU). All measurements are conducted *in situ*.

Data collected in the field consists of stream and air temperature, dissolved oxygen (DO), photosynthetic active radiation (PAR), vegetative character, streamflow velocity, and substrate composition. Since this program is conducting a long-term BACI (before-after, control-impact) study, the data from the 2020 sampling season will function as baseline or control data. No physical specimens are removed from the field for this study.

The data summarized in this report were collected between June 25 and November 11, 2020. Site visits to collect DO, PAR, and flow velocity were conducted on July 2-3, July 15, July 29-30, August 10-11, August 25-26, September 8-9, September 21, October 6-7, October 21-22, and November 6-7.¹ A Wolman pebble count was conducted on July 30 and August 10, 2020. A vegetation survey was conducted on July 8-9 and July 14-15.

Stream and Air Temperatures

Stream and air temperature data were collected at each monitoring point by HOBO Pendant™ temperature loggers and summarized by a thermograph (Appendix A).

Differences in sample size for each logger have occurred due to:

- Timing - Deployment date, and time of day, vary slightly for each temperature logger
- Environmental conditions - Data was removed from the stream temperature samples if the streamflow dropped so that thermographs were exposed to the air, and were no longer collecting water temperature data
- Equipment error - There were a few instances when thermographic equipment stopped working or the data upload process malfunctioned

These differences are reflected by blank space in the thermographs in Appendix A.

Minimum, maximum, and average water and air temperature are summarized below for the time period between the first and last regularly scheduled site visits of the season, June 25 and November 7, 2020 respectively (Figure 1, Table 1).

¹ As stated in the 2020 Irely Creek RCMP Field Report, data from July 15, 2020 was only partially collected.

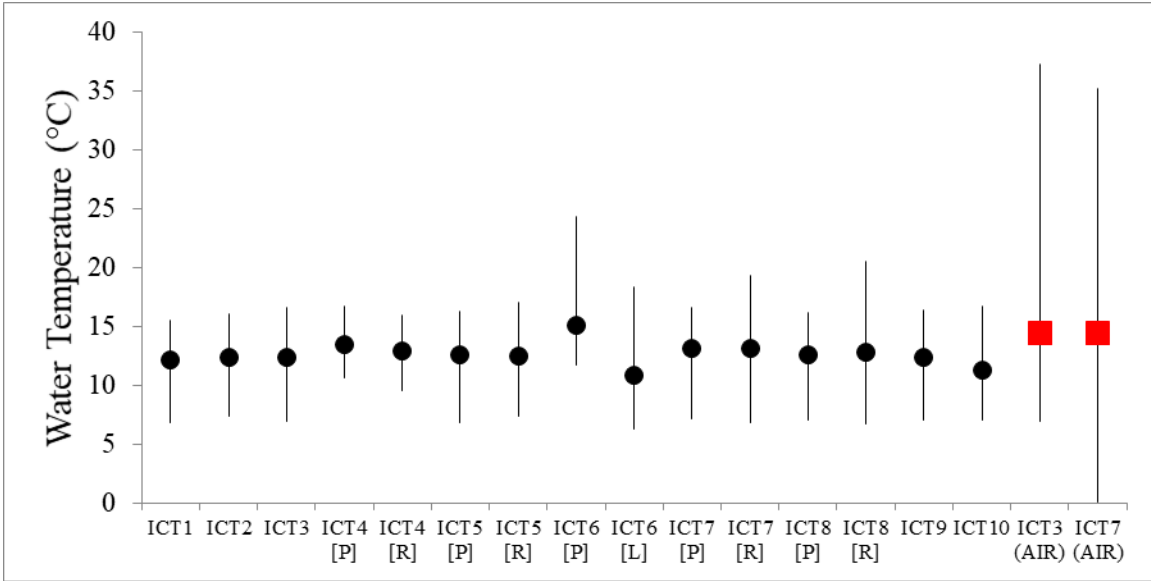


Figure 1. Minimum, maximum, and average stream temperature (°C) for each Irely Creek Transect (ICT) within the study reach. Points represent water temperature averages, while lines represent the range of minimum and maximum for each transect. The square points to the right represent air temperatures. For each transect, the location of the temperature logger within the primary [P], right bank [R] and left bank [L] channels are shown on the x-axis.

Temperature °C	Min	Max	Average	Std. Dev	Sample size (n)	Std. Error
Overall	6.26	24.32	12.63	2.16	115756	0.01
Upstream (ICT1-5)	6.78	17.03	12.60	1.83	59763	0.01
Downstream (ICT6-10)	6.26	24.32	12.66	2.45	55993	0.01
ICT1	6.86	15.48	12.19	1.83	9174	0.02
ICT2	7.33	16.04	12.38	1.74	9747	0.02
ICT3	6.90	16.60	12.34	1.96	9310	0.02
ICT4 [P]	10.59	16.73	13.41	1.19	7470	0.01
ICT4 [R]	9.56	15.96	12.92	1.39	9738	0.01
ICT5 [P]	6.78	16.30	12.60	2.24	8117	0.02
ICT5 [R]	7.33	17.03	12.46	2.07	6207	0.03
ICT6 [P]	11.67	24.32	15.09	1.72	4292	0.03
ICT6 [L]	6.26	18.36	10.85	3.56	2018	0.08
ICT7 [P]	7.12	16.64	13.12	2.39	8312	0.03
ICT7 [R]	6.86	19.30	13.17	2.62	8168	0.03
ICT8 [P]	7.08	16.13	12.57	2.02	8316	0.02
ICT8 [R]	6.73	20.55	12.83	2.70	6902	0.03
ICT9	6.99	16.43	12.37	1.92	8318	0.02
ICT10	7.03	16.73	11.32	1.65	9667	0.02
ICT3 (AIR)	6.90	37.19	14.46	4.75	8304	0.05
ICT7 (AIR)	0.13	35.18	14.41	5.42	9657	0.06

Table 1. Summarized stream and air temperature data (°C) for each Irely Creek Transect (ICT) and temperature logger location within the study reach. For each transect, the location of the data logger within the primary [P], right bank [R] and left bank [L] channels are indicated.

Dissolved Oxygen

Dissolved oxygen (mg/L) was measured and summarized for the seasonal minimum, maximum, and average at each location where data was collected (Figure 2, Table 2). During summer low flow periods when the creek was dry, dissolved oxygen was collected in isolated pools nearest the transect.

Each primary channel location was sampled eight times ($n=8$) between July 29 and November 7.² Side channels were not measured during periods in which there was no or extremely low water levels. A right bank channel [R] study location at Irely Creek Transect 6 (ICT6) was intended to receive a water temperature logger, but the site remained at either low flow levels or dry for much of the sampling period. Dissolved oxygen measurements were collected at that ICT6[R] location when possible, despite the absence of temperature logger.

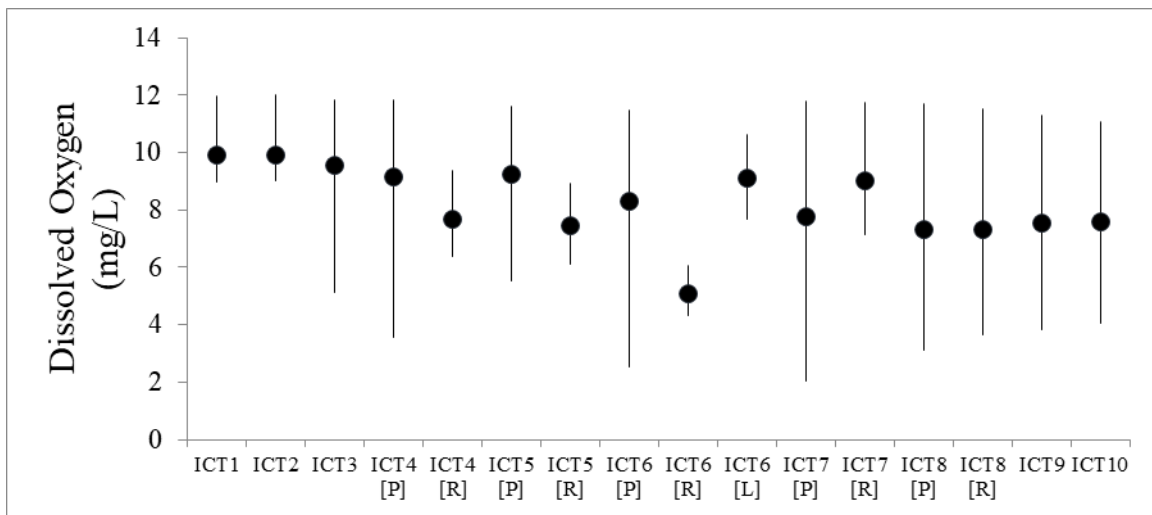


Figure 2. Minimum, maximum, and average dissolved oxygen measurements for each Irely Creek Transect (ICT) within the study reach. Points on the chart represent averages, while lines represent the range of minimum and maximum for each transect. For each transect, the location of the temperature logger within the primary [P], right bank [R] and left bank [L] channels are shown on the x-axis.

² Dissolved oxygen meter was not available during the first two site visits.

Dissolved oxygen (mg/L)	Min	Max	Average	Std. Dev	Sample size (n)	Std. Error
Overall	2.02	12.00	8.36	2.35	114	0.22
Upstream (ICT1-5)	3.57	12.00	9.02	1.79	55	0.24
Downstream (ICT6-10)	2.02	11.77	7.75	2.64	59	0.34
ICT1	8.98	11.98	9.93	1.09	8	0.39
ICT2	9.00	12.00	9.93	1.16	8	0.41
ICT3	5.12	11.83	9.56	2.04	8	0.72
ICT4 [P]	3.57	11.83	9.15	2.54	8	0.90
ICT4 [R]	6.38	9.36	7.68	0.82	8	0.29
ICT5 [P]	5.55	11.63	9.26	1.85	8	0.66
ICT5 [R]	6.10	8.92	7.43	0.90	7	0.34
ICT6 [P]	2.54	11.48	8.30	2.83	8	1.00
ICT6 [R]	4.34	6.05	5.07	0.88	3	0.51
ICT6 [L]	7.69	10.62	9.09	1.47	3	0.85
ICT7 [P]	2.02	11.77	7.76	3.23	8	1.14
ICT7 [R]	7.15	11.75	9.03	1.75	7	0.66
ICT8 [P]	3.10	11.71	7.31	2.88	8	1.02
ICT8 [R]	3.65	11.53	7.31	3.48	6	1.42
ICT9	3.82	11.28	7.54	2.57	8	0.91
ICT10	4.05	11.08	7.60	2.44	8	0.86

Table 2. Summarized dissolved oxygen data (in mg/L) for each Irely Creek Transect (ICT) within the study reach. For each transect, the location of the temperature logger within the primary [P], right bank [R] and left bank [L] are indicated.

Photosynthetic Active Radiation (PAR)

PAR was measured ($\mu\text{mol m}^{-2} \text{s}^{-1}$) at ten equidistant intervals along each cross-stream transect to quantify riparian solar radiation. PAR measurements were averaged at each transect for each site visit, creating a daily average ($n=10$). These daily averages were then transformed into a representation of seasonal average (consisting of the five daily measurement averages) for each transect (Figure 3, $n=10$, $n=5$). PAR data was collected for each transect during five site visits; August 10-11, August 25-26, September 8-9, October 21-22, and November 6-7.

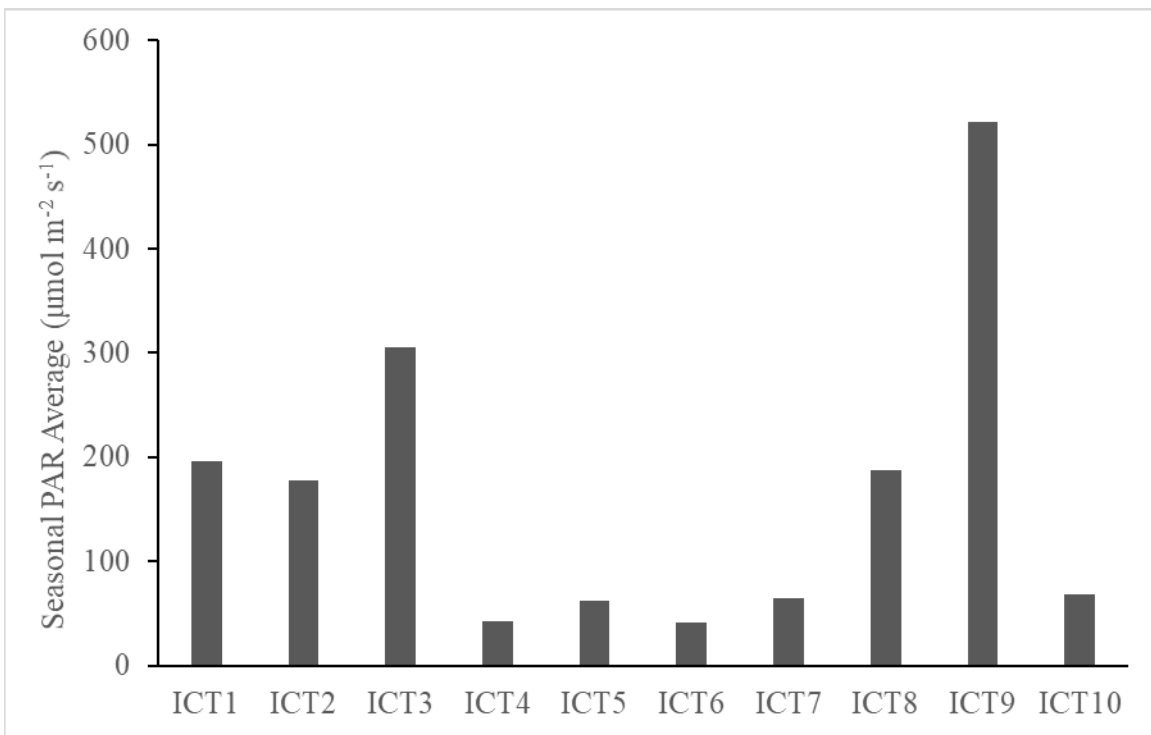


Figure 3. Photosynthetic active radiation (PAR) seasonal average indicating solar radiation along each riparian transect at Irely Creek ($n=10,5$).

Vegetation Surveys and Photosynthetic Active Radiation (PAR)

Vegetative cover surveys were collected at ten equidistant locations along each transect, from right to left bank. PAR measurements were collected in the same manner, at locations near each vegetation survey station. Therefore, *PHARU* percent cover in each quadrat of the vegetation survey was compared to the calculated PAR average ($n=5$) at each measurement station. A significant correlation occurred between the two paired datasets, so that we can reject the null hypothesis that there is no relationship between light availability and *PHARU* colonization in Irely Creek ($r(100)=0.45$, $p= 2.53E-06$) (Figure 4).

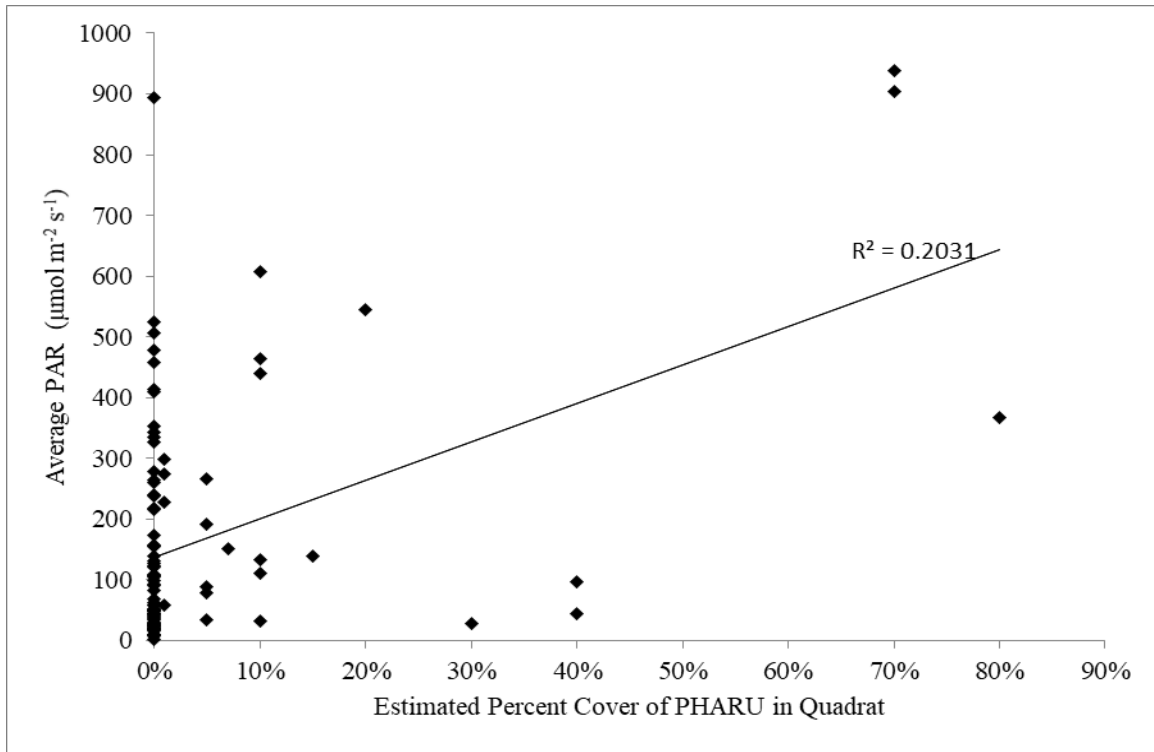


Figure 4. Average solar radiation ($\mu\text{mol m}^{-2} \text{s}^{-1}$) compared to estimated percent cover of *Phalaris arundinacea* at each quadrat of the vegetation survey at Irely Creek ($n=100$).

Vegetation Survey

The vegetation survey revealed a total species richness of 69 species within the entire Irely Creek study reach (Appendix B). Percent cover of *PHARU* was estimated for each of the ten quadrats along each transect of the vegetation survey (100 quadrats). There appeared to be no significant correlation between *PHARU* percent cover and species richness within each quadrat ($r(100)=0.18, p=0.069$, Figure 5).

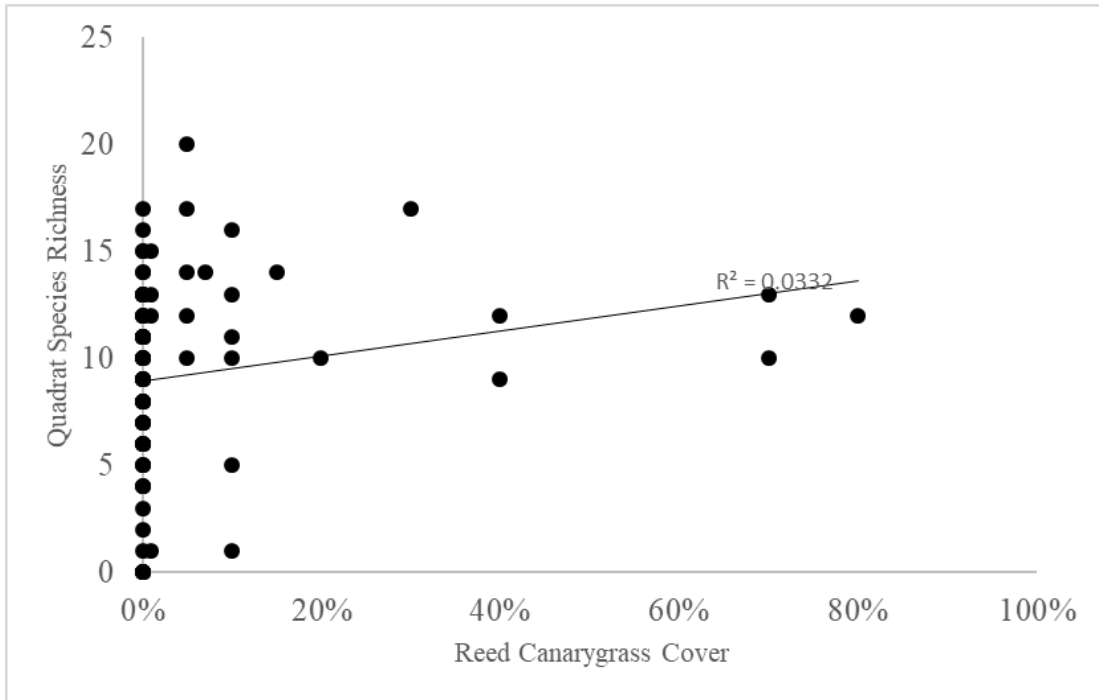


Figure 5. Estimated percent cover of *Phalaris arundinacea* compared to species richness of each quadrat measured during the Irely Creek Vegetation survey ($r(100)=0.18, p=0.069$).

Flow Velocity

Flow velocity (ft/s) was measured during each site visit, at 13 to 20 intervals across the stream at each transect. Measurements were collected and averaged whenever possible to obtain an accurate and representative measurement (deep enough to submerge sampling equipment, and wide enough to get a full sample set of 13-20 measurements) (Figure 6, Appendix C). Each transect location was able to be sampled between four and eight times throughout the 2020 season, with the exception of ICT6, which never had measurable flow due to ponding effects of a beaver dam. The noticeable gap in collected data (Figure 6) is due to the low flow condition of late-summer drought.

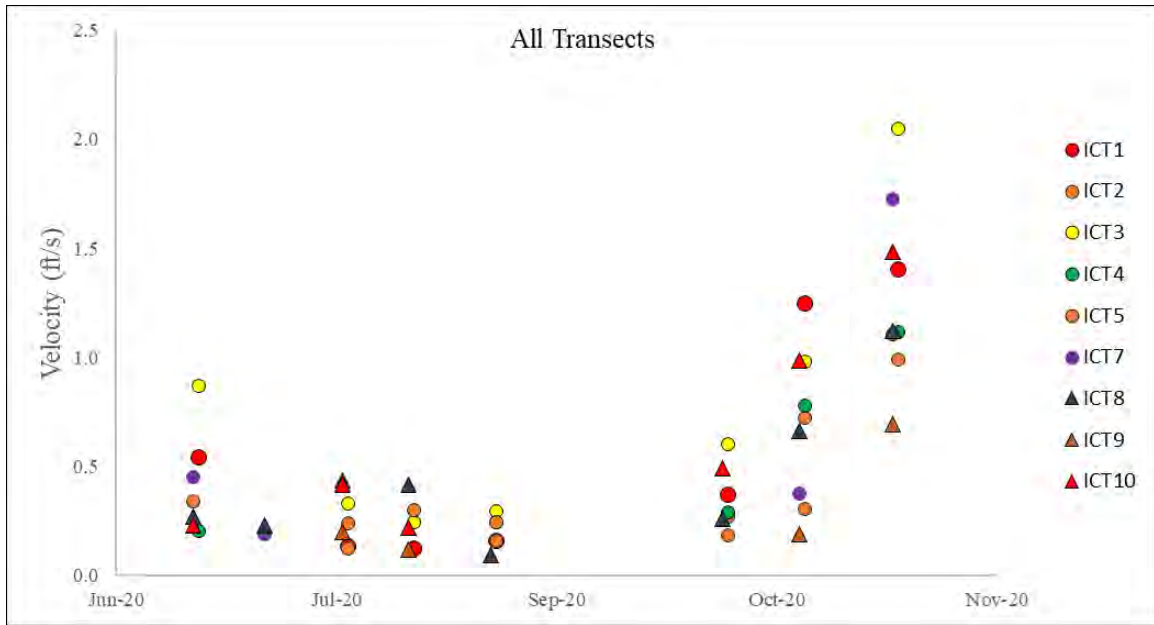


Figure 6. Average flow velocity (ft/s) throughout the 2020 season at each Irely Creek Transect (ICT). Appendix C depicts each transect separately.

Wolman Pebble Count

Pebble counts were conducted at each transect, near a ‘riffle’ or ‘run’ geomorphic habitat unit. The D₅₀ (50th percentile measurement) of each sample was determined to represent general substrate composition (Table 3).

Transect	D ₅₀ Size Range	Size Class
ICT1	17-32 mm	Coarse Gravel
ICT2	33-64mm	Very Coarse Gravel
ICT3	17-32mm	Coarse Gravel
ICT4	17-32mm	Coarse Gravel
ICT5	33-64mm	Very Coarse Gravel
ICT6	Fines (<2mm)	Sand
ICT7	5-8mm	Fine Gravel
ICT8	17-32mm	Coarse Gravel
ICT9	17-32mm	Coarse Gravel
ICT10	17-32mm	Coarse Gravel

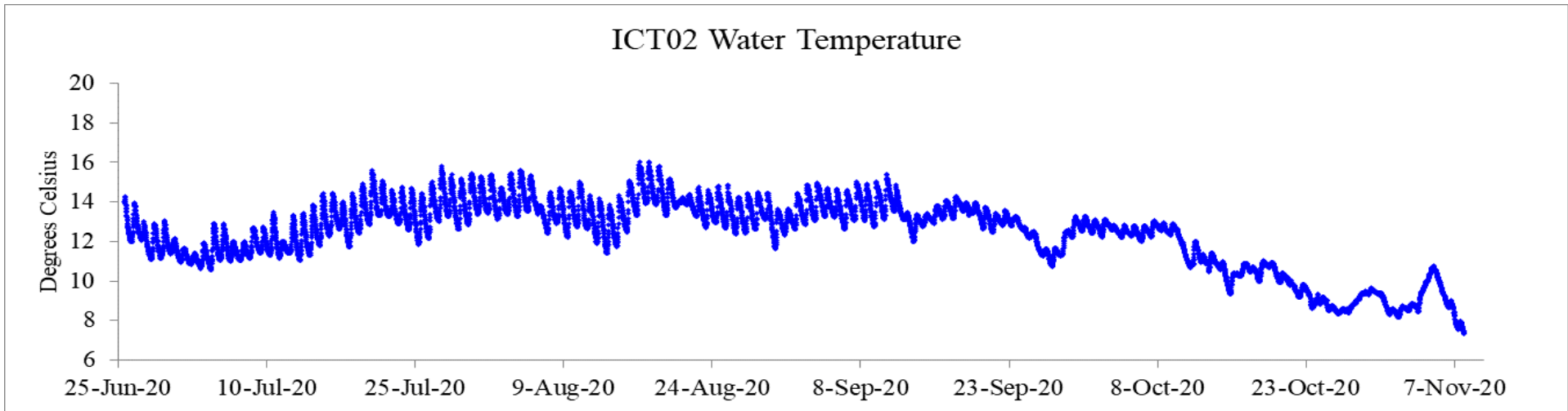
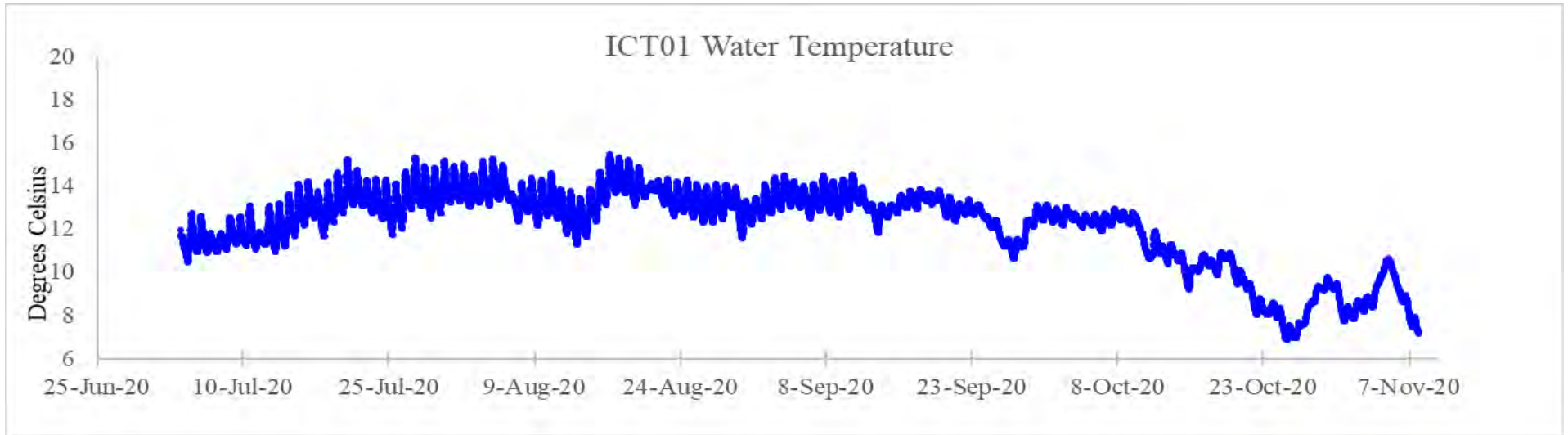
Table 3. D₅₀ size range and general size class for each Irely Creek Transect (ICT) pebble count conducted within the study reach.

Data analysis and interpretation are in process, and will be shared as available for review and discussion.

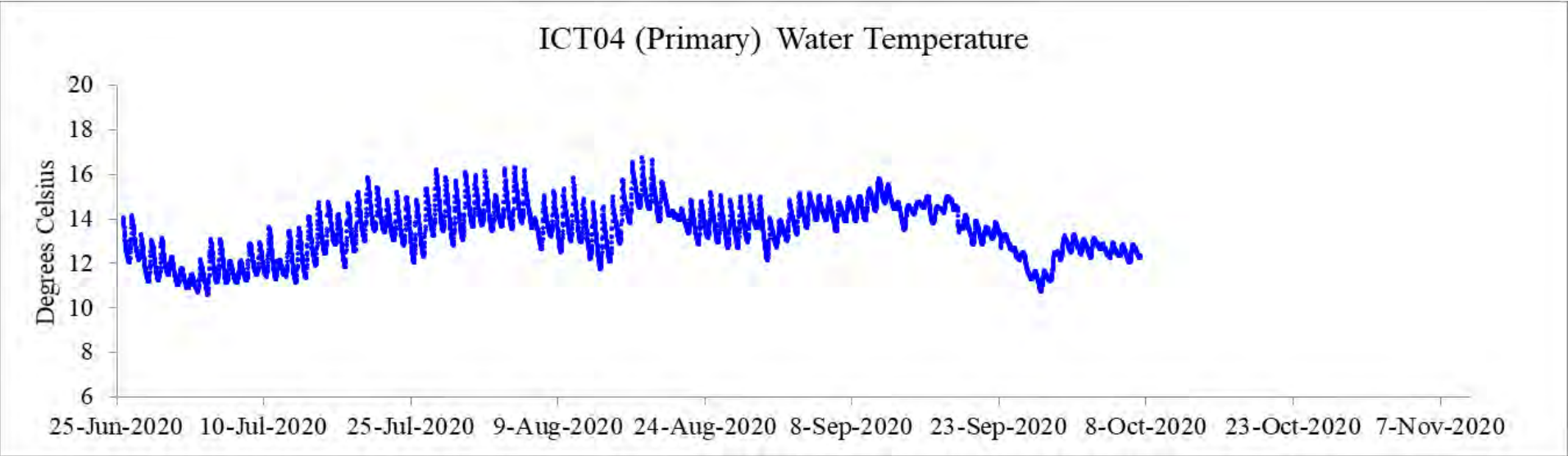
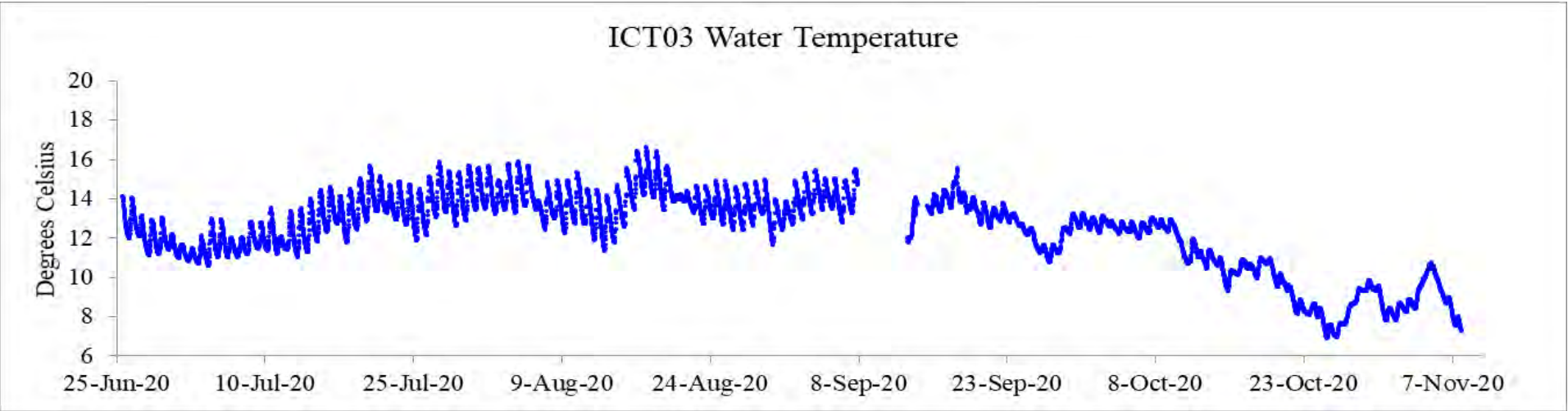
Thank you for your support.

Appendix A

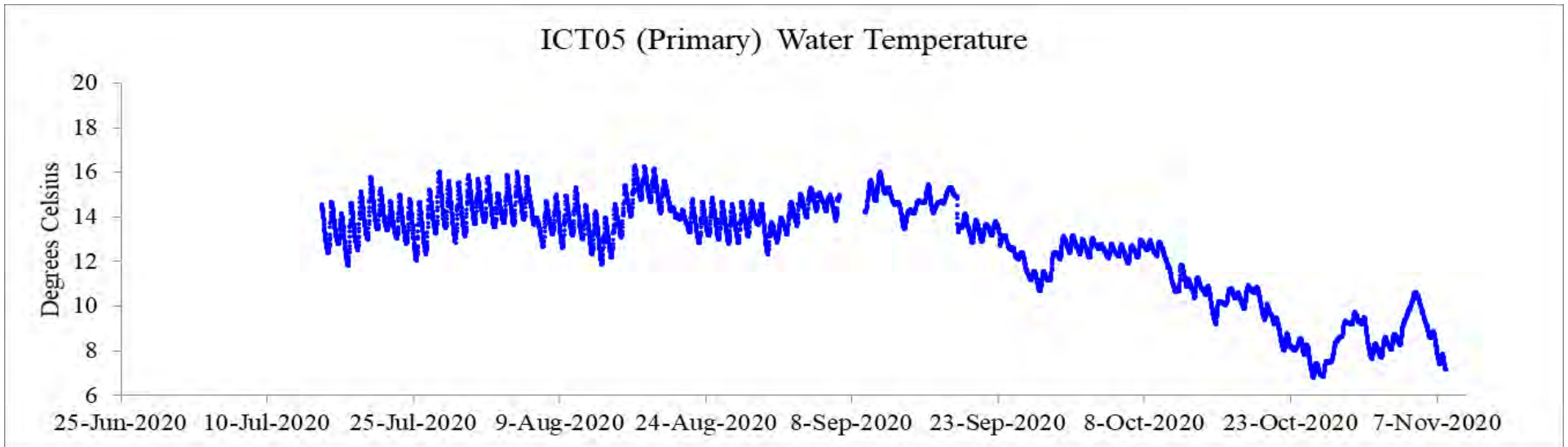
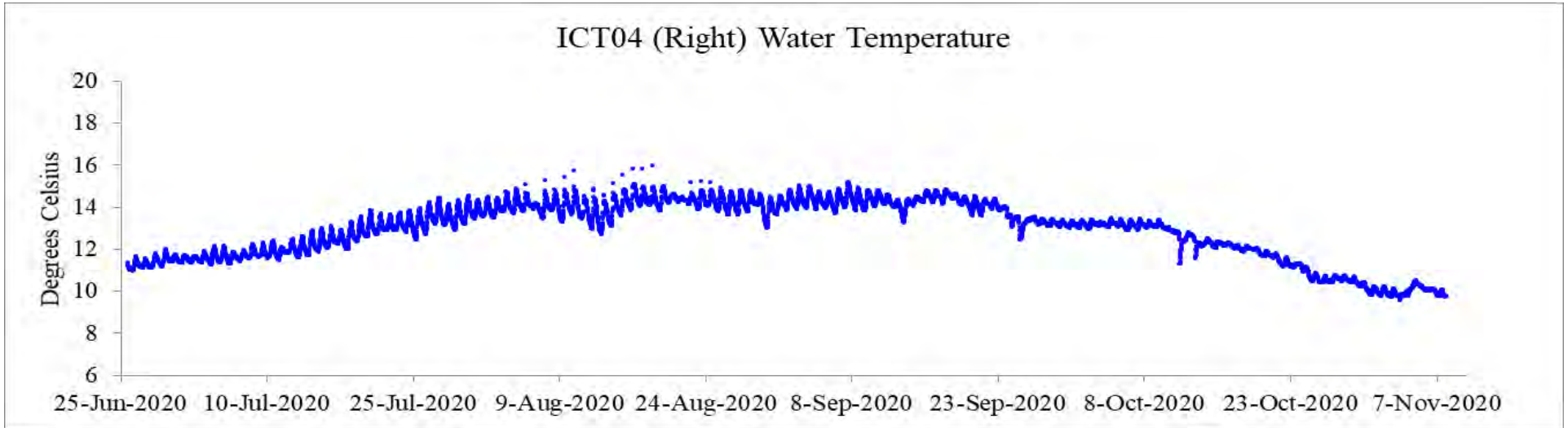
Stream temperatures at each Irely Creek Transect (ICT) thermograph location, followed by upstream and downstream air temperatures, spanning from June 25, 2020 through November 11, 2020 For each transect, the location of the temperature logger within the primary [P], right bank [R] and left bank [L] are indicated.



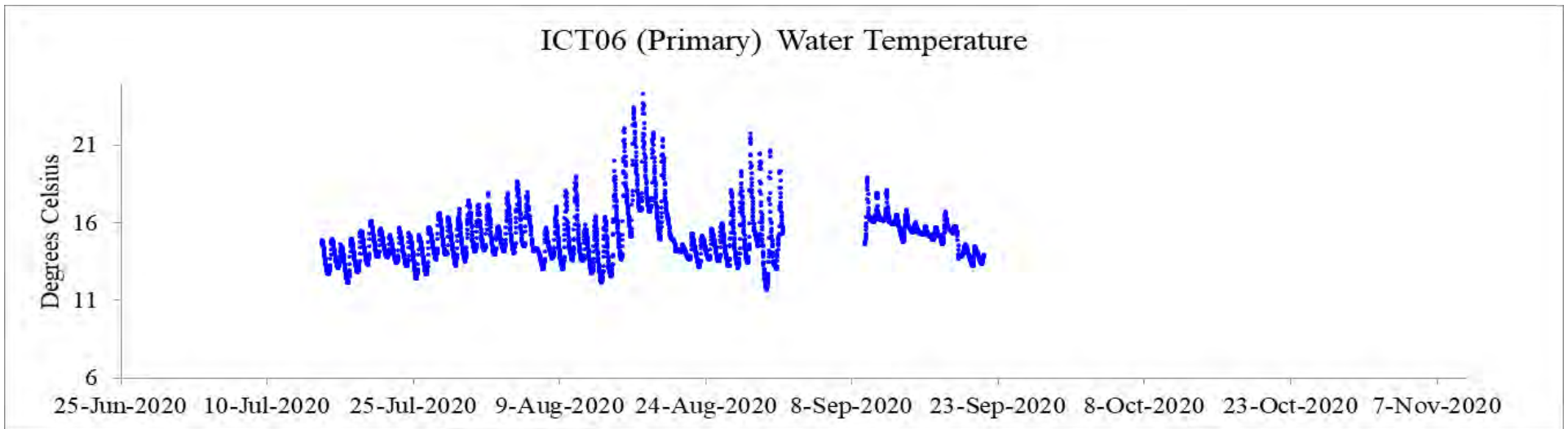
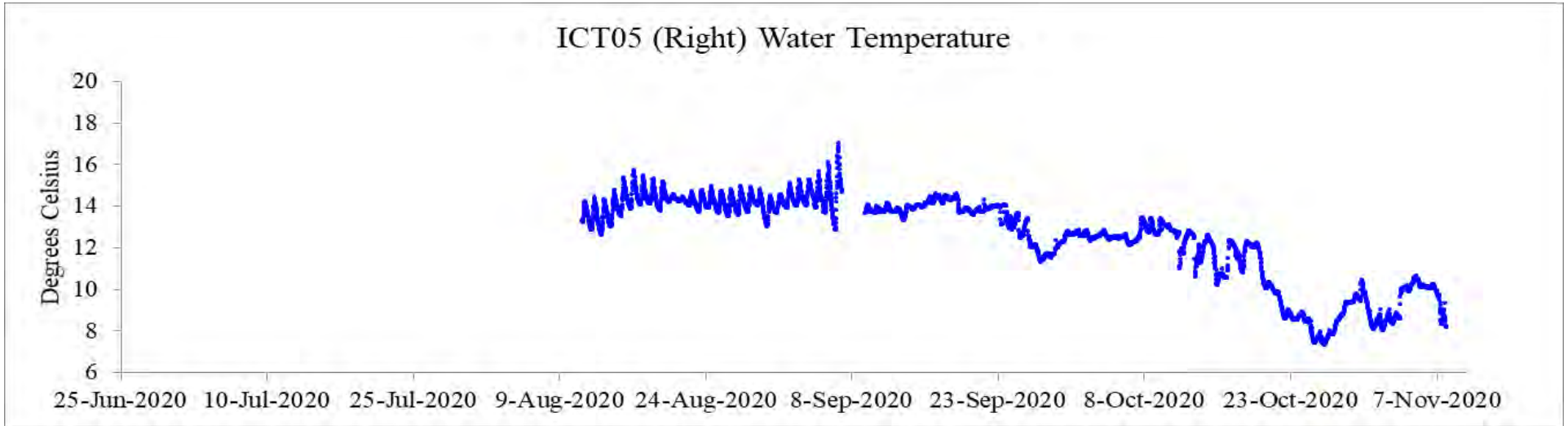
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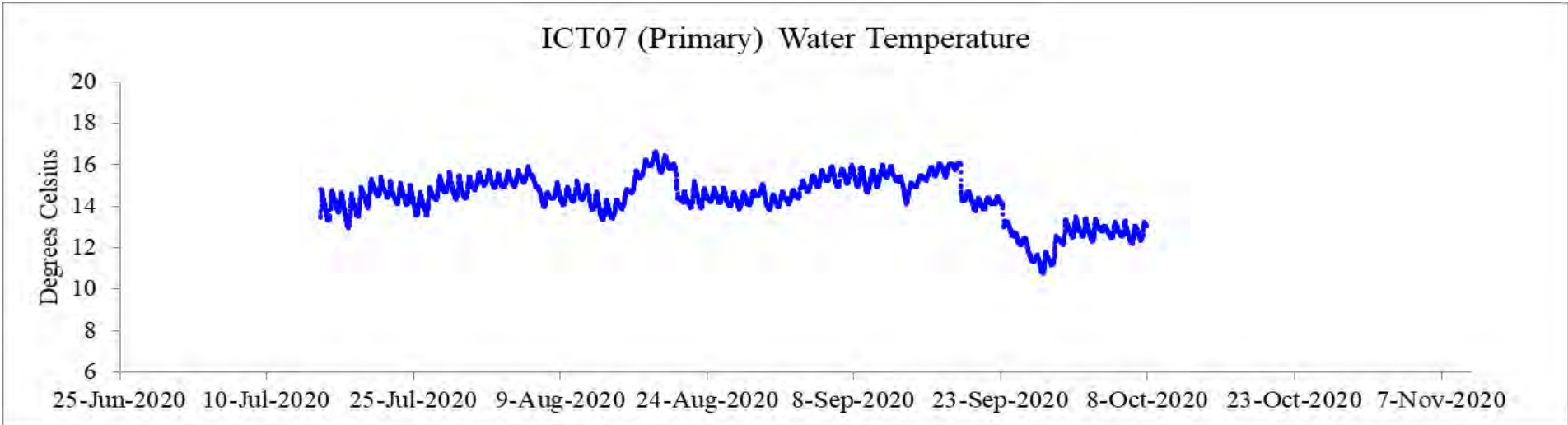
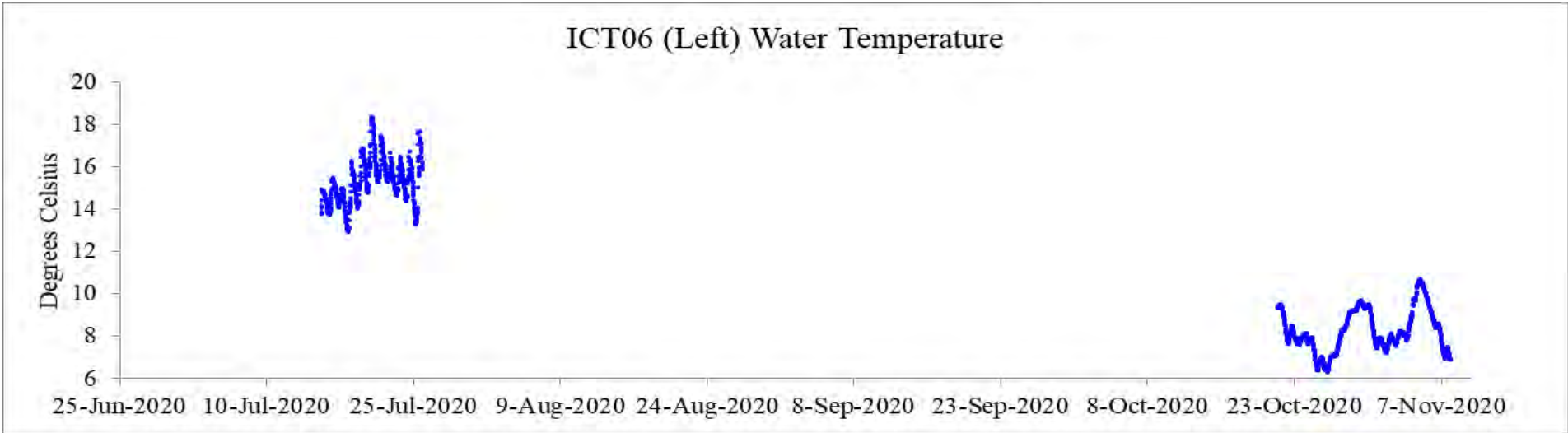
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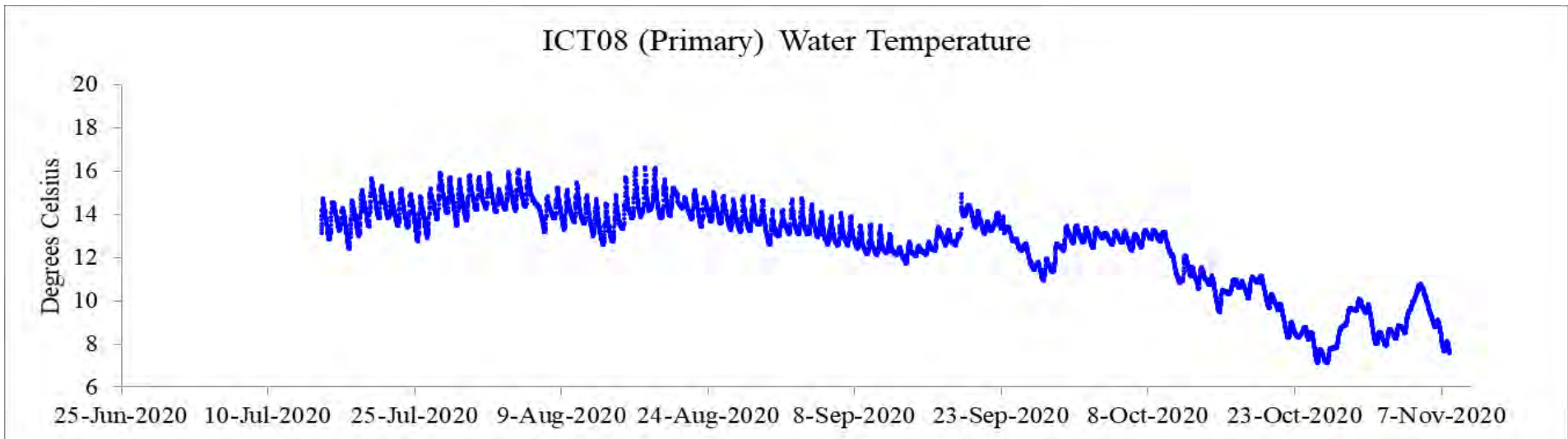
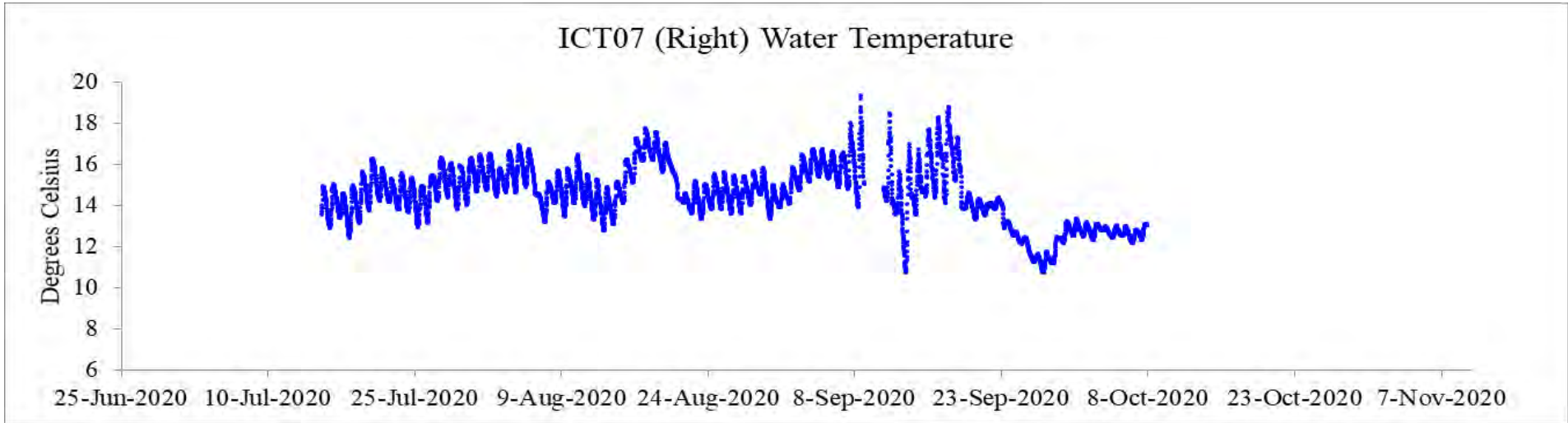
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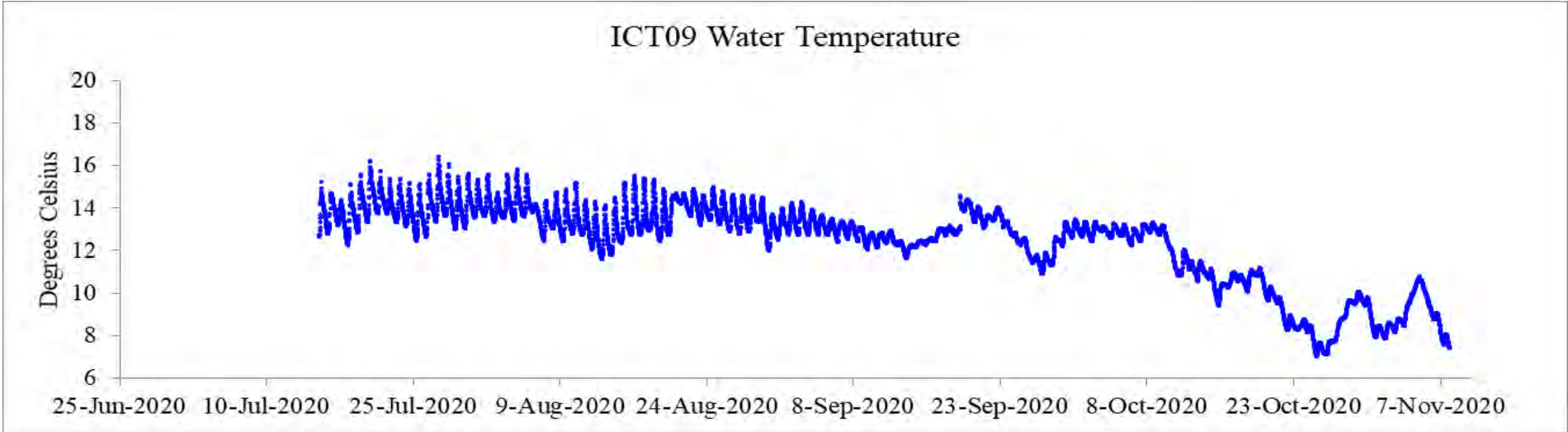
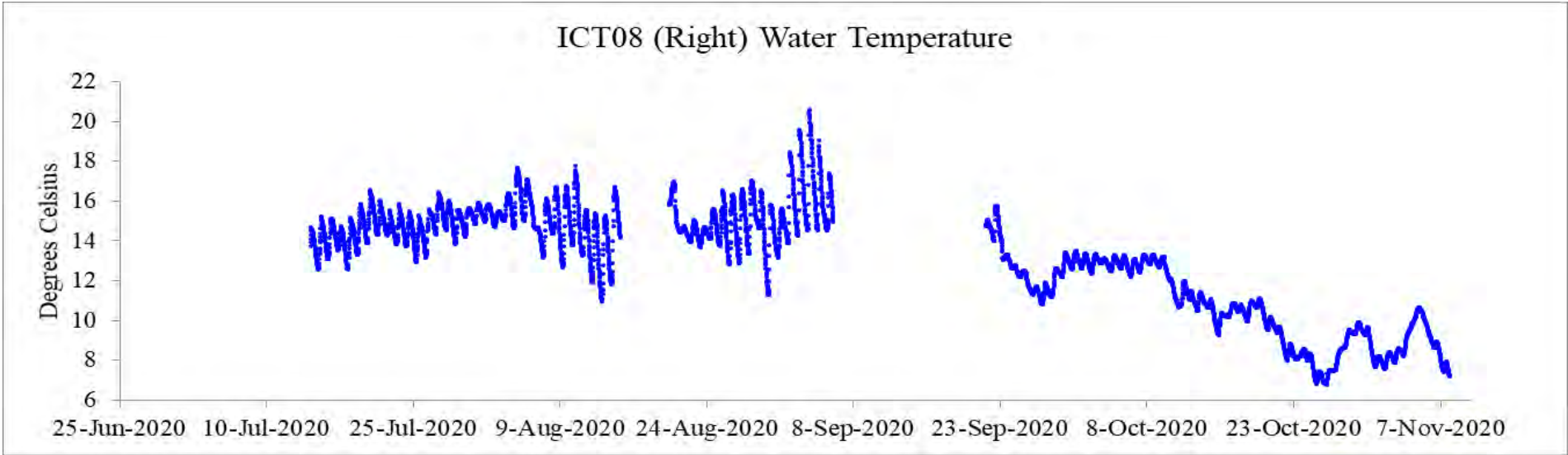
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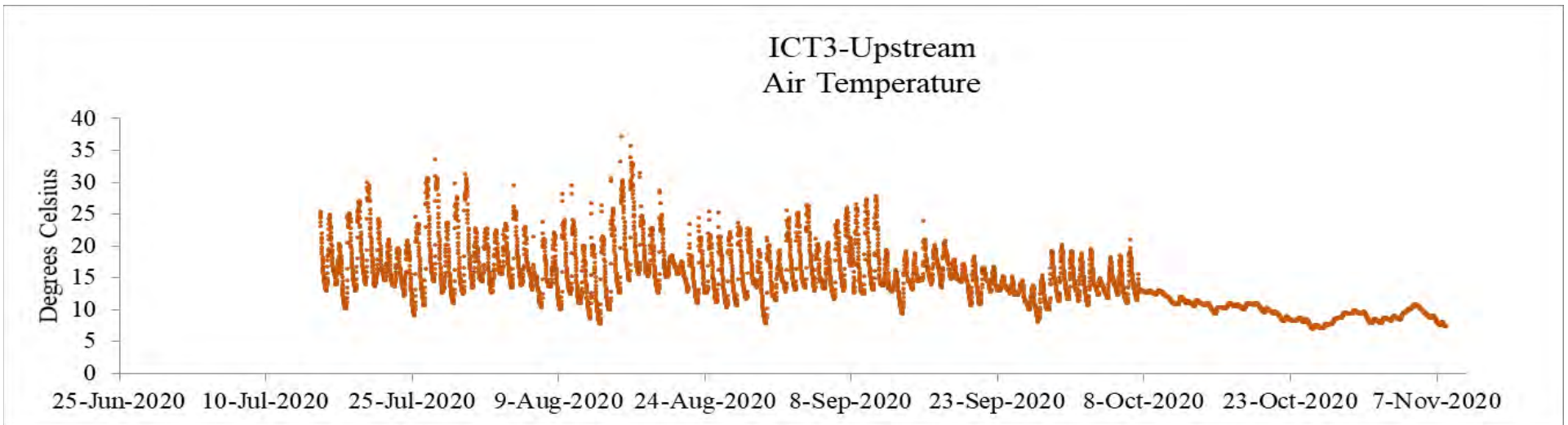
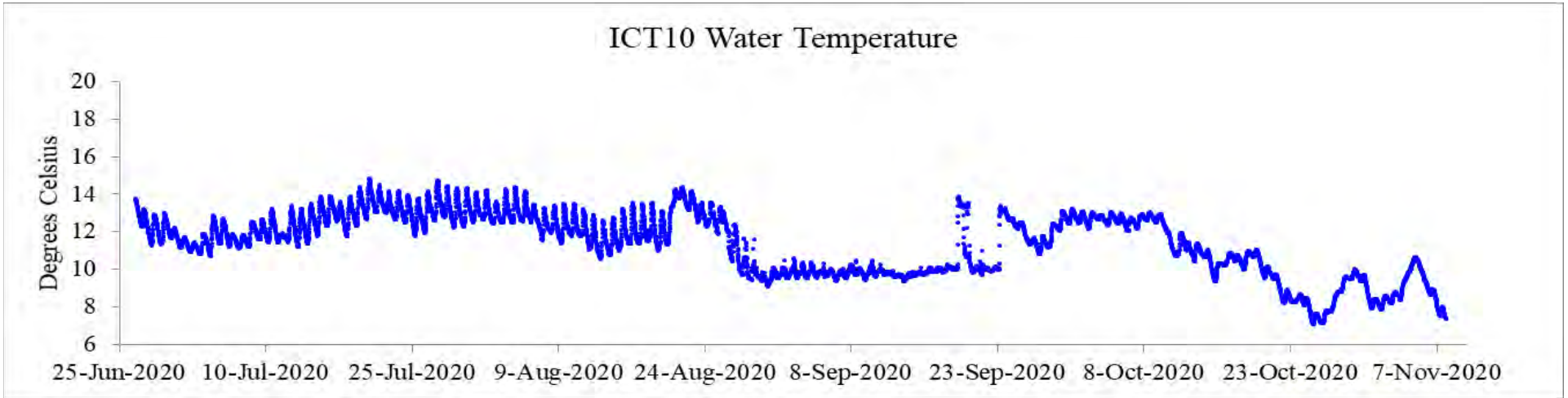
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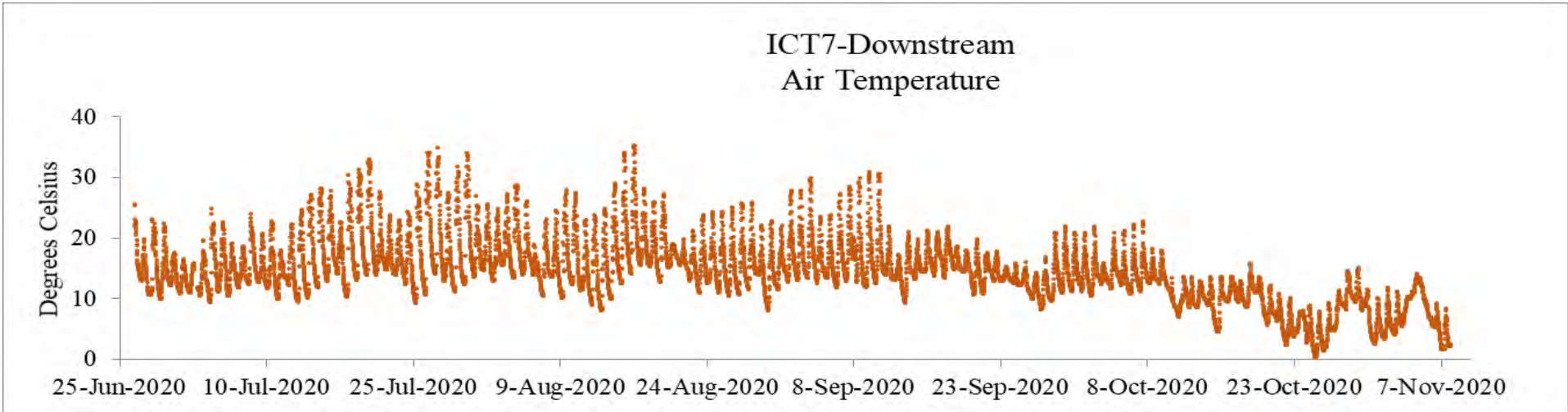
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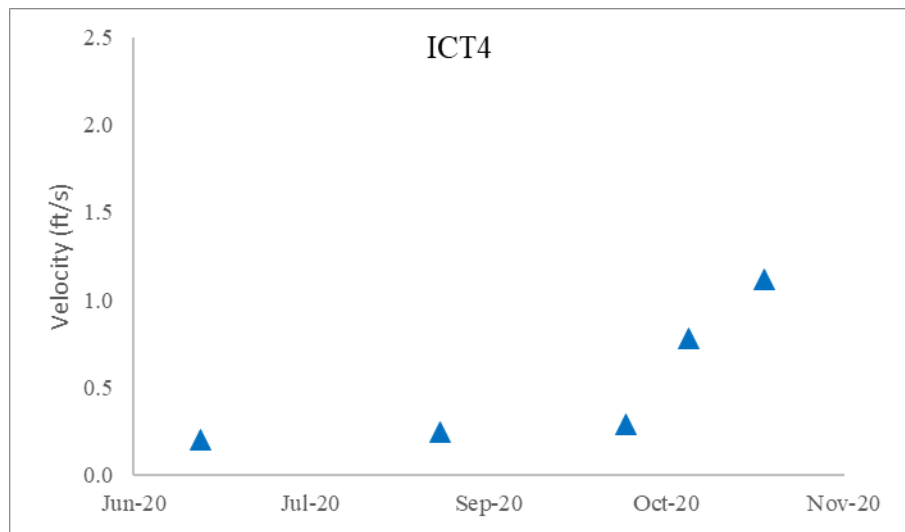
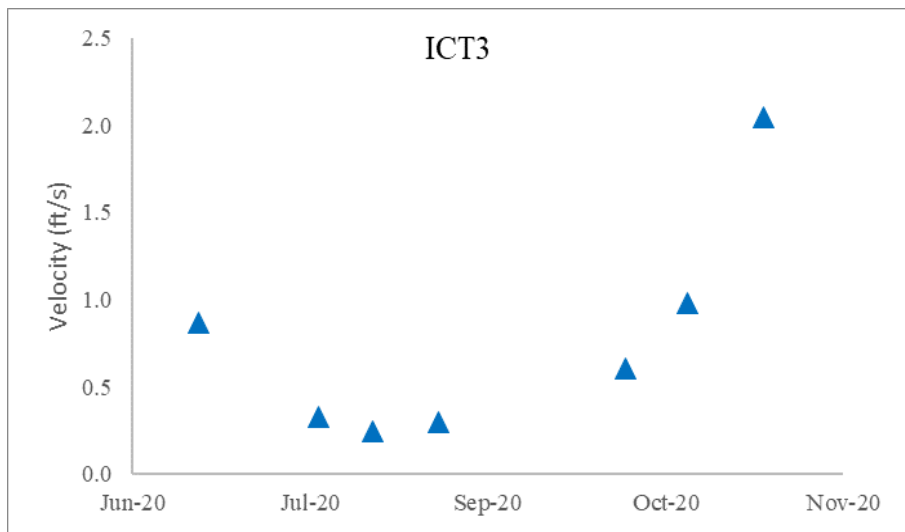
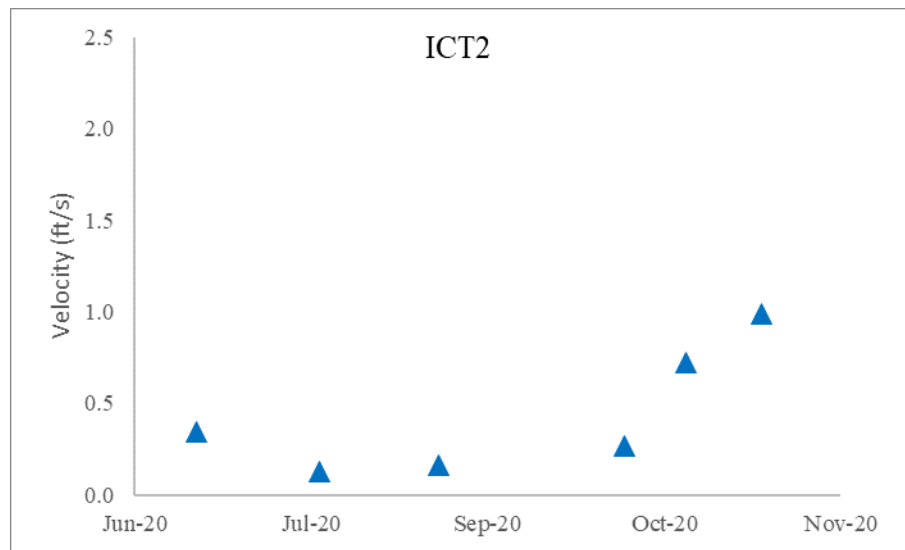
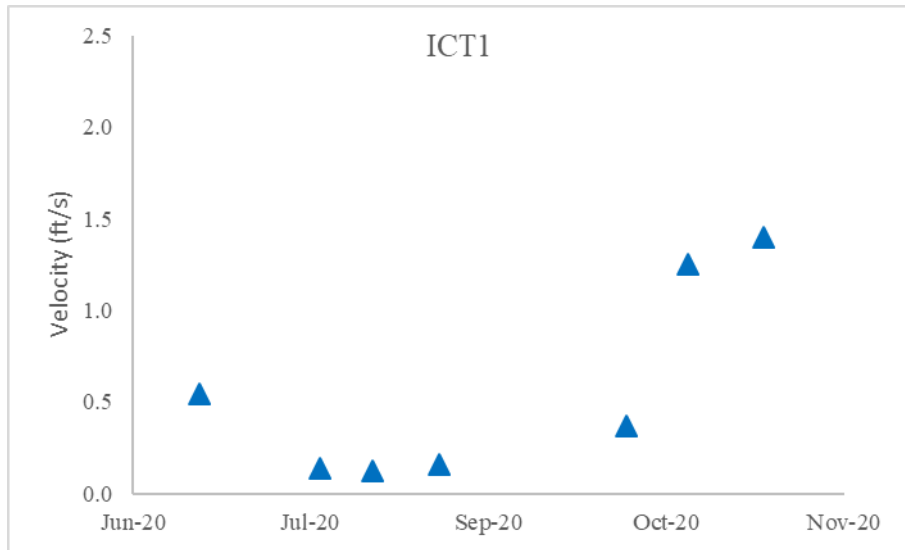
Appendix B

Plant species list for the 2020 Irely Creek vegetation survey. (Updated 11/30/2020)

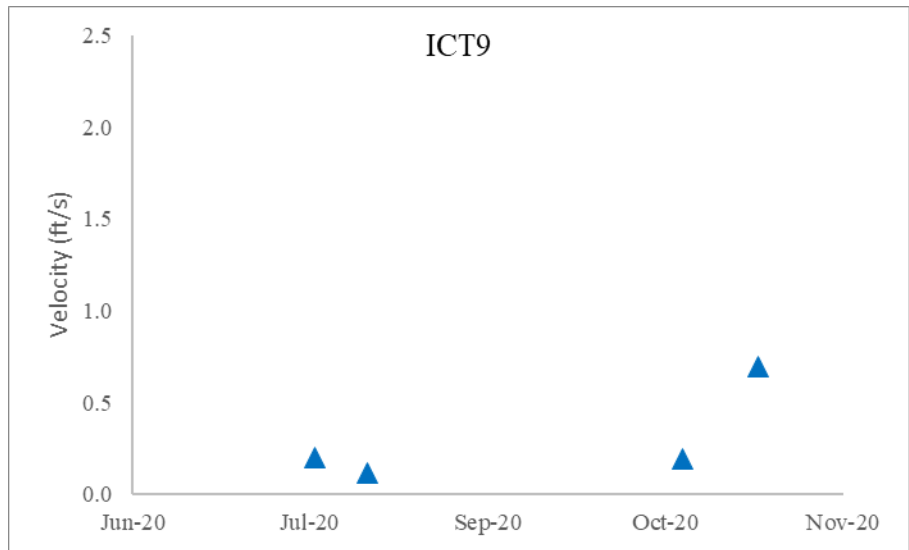
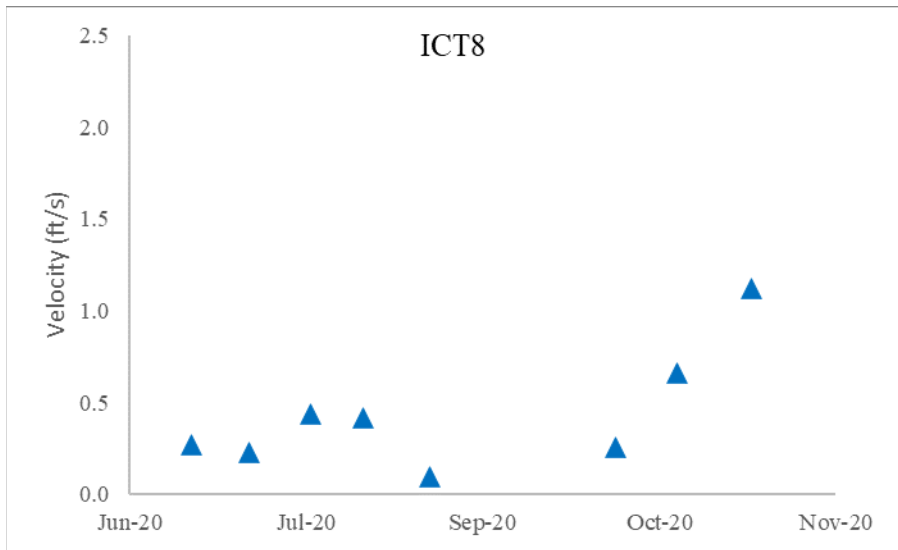
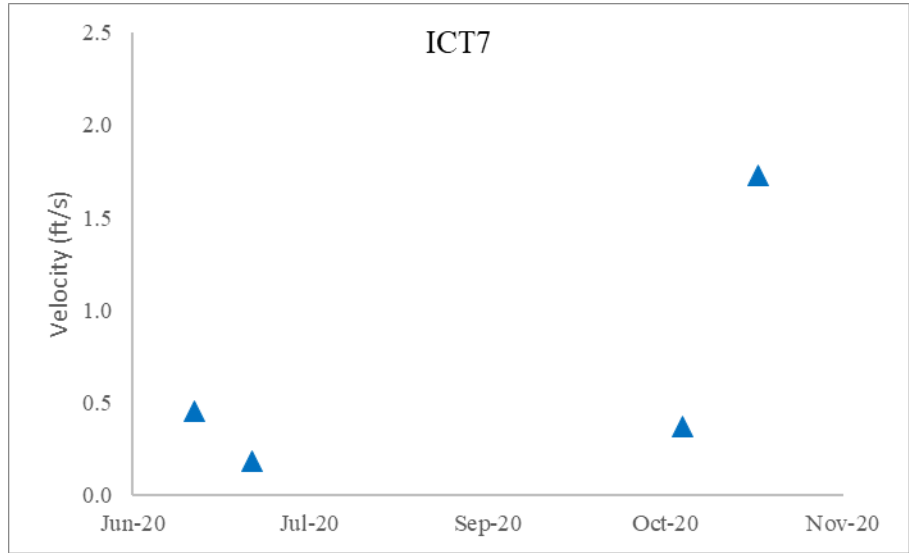
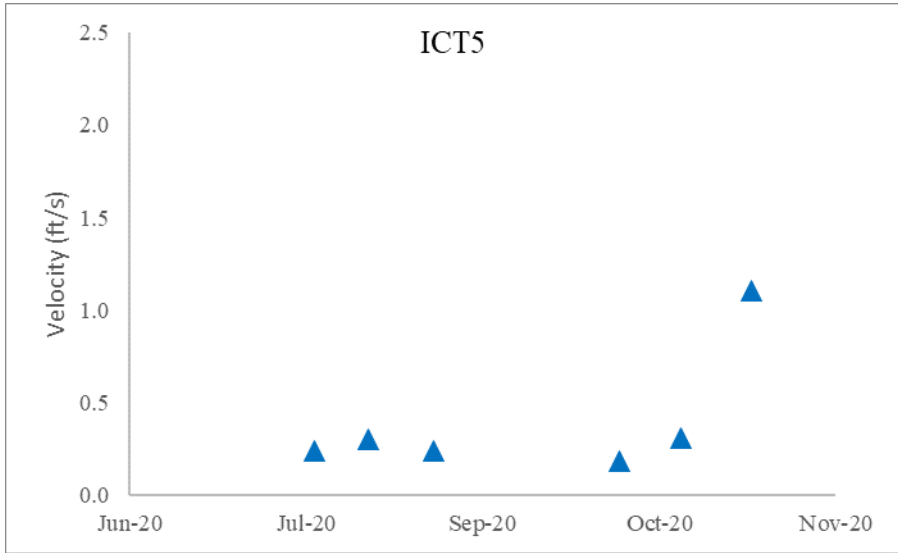
<i>Acer circinatum</i> (vine maple)	<i>Ranunculus repens</i> (creeping buttercup)
<i>Acer macrophyllum</i> (bigleaf maple)	<i>Rhamnus purshiana</i> (cascara)
<i>Achlys triphylla</i> (vanilla leaf)	<i>Ribes bracteosum</i> (stink currant)
<i>Adiantum pedatum</i> (maidenhair fern)	<i>Rubus laciniatus</i> (cutleaf blackberry)
<i>Agrostis capillaris</i> (colonial bentgrass)	<i>Rubus spectabilis</i> (salmonberry)
<i>Angelica genuflexa</i> (kneeling angelica)	<i>Rubus ursinus</i> (trailing blackberry)
<i>Athyrium filix-femina</i> (lady fern)	<i>Rumex occidentalis</i> (Western dock)
<i>Blechnum spicant</i> (deer fern)	<i>Sambucus racemosa</i> (red elderberry)
<i>Boykinia occidentalis</i> (coast boykinia)	<i>Scirpus microcarpus</i> (small-flowered bulrush)
<i>Bromus sitchensis</i> (Alaska brome)	<i>Sisyrinchium angustifolium</i> (blue-eyed grass)
<i>Bromus vulgaris</i> (Columbia brome)	<i>Stachys mexicana</i> (Mexican hedge-nettle)
<i>Carex rossii</i> (Ross' sedge)	<i>Stellaria crispa</i> (crisp starwort)
<i>Cardamine angulata</i> (angled bittercress)	<i>Stellaria calycantha</i> (northern starwort)
<i>Circae alpina</i> (enchanter's nightshade)	<i>Tellima grandiflora</i> (fringecup)
<i>Claytonia sibirica</i> (Siberian miner's lettuce)	<i>Tiarella trifoliata</i> (three-leaf foamflower)
<i>Elymus hirsutus</i> (hairy wildrye)	<i>Thuja plicata</i> (Western red cedar)
<i>Epilobium ciliatum</i> (Watson willowherb)	<i>Tolmiea menziesii</i> (piggyback plant)
<i>Equisetum arvense</i> (common horsetail)	<i>Tsuga heterophylla</i> (Western hemlock)
<i>Equisetum telmateia</i> (giant horsetail)	Unidentified grass spp. (4)
<i>Erythranthe moschatus</i> (musk monkeyflower)	<i>Vaccinium ovalifolium</i> (oval-leaved huckleberry)
<i>Galium aparine</i> (cleavers)	<i>Vaccinium parviflorum</i> (red huckleberry)
<i>Galium triflorum</i> (sweet-smelling bedstraw)	<i>Viburnum edule</i> (highbush cranberry)
<i>Galium trifidum</i> (small bedstraw)	<i>Viola palustris</i> (marsh violet)
<i>Gaultheria shallon</i> (salal)	
<i>Glyceria elata</i> (tall mannagrass)	
<i>Holcus lanatus</i> (velvet grass)	
<i>Lactuca muralis</i> (wall lettuce)	
<i>Luzula parviflora</i> (small-flowered woodrush)	
<i>Lysochiton americanus</i> (western skunk cabbage)	
<i>Maianthemum dilatatum</i> (false lily-of-the-valley)	
<i>Melica harfordii</i> (Harford's melic)	
<i>Mitella pentandra</i> (five-stamen miterwort)	
<i>Moehringia macrophylla</i> (bigleaf sandwort)	
Mosses, lichens, and other bryophytes	
<i>Nepeta glechoma</i> (creeping charlie)	
<i>Oenanthe sarmentosa</i> (water parsley)	
<i>Oxalis oregana</i> (wood sorrel)	
<i>Petasites palmatus</i> (Arctic sweet coltsfoot)	
<i>Phalaris arundinacea</i> (reed canarygrass; PHARU)	
<i>Picea sitchensis</i> (sitka spruce)	
<i>Polystichum munitum</i> (sword fern)	
<i>Prunella vulgaris</i> (self-heal)	
<i>Pteridium aquilinum</i> (bracken fern)	

Appendix C

Stream flow velocity averages collected at each site visit in 2020. There is one figure for each Irely Creek Transect (ICT).



Appendix C continued:



Appendix C continued:

