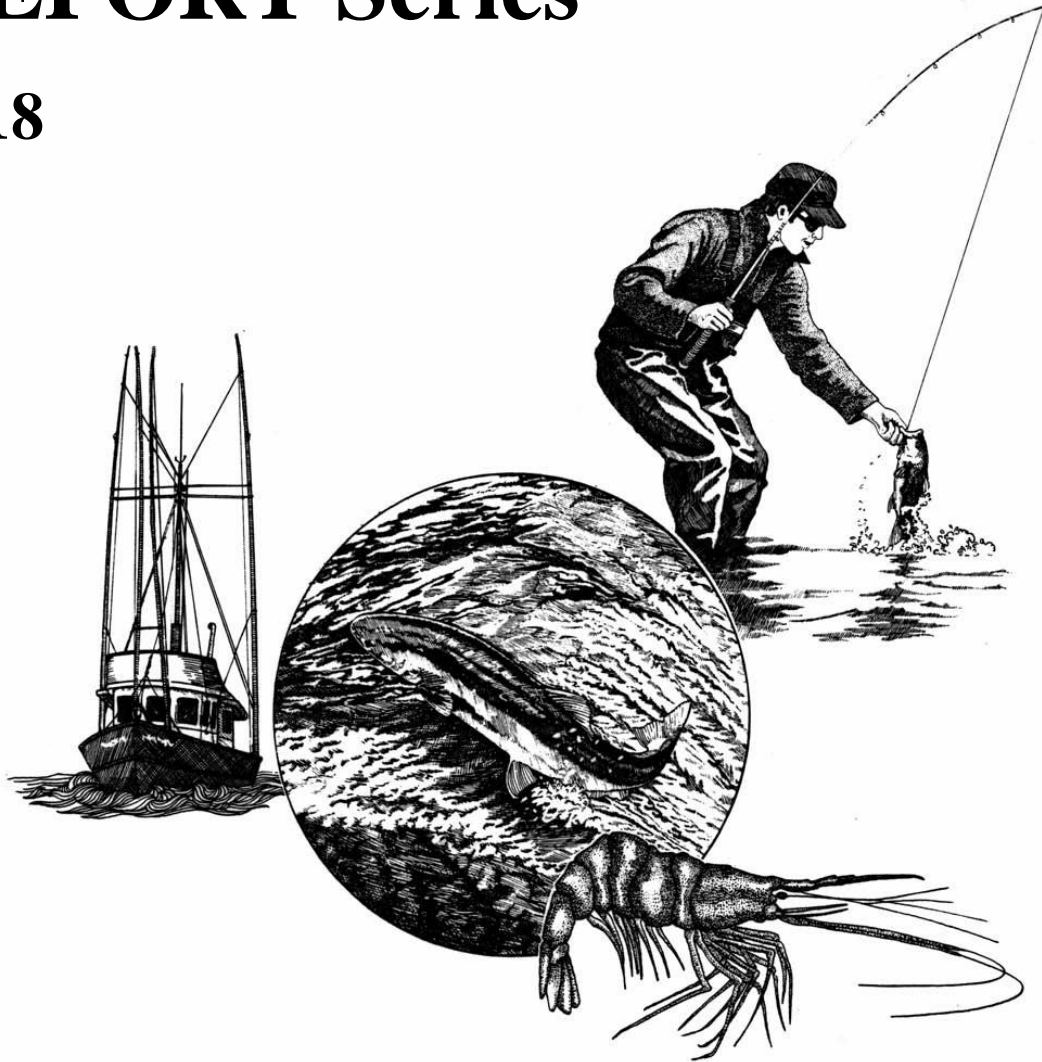


ODFW PROGRESS REPORT Series

2018



Oregon Department of Fish and Wildlife

*Passage Success of Warner Suckers at the MC Diversion on Twentymile
Creek*

Contract Number: F17AC00449

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Twentymile Creek

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Photograph of the MC Diversion showing old culverts and new box culvert.

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ABSTRACT

Warner Suckers *Catostomus warnerensis* are endemic to the lakes and tributaries of the Warner Basin, southeastern Oregon. The species was listed as threatened by the U.S. Fish and Wildlife Service in 1985 due to habitat fragmentation and threats from introduced nonnative fish. Recent recovery efforts have focused on providing passage at irrigation diversion dams that restrict Warner Sucker movement within the Warner Basin. Our objective in 2018 was to evaluate Warner Sucker passage success at the recently constructed MC Diversion fish bypass. Flows through the bypass were inconsistent and generally low during the study period. The inability to increase flows through the bypass without causing water to overtop the MC Dam resulted in irrigators operating the bypass below its designed flow capacity. Only 1 of 21 suckers released below the diversion was successful at passing through the bypass. Flow through the bypass during the passage event was approximately 8 cfs ($0.227 \text{ m}^3\text{s}^{-1}$). Four other suckers made repeated attempts to pass the weir in late May, but were unsuccessful. Flows through the bypass weir during the unsuccessful attempts was $<3.6 \text{ cfs}$ ($<0.102 \text{ m}^3\text{s}^{-1}$). The only other successful upstream passage was by a small (106 mm fork length) sucker through the old diversion culverts. It is possible this fish passed during a brief rise in water level in the MC Canal associated with the transitioning of flows from the bypass channel to the MC Canal that may have temporarily improved passage conditions through the culverts.

INTRODUCTION

Warner Suckers *Catostomus warnerensis* are endemic to the Warner Basin, an endorheic subbasin of the Great Basin in southeastern Oregon, northwestern Nevada, and extreme northeastern California. Historically, the species was abundant and its range included three relatively permanent lakes (Hart, Crump, and Pelican lakes), several ephemeral lakes, and three major tributary drainages (Honey, Deep, and Twentymile creeks) (U.S. Fish and Wildlife Service 1985). Warner Sucker abundance and distribution has declined over the past century and it was federally listed as threatened in 1985 due to habitat fragmentation and threats posed by the proliferation of piscivorous nonnative game fishes (U.S. Fish and Wildlife Service 1985).

Warner Suckers inhabit the lakes and low gradient stream reaches of the Warner Basin. The Warner Sucker metapopulation is comprised of both stream-dwelling and lake-dwelling fish. The stream-dwelling Warner Suckers inhabit and spawn in Honey, Deep, and Twentymile creeks. The lake-dwelling Warner Suckers typically exhibit an adfluvial life history; however, upstream migration may be blocked by low stream flows during low water years or by irrigation diversion dams. When this happens, spawning and rearing may occur in nearshore areas of the lakes (White et al. 1990), where large populations of lake-dwelling nonnative fishes may reduce recruitment by preying on young Warner Suckers (U.S. Fish and Wildlife Service 1998). The stream-dwelling Warner Suckers exhibit a fluvial life-history and spawn in the three major tributary drainages. Threats specific to the stream-dwelling Warner Suckers include water withdrawals for irrigation and impacts to their habitat from grazing. Stream-dwelling Warner Suckers recolonized the lakes after past lake drying events in 1934, 1991–92, and 2015.

The Recovery Plan for the Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin (U.S. Fish and Wildlife Service 1998) sets recovery criteria for delisting Warner Suckers. These criteria require that:

- 1) a self-sustaining metapopulation is distributed throughout the Twentymile Creek, Honey Creek, and Deep Creek (below the falls) drainages, and in Pelican, Crump, and Hart lakes, 2) passage is restored within and among the Twentymile Creek, Honey Creek, and Deep Creek (below the falls) drainages so that the individual populations of Warner Suckers can function as a metapopulation, and 3) no threats exist that would likely threaten the survival of the species over a significant portion of its range.

Efforts are underway to provide fish passage at migration barriers throughout the basin (criterion two) (Scheerer et al. 2017), with some of the most recent work occurring on Twentymile Creek.

Twentymile Creek flows north from headwaters in California, Nevada, and Oregon, to the southern portion of the Warner Valley. Historically, water from Twentymile and Deep creeks formed a large marsh in the southern valley that extended to Crump Lake. Beginning in the late 1930's, the marsh was diked and drained and the meandering creeks were engineered into a series of irrigation canals (Hunt 1964).

Presently, Twentymile Creek has two irrigation diversions above the valley floor: the MC Diversion is located just upstream from the valley floor and the Dyke Diversion is located about 1.7 km upstream from the MC Diversion. The replacement of an aging Denil fishway with a sucker-friendly fishway at the Dyke Diversion in 2014–2015 has been successful at providing upstream passage of Warner Suckers (Scheerer et al. 2016, 2017). At the MC Diversion, a low-head dam creates head for water to be diverted through three 0.91-m diameter culverts into the MC Canal. Flow through each culvert is controlled with a slide gate. The MC Canal, also considered to be the lower portion of Twentymile Creek, provides 1.1 km of sucker habitat before it is diverted into smaller canals at the Cahill Diversion. Scheerer et al. (2017) estimated 963 Warner Suckers resided in the MC Canal in 2016. High water velocities and shallow depths through the culverts are believed to impede upstream fish passage, thereby effectively disconnecting fish residing in the canal to the rest of Twentymile Creek. To address passage issues at the MC Diversion, the Lake County Umbrella Watershed Council, U.S. Fish and Wildlife Service, and the Bureau of Land Management worked with River Design Group, Inc. in 2017 to construct a fish-friendly bypass at the MC Diversion.

The design of the new fish passage at the MC Diversion consists of a fish friendly box culvert located adjacent to the three old culverts and an 89-m bypass canal connecting the box culvert to the MC Canal (Figure 1). A slide gate controls flow entering the box culvert and a concrete V-notch weir at the downstream end of the box culvert (Figure 2) regulates flow and depth inside the culvert. Our objective in 2018 was to evaluate Warner Sucker passage success through the new fishway at the MC Diversion on Twentymile Creek.

METHODS

We installed and operated five Passive Integrated Transponder (PIT) antennas upstream and downstream from the MC Diversion fish bypass (Figure 1) to assess passage success of Warner Suckers. Antennas were installed in front of the slide gate of the box culvert (antenna A) and around the weir at the downstream end of the culvert (B). An additional antenna was positioned in front of the old circular culverts (E). Antennas were also installed in the bypass channel near the confluence with the MC Canal (C) and in the MC canal upstream of the confluence (D) to assess fish route selection and travel time in the bypass channel. Most antennas were fixed flat on the substrate (Antennas A, C, D, and E) but the weir antenna (B) was a loop design installed around the weir opening (Figure 2). We installed a continuous detection beacon on antenna A to test continuity of operation of the antenna. Antennas were operated from 04 April–21 July 2018. We tested antenna performance and downloaded fish detection data monthly.

We installed water level loggers (Onset HOHBO® U20L) on 17 April in the box culvert and the MC Canal (upstream of the bypass confluence) that recorded water level every 30 minutes. Using water level data, flow through the V-notch weir was calculated

using the Kindsvater-Shen equation (U.S. Bureau of Reclamation 1997). Approximately once a month we measured stream flow in the MC canal (upstream of the bypass confluence) with water velocities measured with a Marsh-McBirney portable flow meter.

Warner Suckers were captured with hoop nets set in Twentymile and Twelvemile creeks upstream of the MC Diversion from 05 April – 18 April 2018. Nets were set overnight. We measured fork length (FL, nearest mm) on all captured suckers, and we PIT tagged all suckers >80 mm FL that appeared healthy. Fish ≥ 120 mm FL were tagged with a 23 mm half-duplex tag and fish <120 mm FL were tagged with a 12 mm half-duplex tag. All tagged fish were released below the MC Diversion in a pool just downstream of the MC Canal and bypass channel confluence.

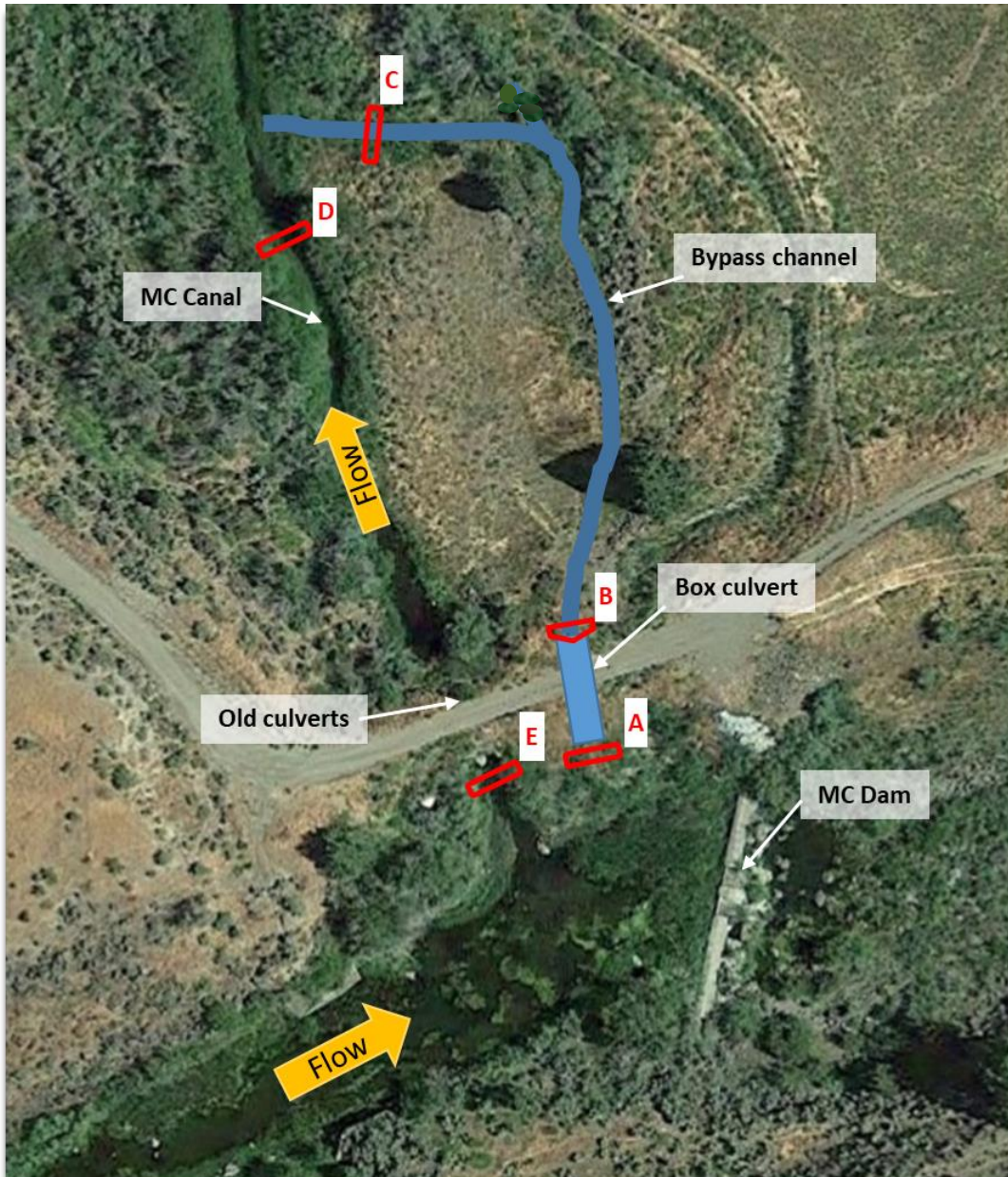


Figure 1. Plan view of MC Diversion fish passage project. New box culvert and bypass channel shown in blue. The five PIT antenna locations are shown in red.



Figure 2. The V-notch weir and loop PIT antenna on the downstream end of box culvert at the MC Diversion fish passage project. Photo taken on 03 May 2018.

RESULTS

Flow through the fish bypass was inconsistent during the study period. From April to early May, flows oscillated daily due to the water freeze/thaw cycle occurring in the Twentymile Creek basin (Figure 3). This usually resulted in brief periods of no flow in the bypass in April. The bypass rarely operated in mid-May. After a large flow pulse through the bypass on 26 May, associated with a flood event on Twentymile Creek (Appendix Figure 1), flows through the bypass remained relatively stable at approximately 3 cfs ($0.085 \text{ m}^3\text{s}^{-1}$) until the bypass was shut down on 17 June (Figure 3). Throughout the study period, attempts to increase flow through the bypass by manipulating the slide gates resulted in water overtopping the MC dam and draining to Greaser Reservoir. Therefore, irrigators operated the bypass below its designed target flows of 5.8–14.7 cfs ($0.164\text{--}0.416 \text{ m}^3\text{s}^{-1}$) with most flow entering the MC Canal via the old culverts.

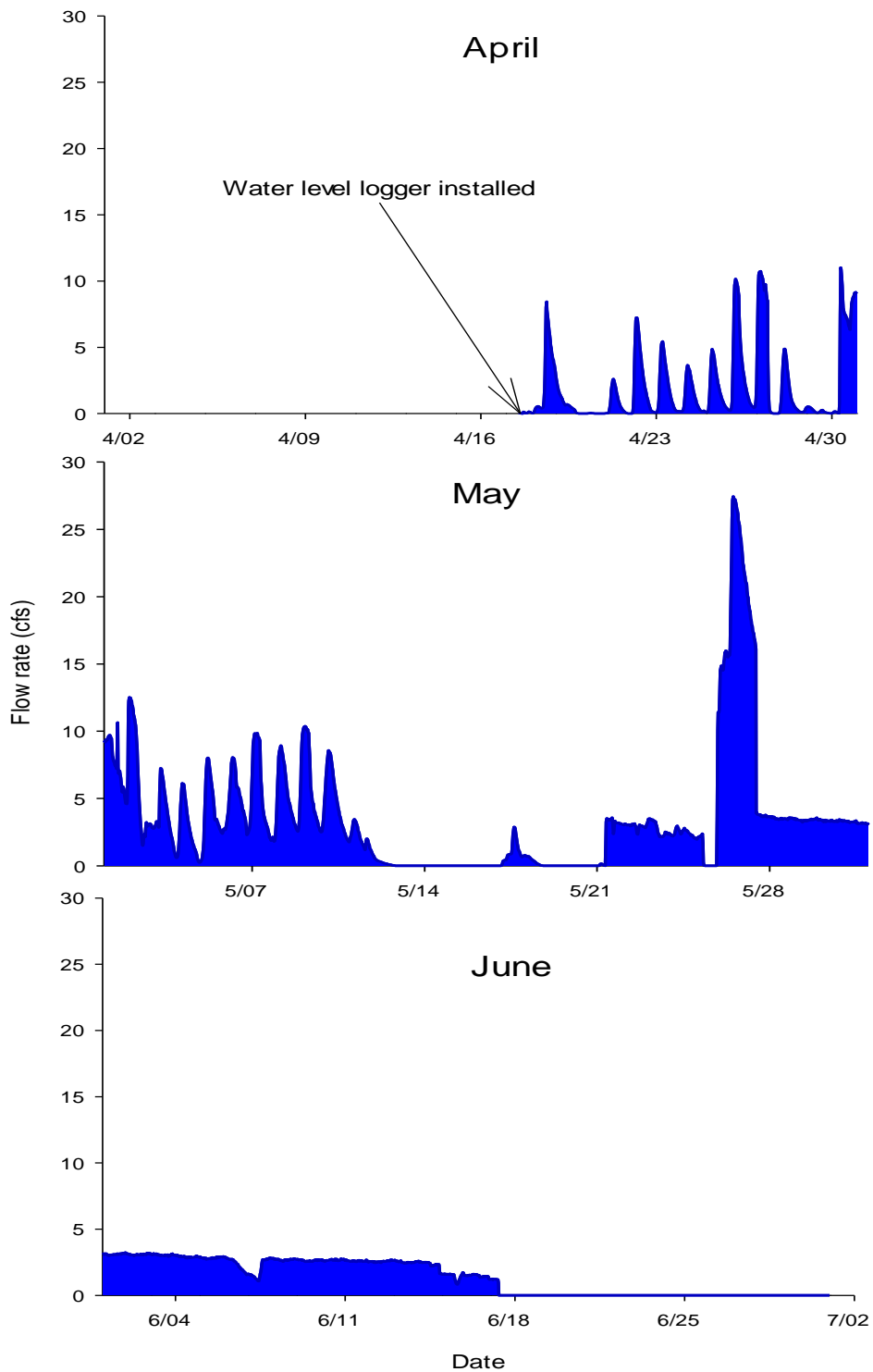


Figure 3. Flow rates through the bypass weir during the study period, 2018. Peak flow on 26 May was likely overestimated since water level was up the vertical walls of the weir, thereby biasing Kindsvater-Shen calculation for V-notch weir.

A total of 24 Warner Suckers were captured in 34 hoop net sets above the MC Diversion. We tagged 21 suckers ranging in size from 80–290 mm FL (Figure 4) and one 153 mm FL Redband Trout *Oncorhynchus mykiss*. All tagged fish were released below the MC Diversion. Seventeen of the 21 suckers were detected by at least one of the antennas during the study period, with most moving back and forth several times between antennas C and D (Appendix Table 1).

Only one sucker was detected successfully passing the MC Diversion through the new fish bypass. A 202 mm FL sucker was released below the MC Diversion on the morning of 05 April. It was detected that evening entering the bypass channel at 20:29 (antenna C) and at the weir at 21:59 (antenna B; 1.5 h travel time through the bypass channel). Our antenna in front of the box culvert (antenna A) was out of tune and did not detect the fish, but the fish was detected several times by the antenna upstream from the old culverts (antenna E), verifying that it successfully made it through the bypass. Although water level loggers were not yet installed to measure weir flow, Twentymile Creek flow measured upstream from the Dyke Diversion (https://apps.wrd.state.or.us/apps/sw/hydro_near_real_time/; Station ID 10366000) at the time of the passage event was 12.9 cfs ($0.365 \text{ m}^3\text{s}^{-1}$) and all flow at the MC Diversion was going through the bypass except for water diverted into the small canal just to the east of the bypass that irrigates nearby fields. Assuming the Dyke Diversion was drawing its full water right of 2.5 cfs and the small canal near the bypass was drawing about 2 cfs, approximately 8 cfs ($0.227 \text{ m}^3\text{s}^{-1}$) was likely flowing through bypass during the passage event.

There were four other suckers that approached the weir in late May but were unsuccessful in passing it. Flow through the weir during these passage attempts ranged from 2.6–3.6 cfs ($0.073\text{--}0.102 \text{ m}^3\text{s}^{-1}$) (Table 1). One fish attempted to pass on 22 May and the remaining three attempted to pass from 28 May–04 June. No fish were detected approaching the weir during the high flow event on 26 May. Each sucker made multiple attempts to pass the weir over a period of 0.4–4.8 d (Table 1) before dropping back out of the bypass channel. During each attempt, fish were detected by the weir antenna for an average of 1.8 s (range: 0.6–12.7 s) before dropping back downstream out of the antenna's detection range, which was approximately 0.25 m. Similarly, the one Redband Trout release below the MC diversion was detected on 29 May and made several attempts to pass the weir before dropping back out of the bypass channel (Table 1).

Surprisingly, the only other successful passage through the MC Diversion was by a 106 mm FL sucker that passed through the old culverts on 17 June, the day the bypass channel was shut down and all water was routed through the old culverts. The bypass slide gate was closed in the morning (~8:00), which coincided with a brief (~1 hour) water level increase of 0.48 m in the MC Canal below the old culverts (Figure 6). The fish entered the MC Canal from the bypass channel earlier in the morning (04:54) and was detected on the antenna upstream of the culverts (antenna E) that evening (19:58).

Table 1. Metrics on weir passage attempts by Warner Suckers and a Redband Trout at the MC Diversion, 2018. Duration was the total time between first and last detection on the weir antenna.

Species	PIT tag ID	Fork length (mm)	Date/Time of first detection	Duration (d)	Attempts	Weir flow range (cfs)
Sucker	158EC902	157	5/22/18 4:00	0.4	2	2.6–3.1
Sucker	158E7261	130	5/31/18 3:52	4.7	10	3.0–3.3
Sucker	158EC8CD	145	5/28/18 1:55	2.8	8	3.1–3.6
Sucker	158EC8DD	224	5/30/18 3:07	4.8	7	3.0–3.4
Trout	158E7296	153	5/29/18 3:45	1.1	4	3.4–3.5

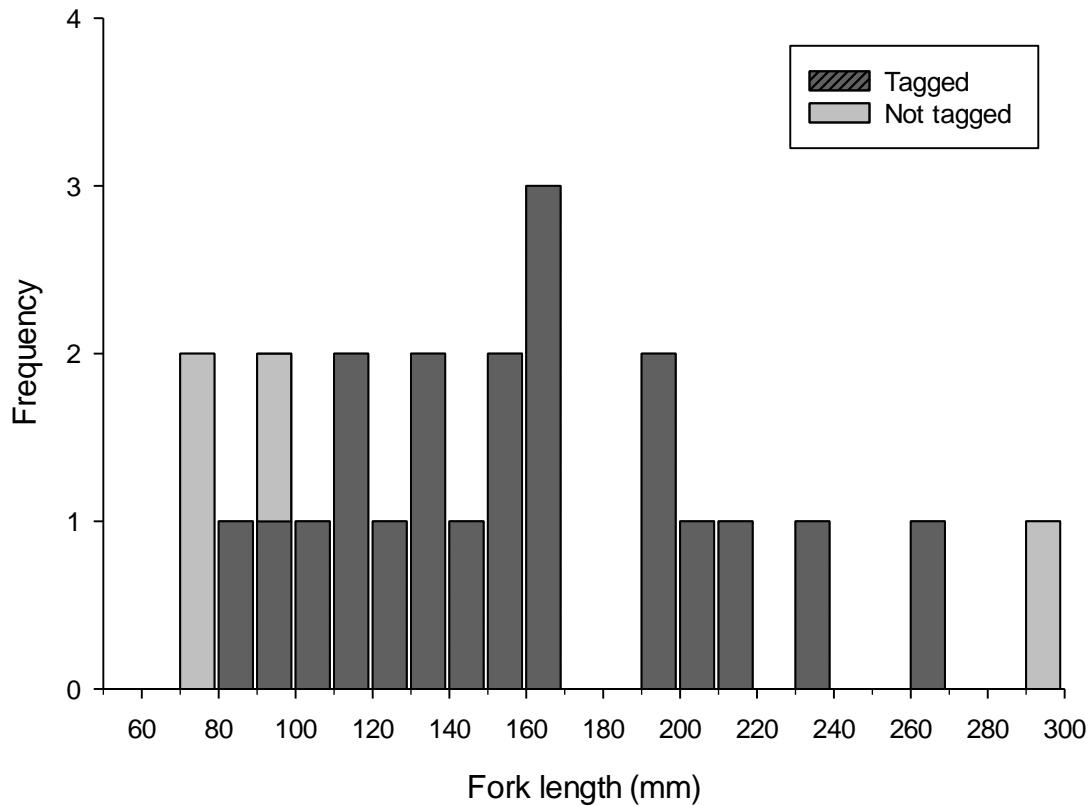


Figure 4. Length frequency of Warner Suckers captured and PIT tagged above the MC Diversion in April, 2018. Tagged fish were released below the diversion.

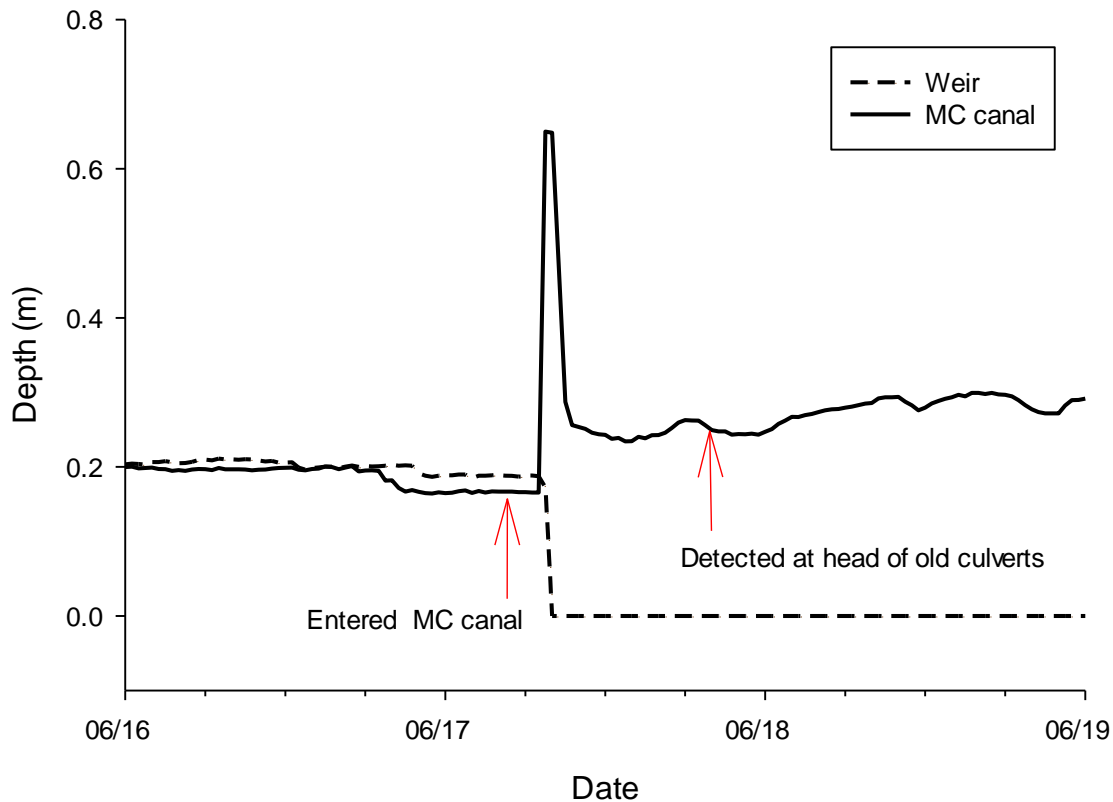


Figure 5. Water level over the bypass weir notch and in the MC Canal during the period of bypass shut down and successful Warner Sucker passage through the old culverts. Red arrows indicate when the fish was detected at PIT antennas.

DISCUSSION

The inability to increase flows through the bypass without causing water to overtop the MC Dam resulted in inconsistent and generally low flows through the bypass during the study period. This problem was recognized by managers soon after bypass operations began and structural modifications to improve flow have been initiated. Despite the operational limitations during the study period, some useful information was gained on flow requirements needed for successful fish passage. The successful passage of one fish through the bypass indicated that fish can pass the weir when flows are approximately 8 cfs ($0.23 \text{ m}^3\text{s}^{-1}$). Fish were unsuccessful at passing over the weir when flows were <3.6 cfs ($0.10 \text{ m}^3\text{s}^{-1}$), including one Redband Trout. One possible reason for unsuccessful upstream passage at these low flows may be the large rocks located directly downstream of the weir (Appendix Figure 2). Passage during low flow conditions could possibly be improved if the rocks were removed to allow better access to the weir notch.

The successful upstream passage through the old culverts by a relatively small fish (106 mm FL) was unexpected. Warner Suckers have relatively low burst swimming speeds (Scheerer and Clements 2014) with smaller fish having reduced burst speeds. It is believed that the high water velocities in the culverts prevents successful upstream passage (Scheerer et al. 2016). It is possible that the fish passed through the culverts during the brief (~1 hour) increase in water level in the MC Canal (coinciding with the bypass shutdown) that may have temporarily improved passage conditions in the culverts. It may have taken about an hour for water to drain out of the bypass channel after the shutdown causing the increased flows from the old culverts to start pooling in the MC Canal at the confluence with the bypass channel. The water level rise detected at our data logger location would suggest water backed up into the old culverts, possibly decreasing water velocities inside the culverts and improving passage conditions. Observing the hydrologic dynamics in the MC Canal during these flow transitions would confirm if this indeed takes place.

ACKNOWLEDGEMENTS

We would like to thank Paul Scheerer for providing valuable advice on collecting Warner Suckers in Twentymile Creek. We would also like to thank the Robinsons and O'Keefes for allowing us access on their property.

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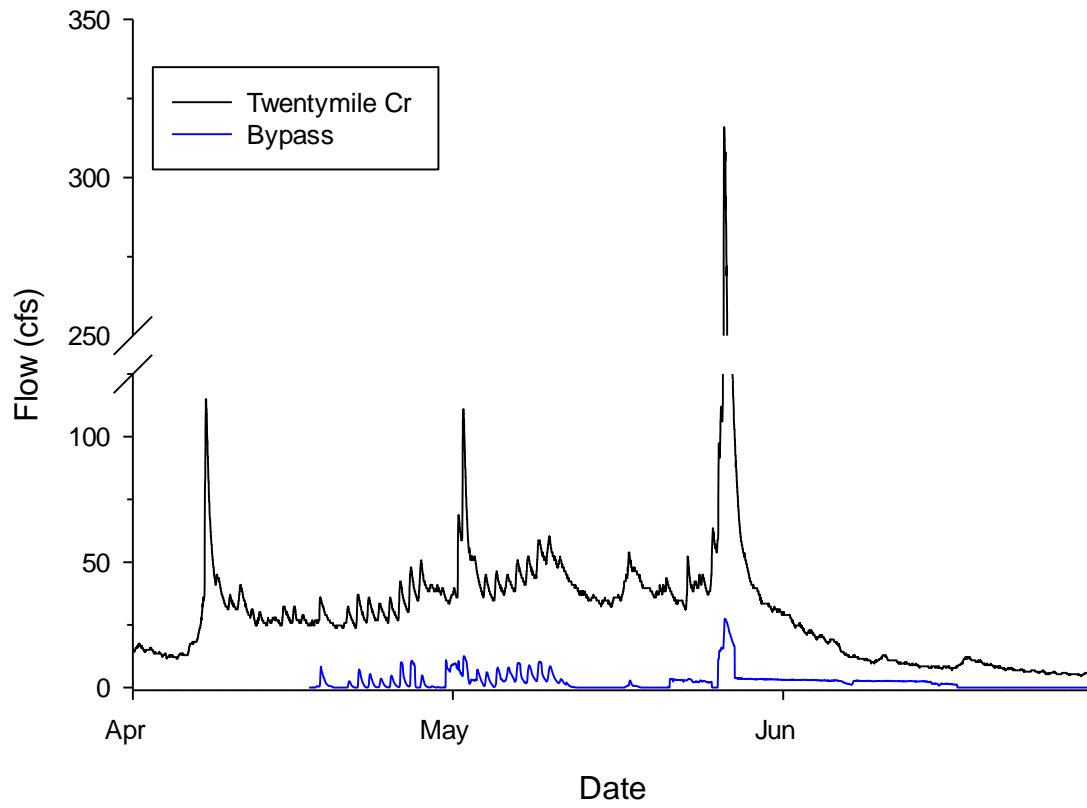
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APPENDIX

Appendix Table 1. Tagging and antenna detection summary of Warner Suckers and a Redband Trout tagged in Twentymile Creek and released below MC Diversion, 2018. Antenna locations can be found in Figure 1. Antenna detections are the total number of detections per antenna that were at least 1 hour apart from previous detection on the antenna.

Release date	Capture UTM (11T)	Species	Fork length (mm)	PIT tag size (mm)	PIT Code	Antenna detections				
						A	B	C	D	E
04/05/18	0254582 4661446	Sucker	185	24	158E725D	0	0	2	4	0
04/05/18	0254582 4661446	Sucker	145	24	158EC8CD	0	18	40	72	0
04/05/18	0255060 4660746	Sucker	260	24	158E7265	0	0	0	9	0
04/05/18	0255060 4660746	Sucker	290	24	158E7294	0	0	16	47	0
04/05/18	0255060 4660746	Sucker	202	24	158EC8D1	3	2	1	0	10
04/05/18	0255060 4660746	Sucker	193	24	158EC8DA	0	0	1	13	0
04/05/18	0255060 4660746	Sucker	112	12	15AB3BF8	0	0	0	2	0
04/06/18	0254585 4661443	Sucker	110	12	15AB3BFB	0	0	0	2	0
04/06/18	0255069 4660754	Sucker	224	24	158EC8DD	0	12	3	1	0
04/06/18	0255069 4660754	Sucker	106	12	15AB3C38	0	0	132	7	1
04/17/18	0255146 4660872	Sucker	130	24	158E7261	0	15	26	2	0
04/17/18	0255146 4660872	Sucker	124	24	158E7263	0	0	0	0	0
04/17/18	0255146 4660872	Sucker	153	24	158E7270	0	0	67	8	0
04/17/18	0255146 4660872	Sucker	188	24	158EC8D7	0	0	56	7	0
04/17/18	0254864 4658979	Sucker	96	12	15AB3C35	0	0	0	1	0
04/18/18	0255146 4660872	Sucker	133	24	158E7253	0	0	0	0	0
04/18/18	0255146 4660872	Sucker	154	24	158E7260	0	0	6	14	0
04/18/18	0255146 4660872	Trout	153	24	158E7296	0	7	3	14	0
04/18/18	0255146 4660872	Sucker	157	24	158EC902	0	2	2	8	0
04/18/18	0255146 4660872	Sucker	148	24	158EC907	0	0	0	0	0
04/18/18	0255146 4660872	Sucker	82	12	15AB3C17	0	0	0	0	0
04/18/18	0255146 4660872	Sucker	80	12	15AB3C4B	0	0	0	0	0



Appendix Figure 1. Flow rate of Twentymile Creek and MC Diversion Bypass during the study period, 2018.



Appendix Figure 2. Photo of large rocks below the bypass weir entrance, 2018.



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