Examination of larval fish survey data and discharge.

San Juan River Recovery Implementation Program

Environmental Flows Workshop #2

(sub-group meeting)

3 December 2015

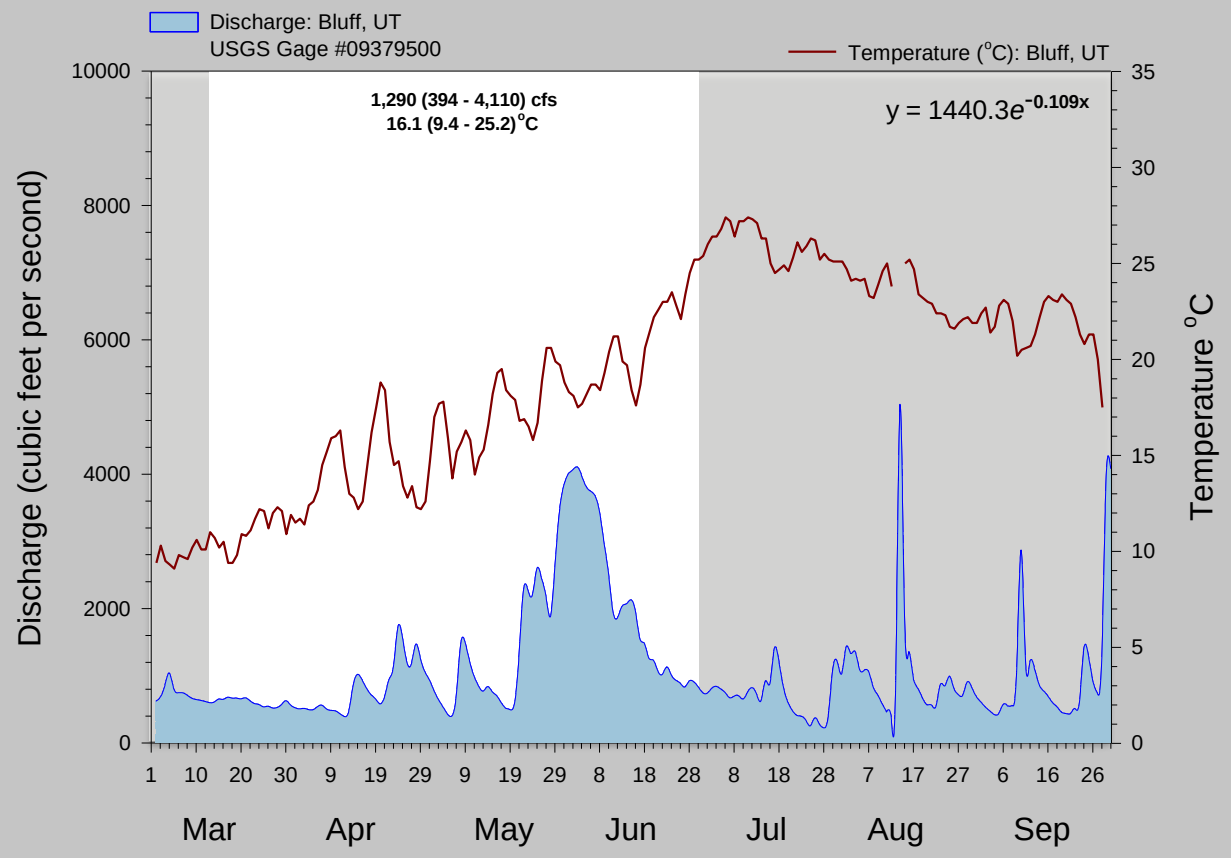
Covariates used in models in addition to year and reach

Razorback Sucker 1999-2014	**Mean April flow** and temperature	**Mean May flow** and temperature	Annual # stocked	Cumulative # stocked	Fall Monitoring Captures
Colorado Pikeminnow 2003-2014	**Mean June flow** and temperature	**Mean July flow** and temperature	Fall Monitoring Captures: • 450+ mm TL • 300-449 mm TL		

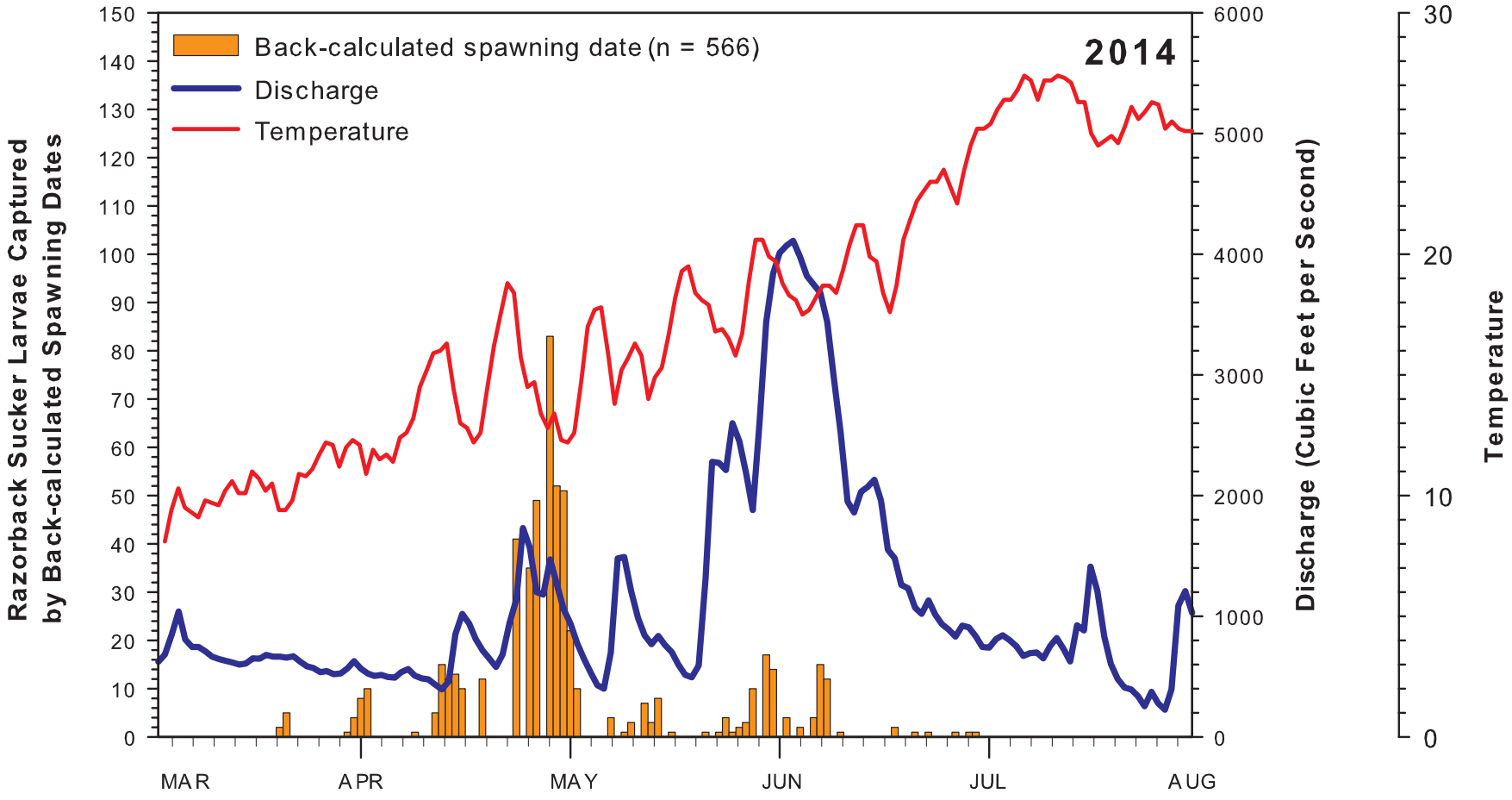
General linear models of Razorback Sucker mixture-model estimates Delta(δ) and Mu(μ)

Model	K	AIC_C	Weight AIC_C
δ(Cum.Stock+random) μ(Cum.Stock+random)	9	3,267.38	0.720
δ(May flow+random) μ(May flow+random)	**9**	**3,270.63**	**0.139**
δ(Monitor+random) μ(Monitor+random)	9	3,292.62	0.091
δ(CumStock+random) μ(Year)	35	3,273.34	0.036
δ(Monitor+random) μ(Year)	35	3,276.81	0.006
δ(May flow+random) μ(Year)	**35**	**3,278.24**	**0.003**
δ(Year) μ(May flow+random)	21	3,279.10	0.002
δ(Year) μ(May flow)	20	3,279.18	0.002
δ(Year) μ(Year)	48	3,280.56	<0.001
δ(April flow+random) μ(April flow+random)	**9**	**3,282.64**	**<0.001**

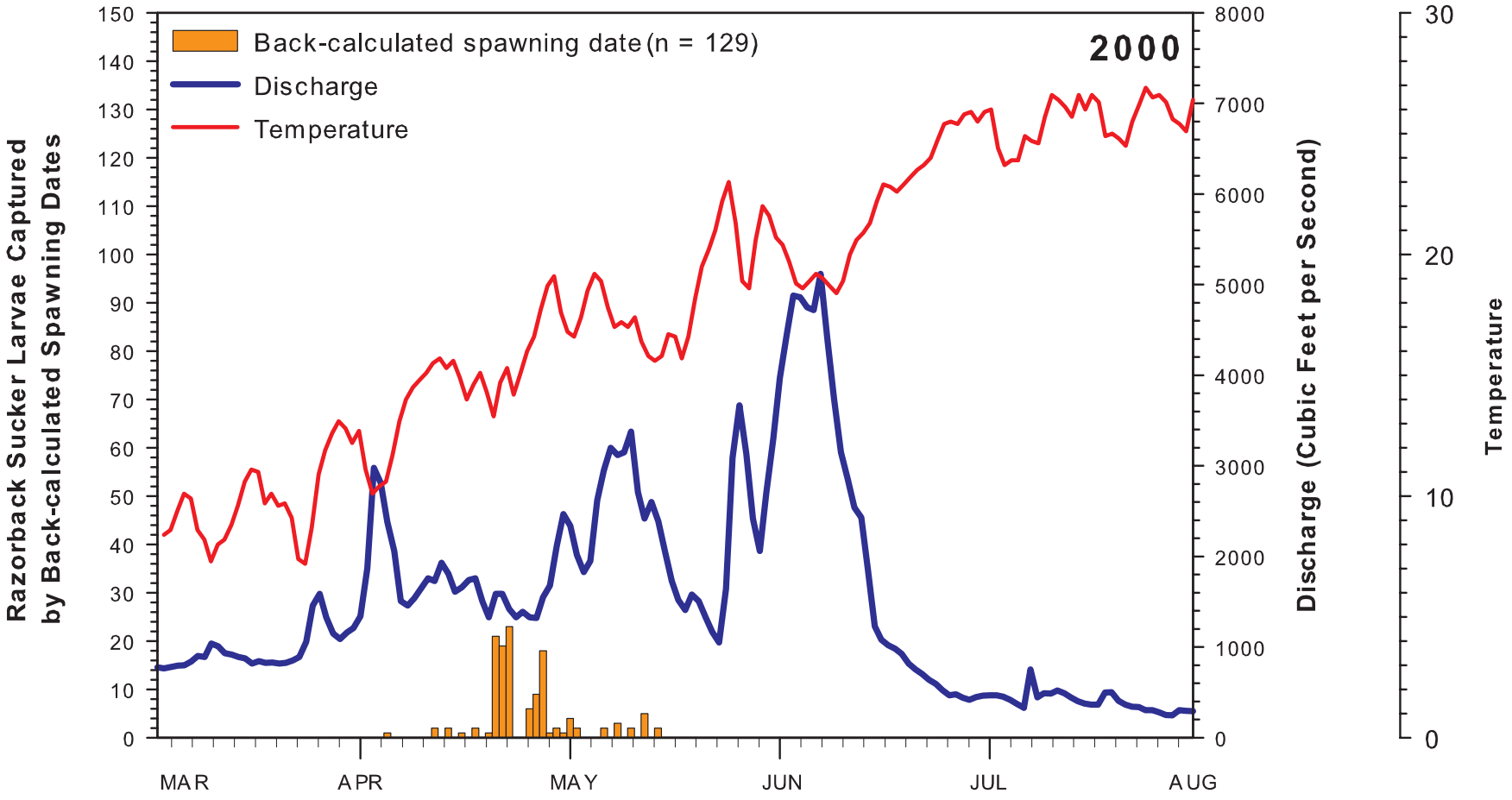
Back-calculated spawning dates
of larval Razorback Sucker. 13 March – 30 June (110d)



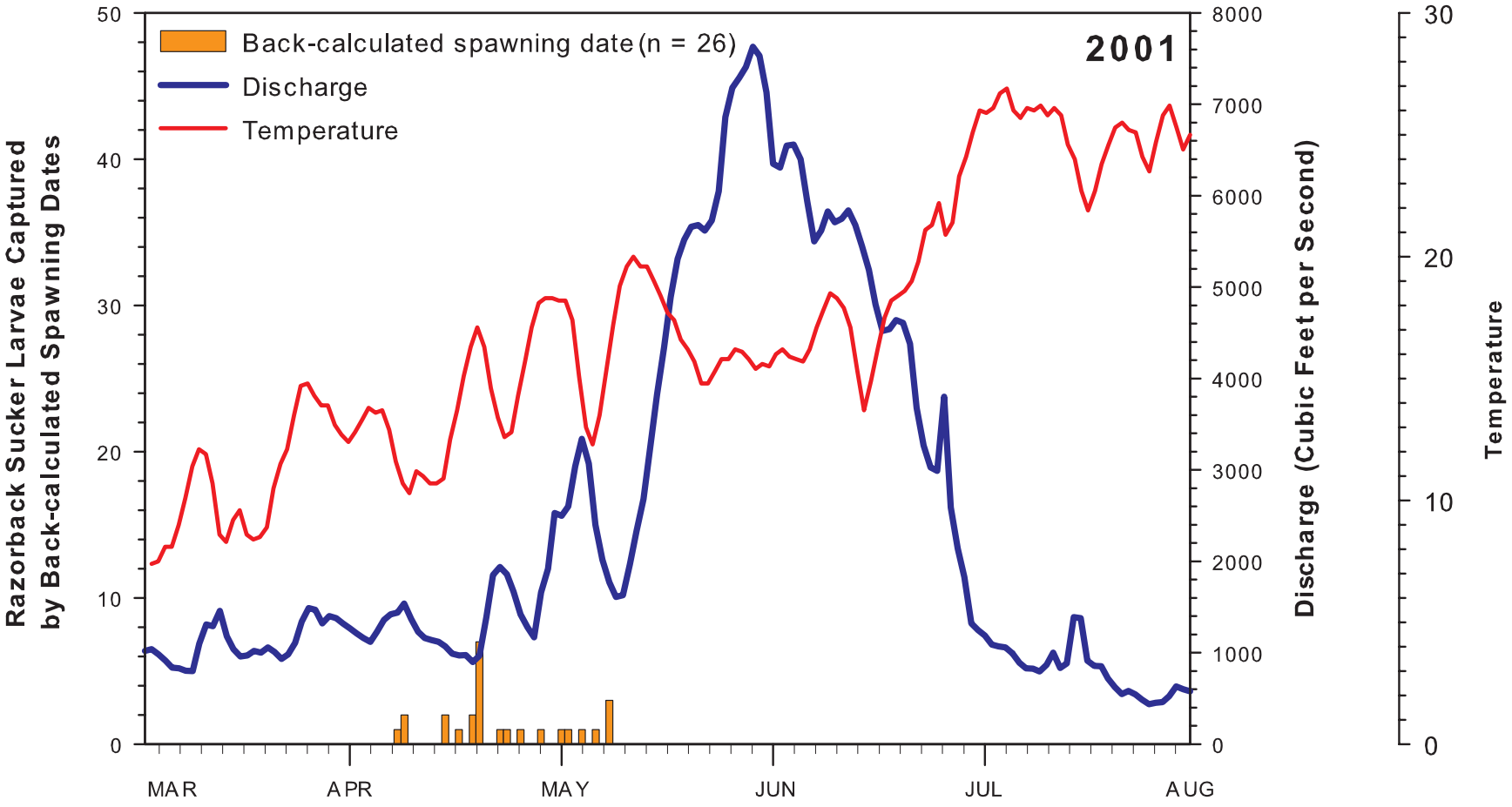
Back-calculated spawning dates for 2014



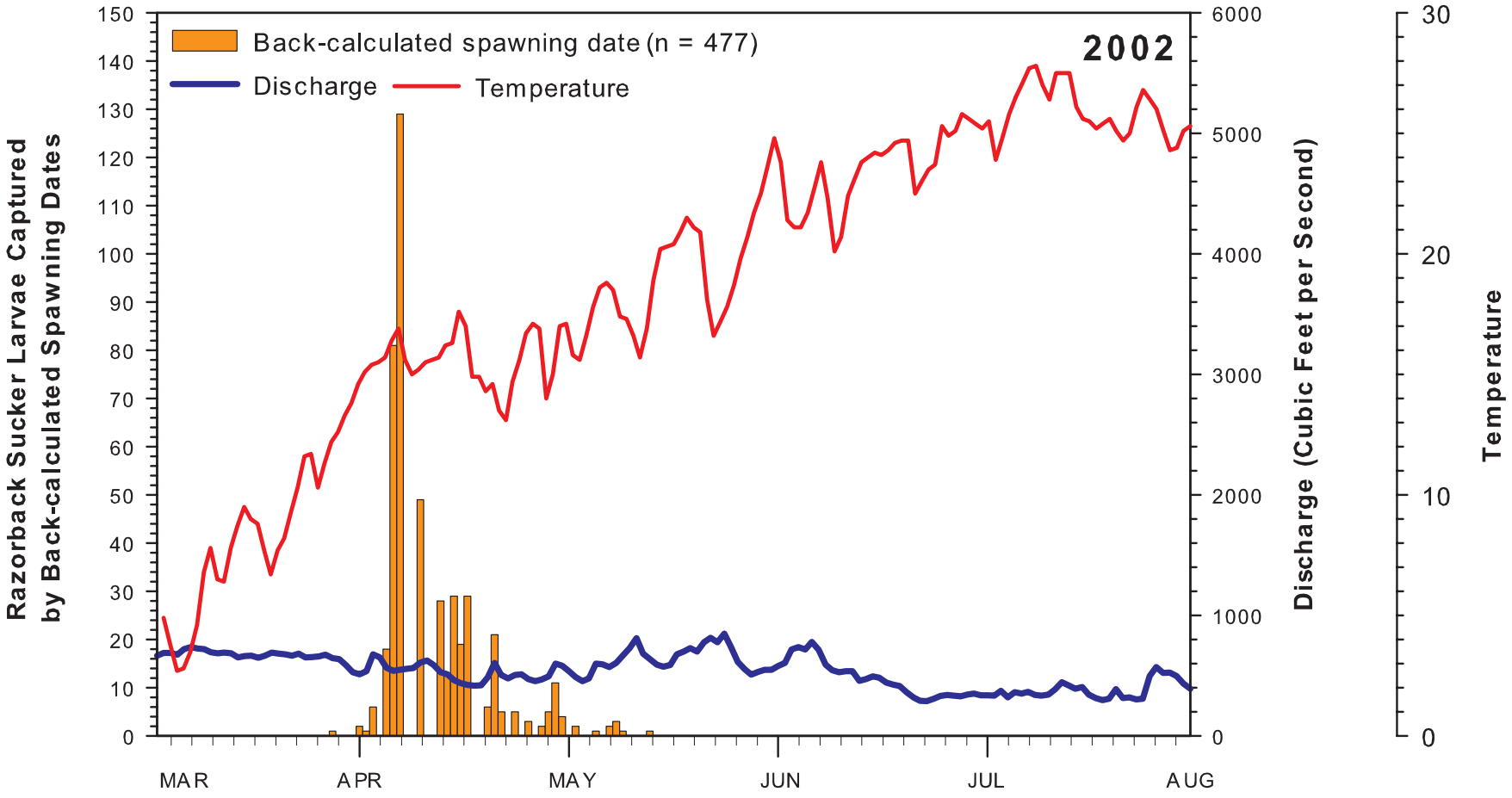
Back-calculated spawning dates for 2000



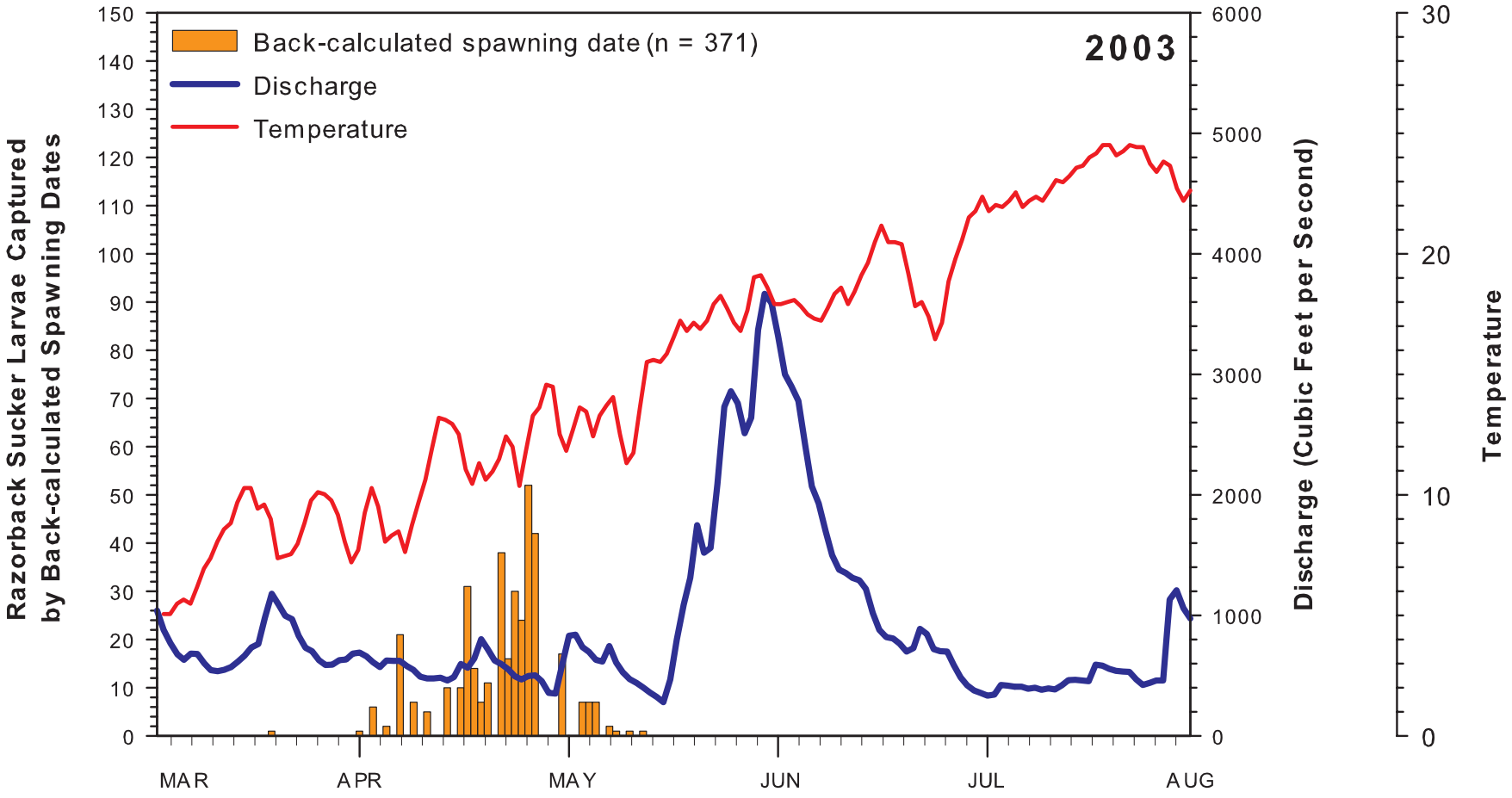
Back-calculated spawning dates for 2001



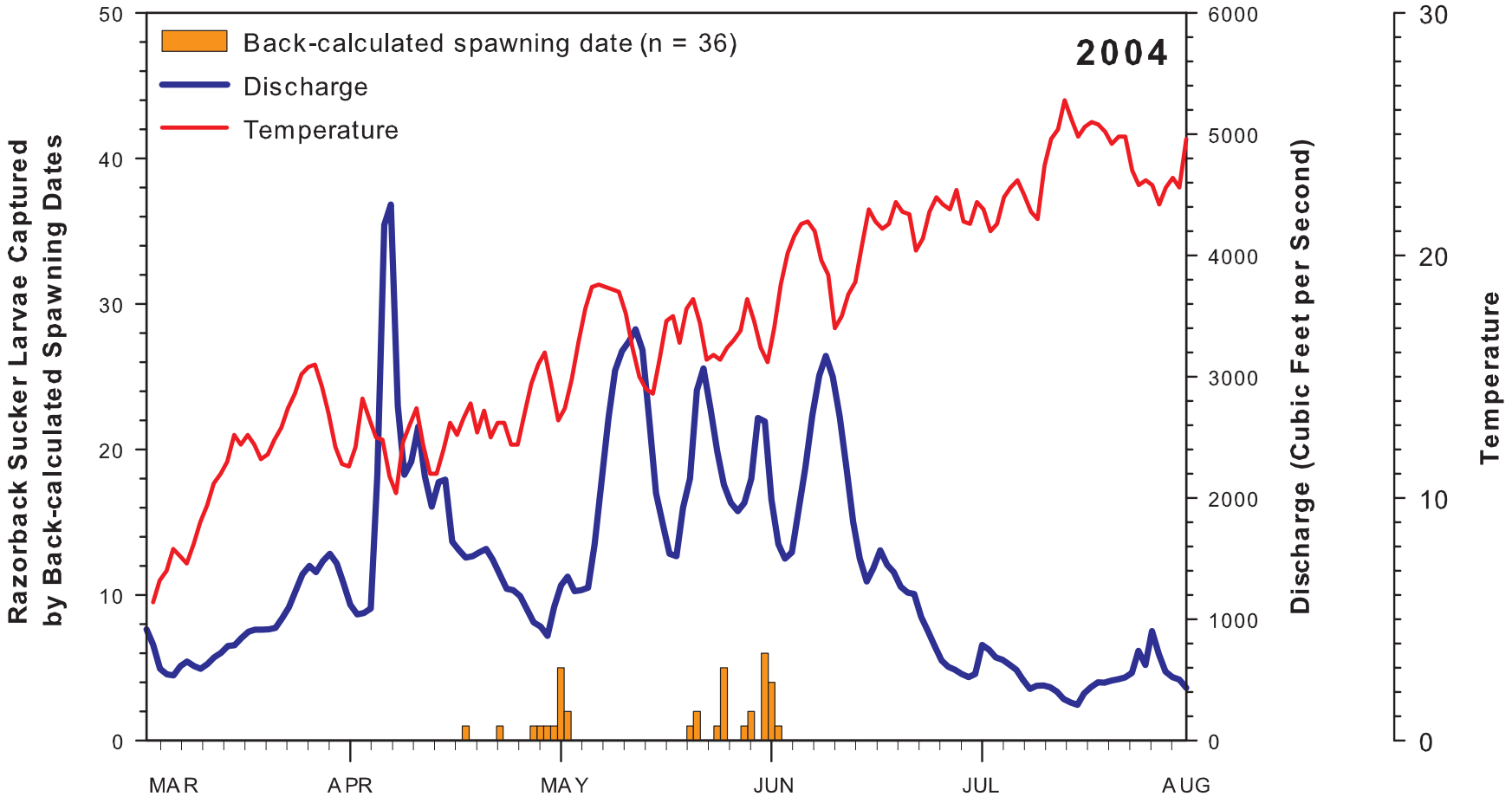
Back-calculated spawning dates for 2002

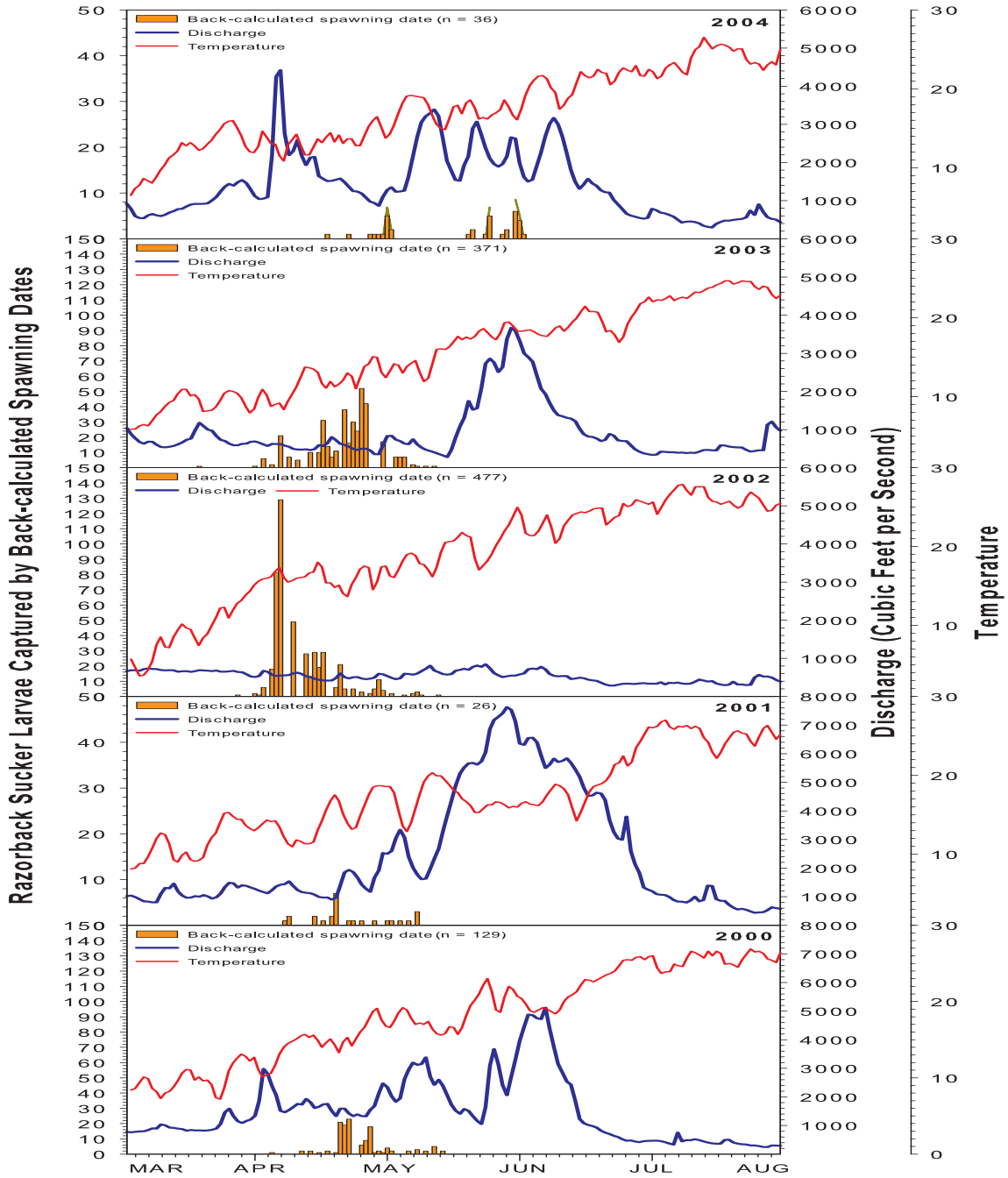


Back-calculated spawning dates for 2003

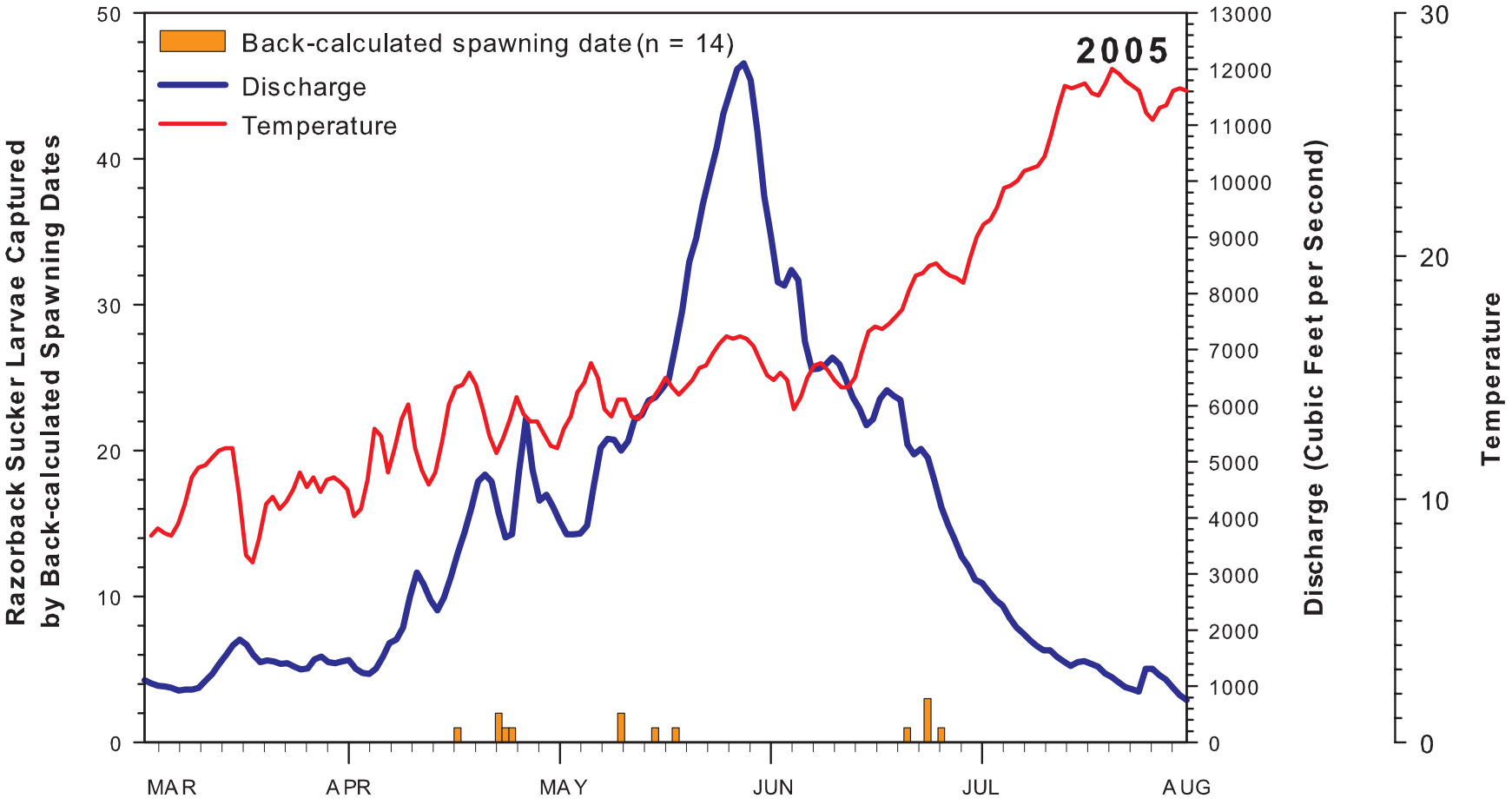


Back-calculated spawning dates for 2004

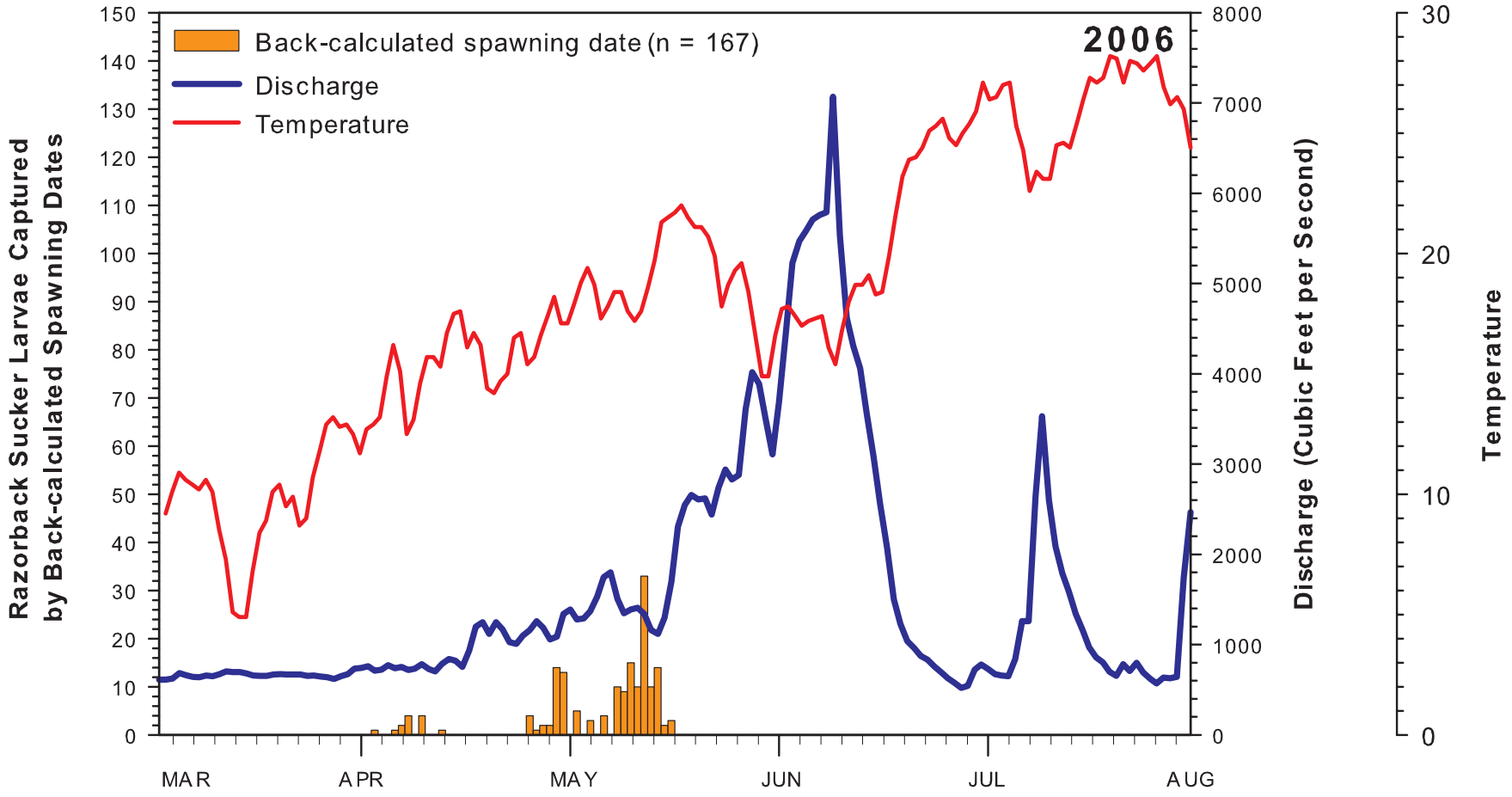



Razorback Sucker Larvae Captured by Back-calculated Spawning Dates
Discharge (Cubic Feet per Second)
Temperature
Back-calculated spawning date (n = 36)
Discharge
Temperature
2004
Back-calculated spawning date (n = 371)
Discharge
Temperature
2003
Back-calculated spawning date (n = 477)
Discharge
Temperature
2002
Back-calculated spawning date (n = 26)
Discharge
Temperature
2001
Back-calculated spawning date (n = 129)
Discharge
Temperature
2000
MAR
APR
MAY
JUN
JUL
AUG

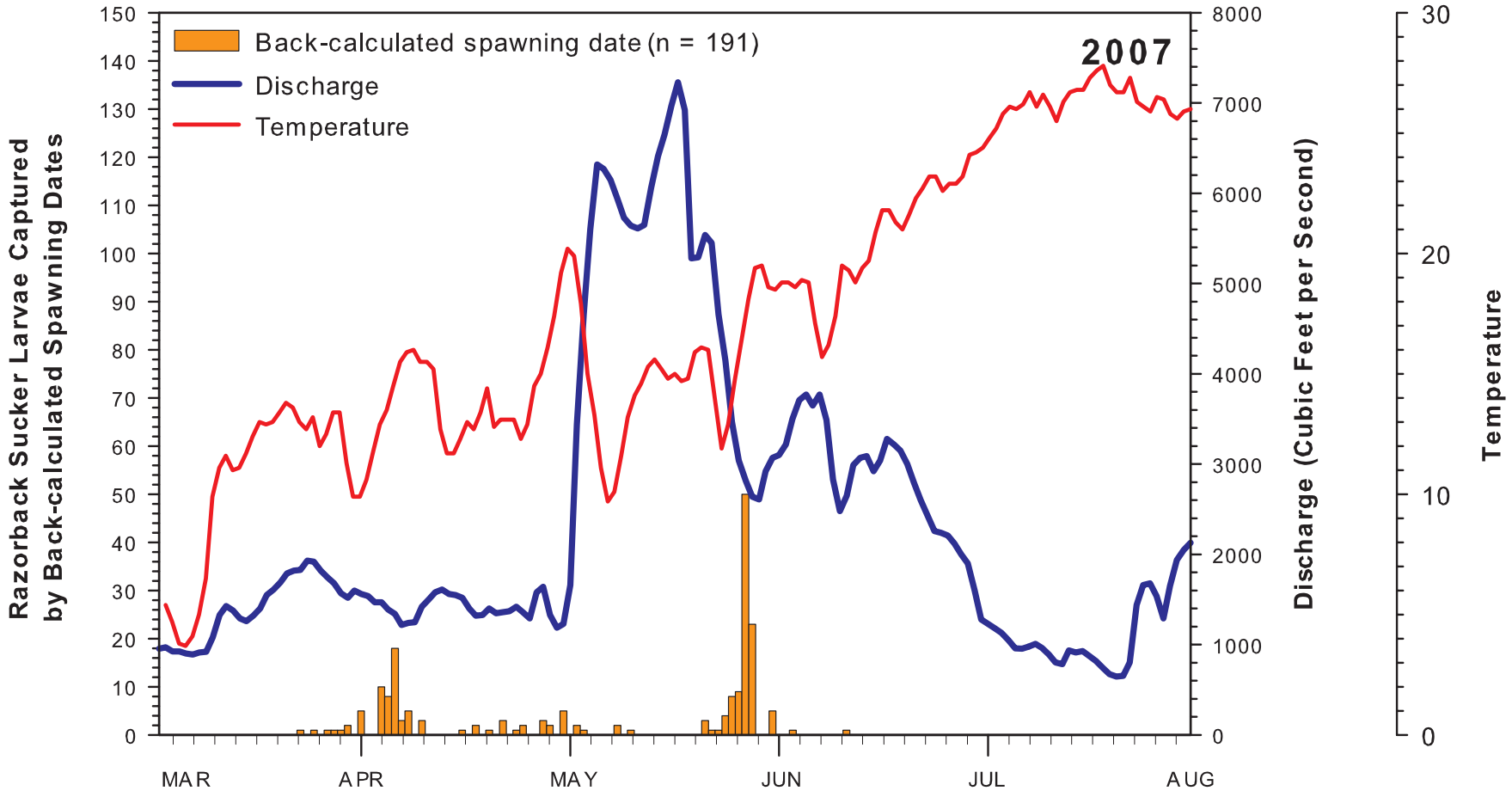
Back-calculated spawning dates for 2005



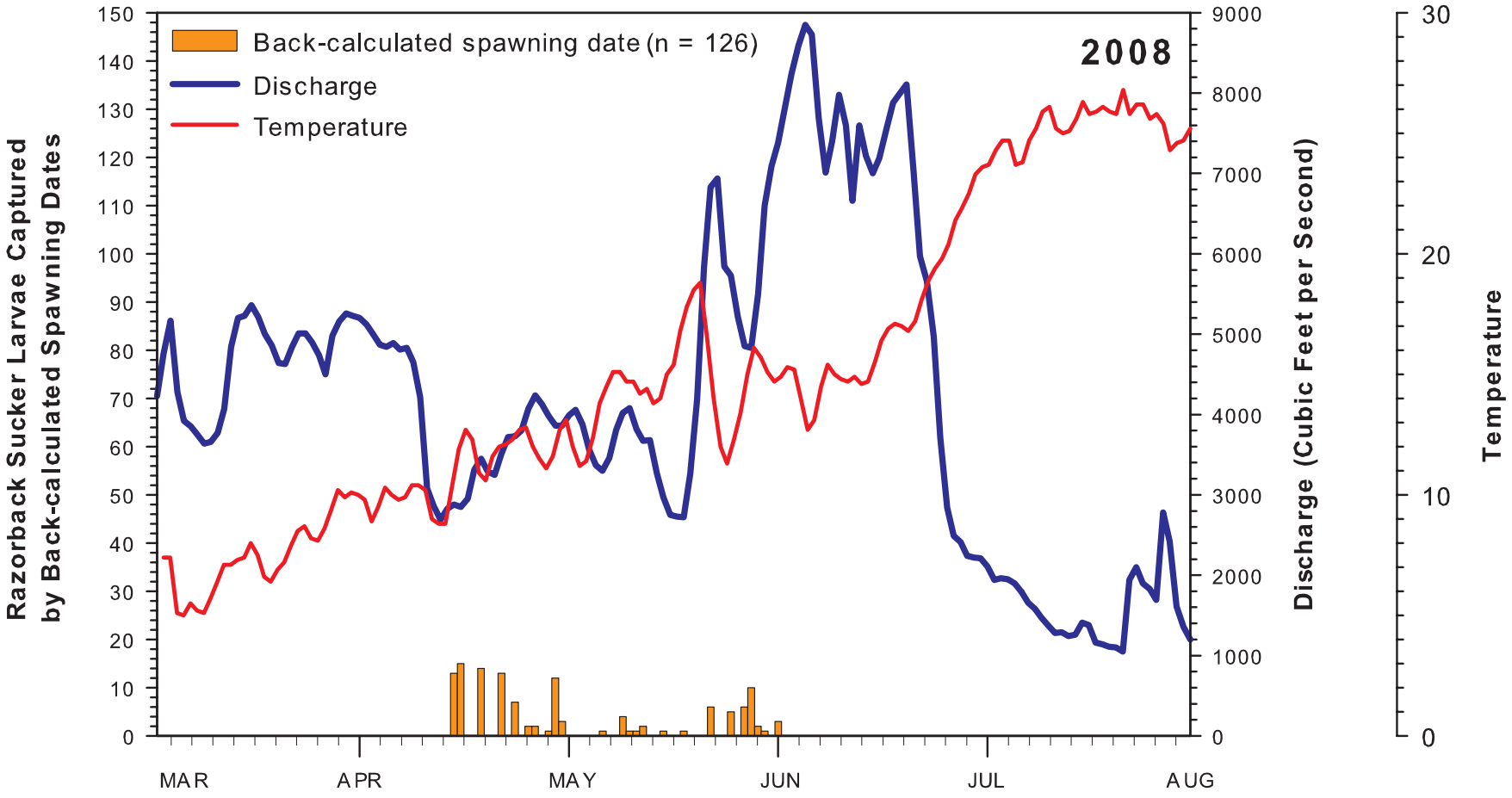
Back-calculated spawning dates for 2006



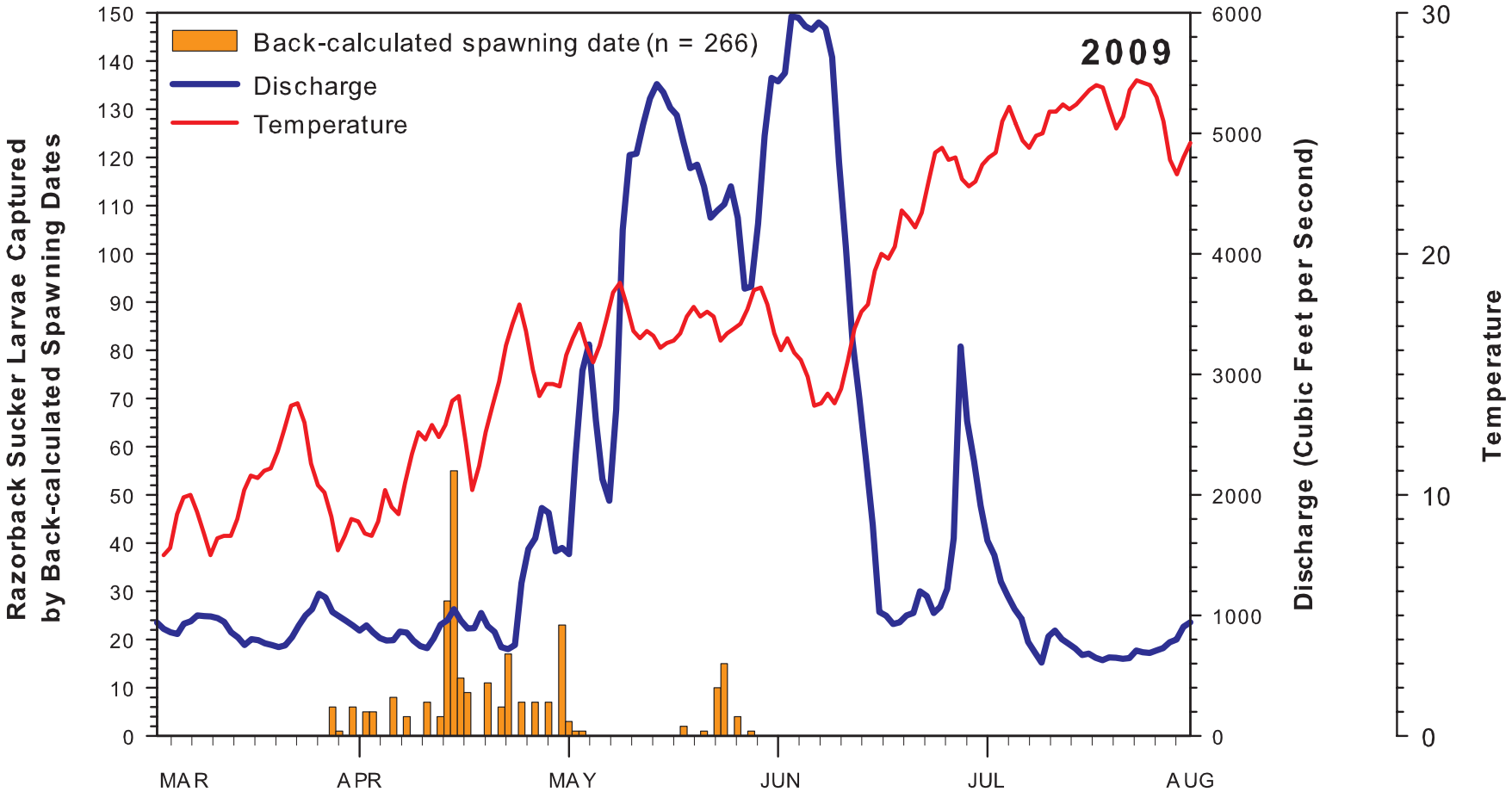
Back-calculated spawning dates for 2007

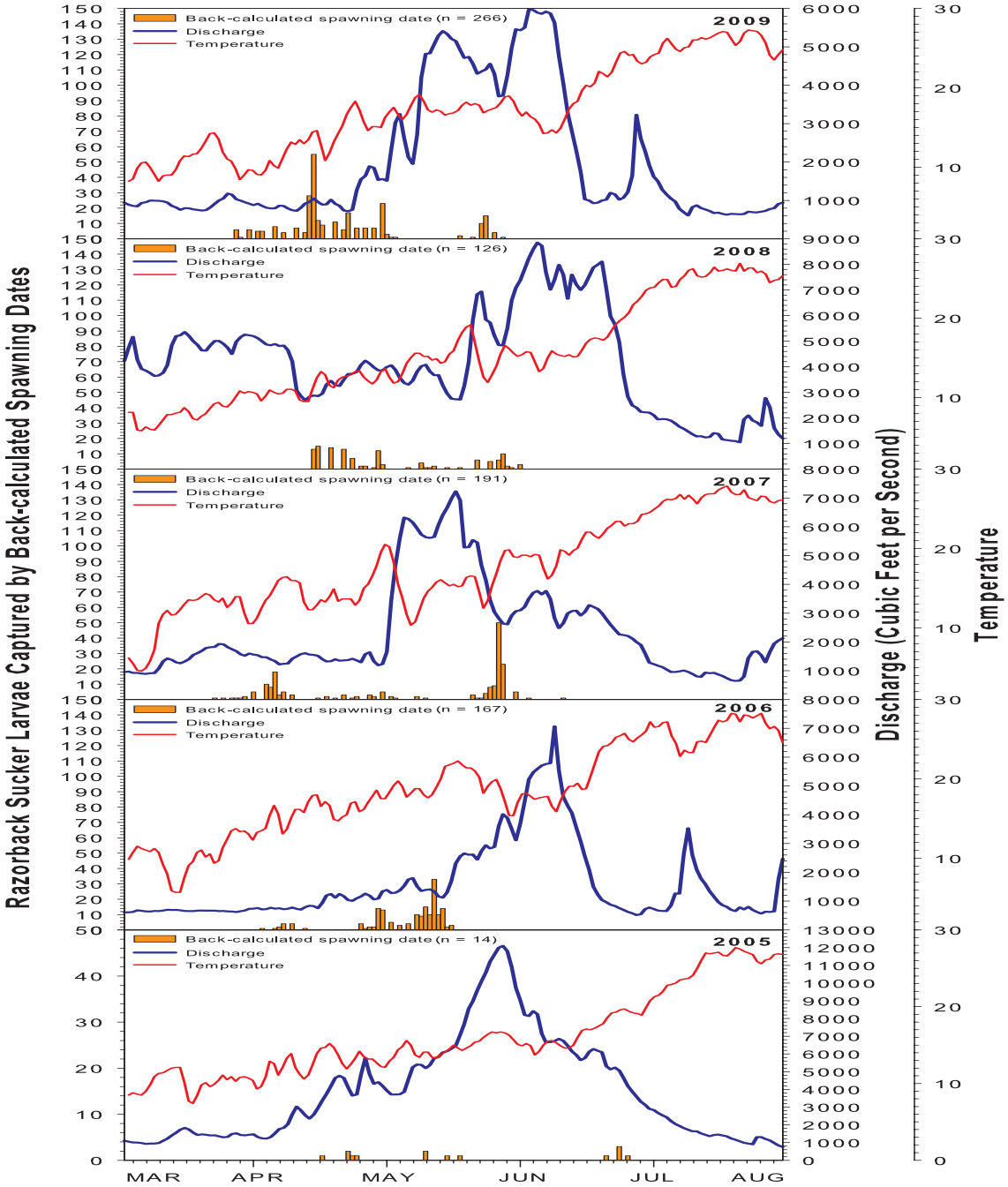


Back-calculated spawning dates for 2008

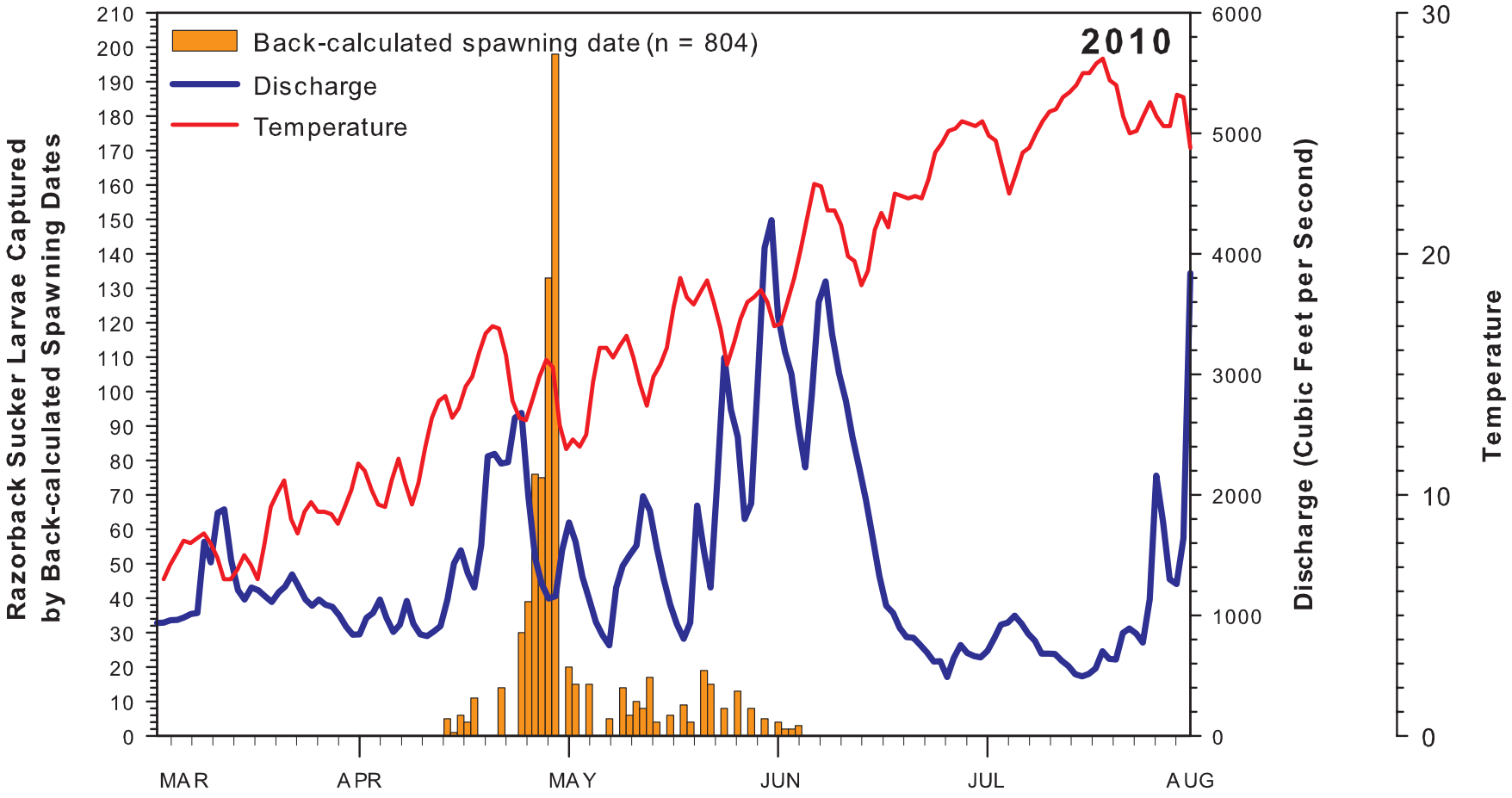


Back-calculated spawning dates for 2009

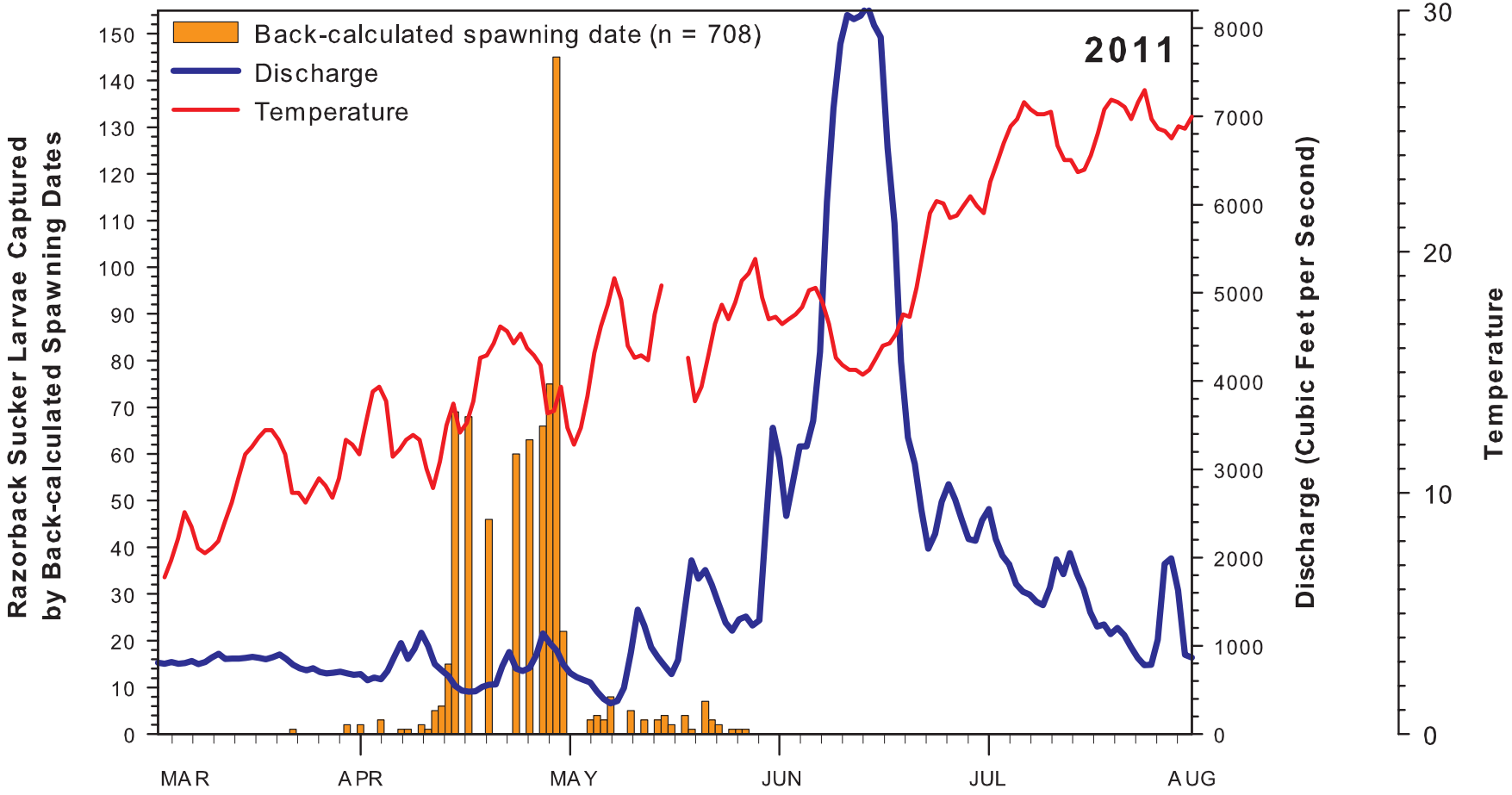



Razorback Sucker Larvae Captured by Back-calculated Spawning Dates
Discharge (Cubic Feet per Second)
Temperature
Back-calculated spawning date (n = 266)
Discharge
Temperature
2009
Back-calculated spawning date (n = 126)
Discharge
Temperature
2008
Back-calculated spawning date (n = 191)
Discharge
Temperature
2007
Back-calculated spawning date (n = 167)
Discharge
Temperature
2006
Back-calculated spawning date (n = 14)
Discharge
Temperature
2005
MAR
APR
MAY
JUN
JUL
AUG

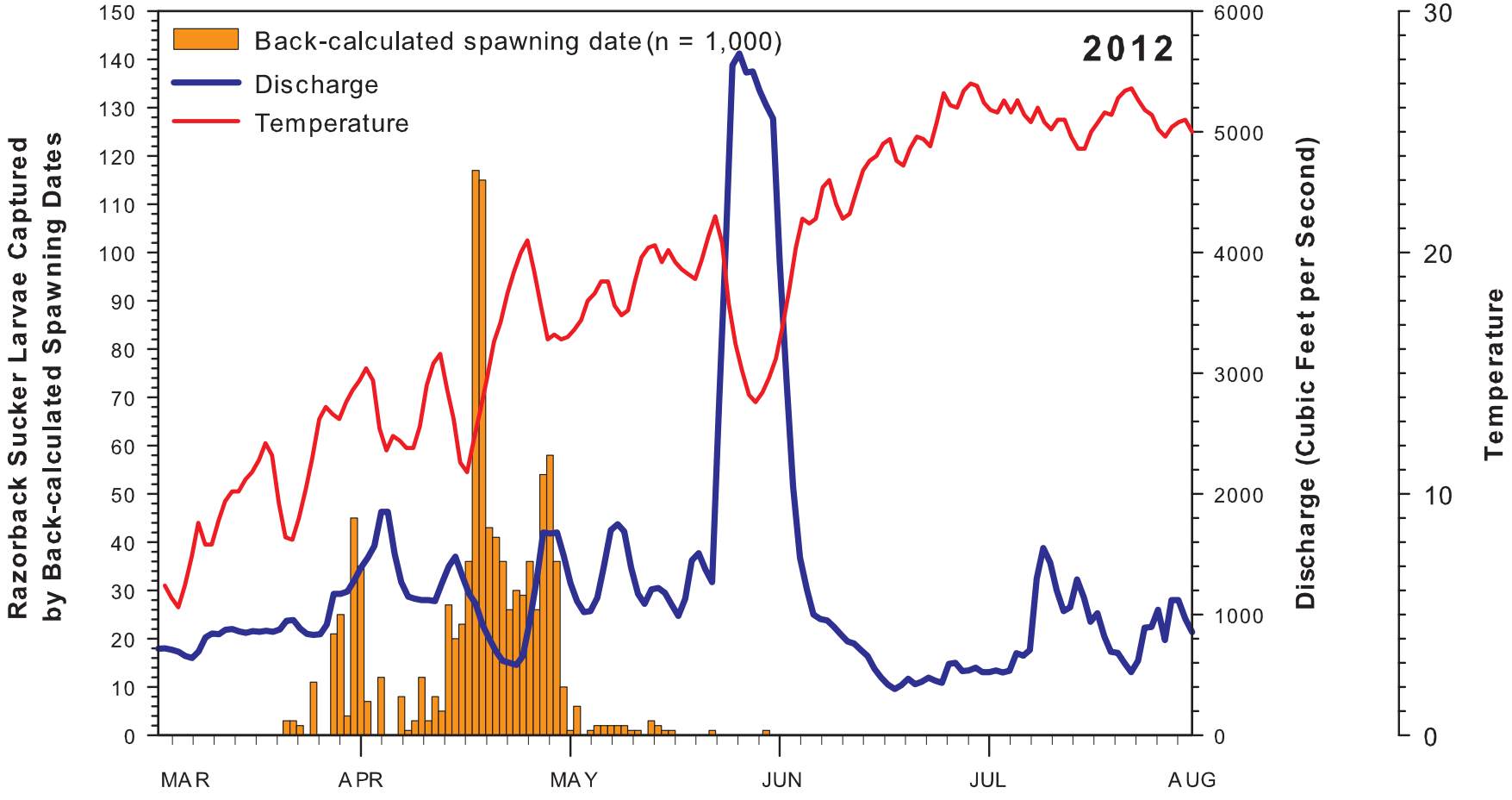
Back-calculated spawning dates for 2010



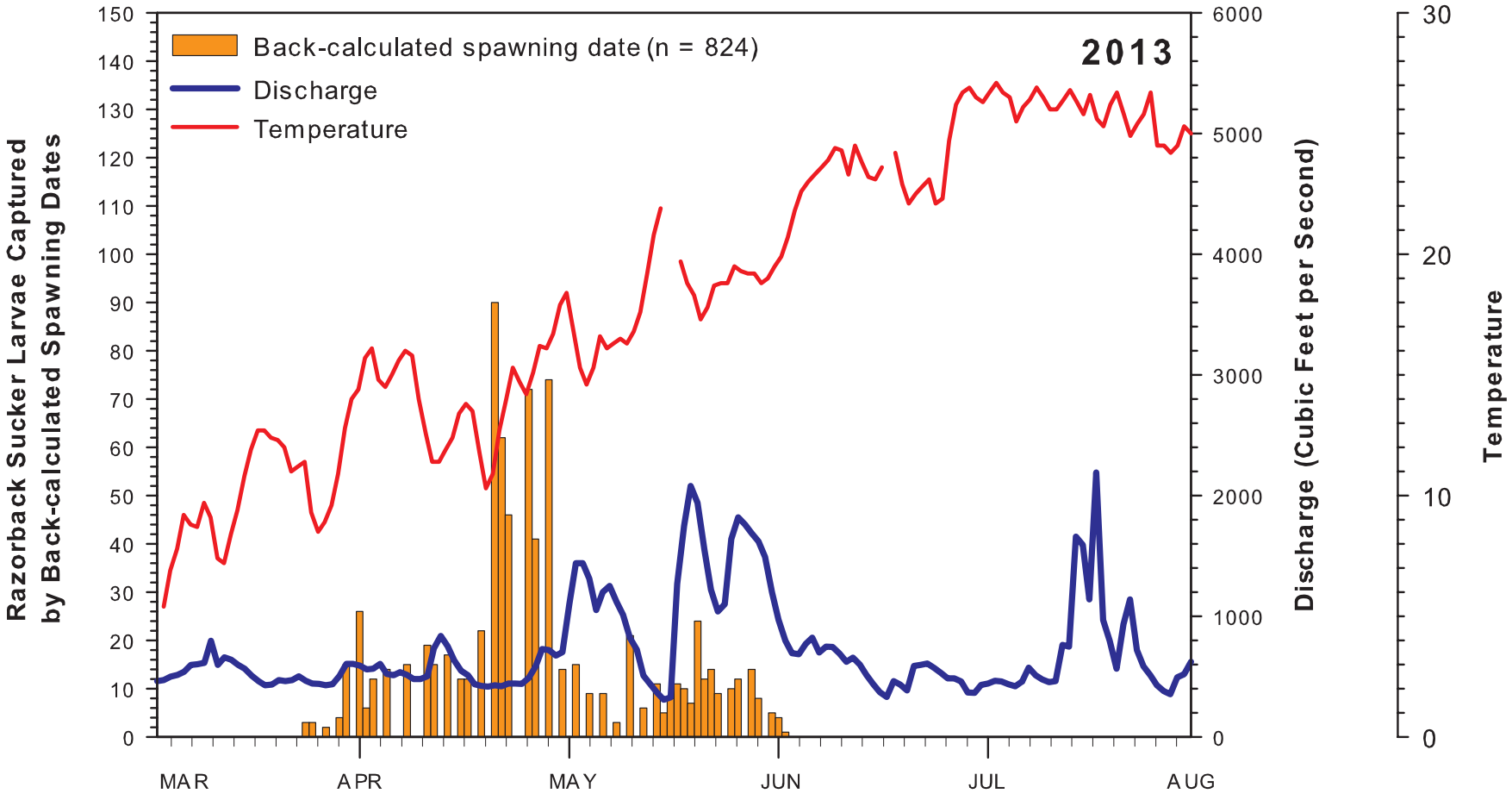
Back-calculated spawning dates for 2011



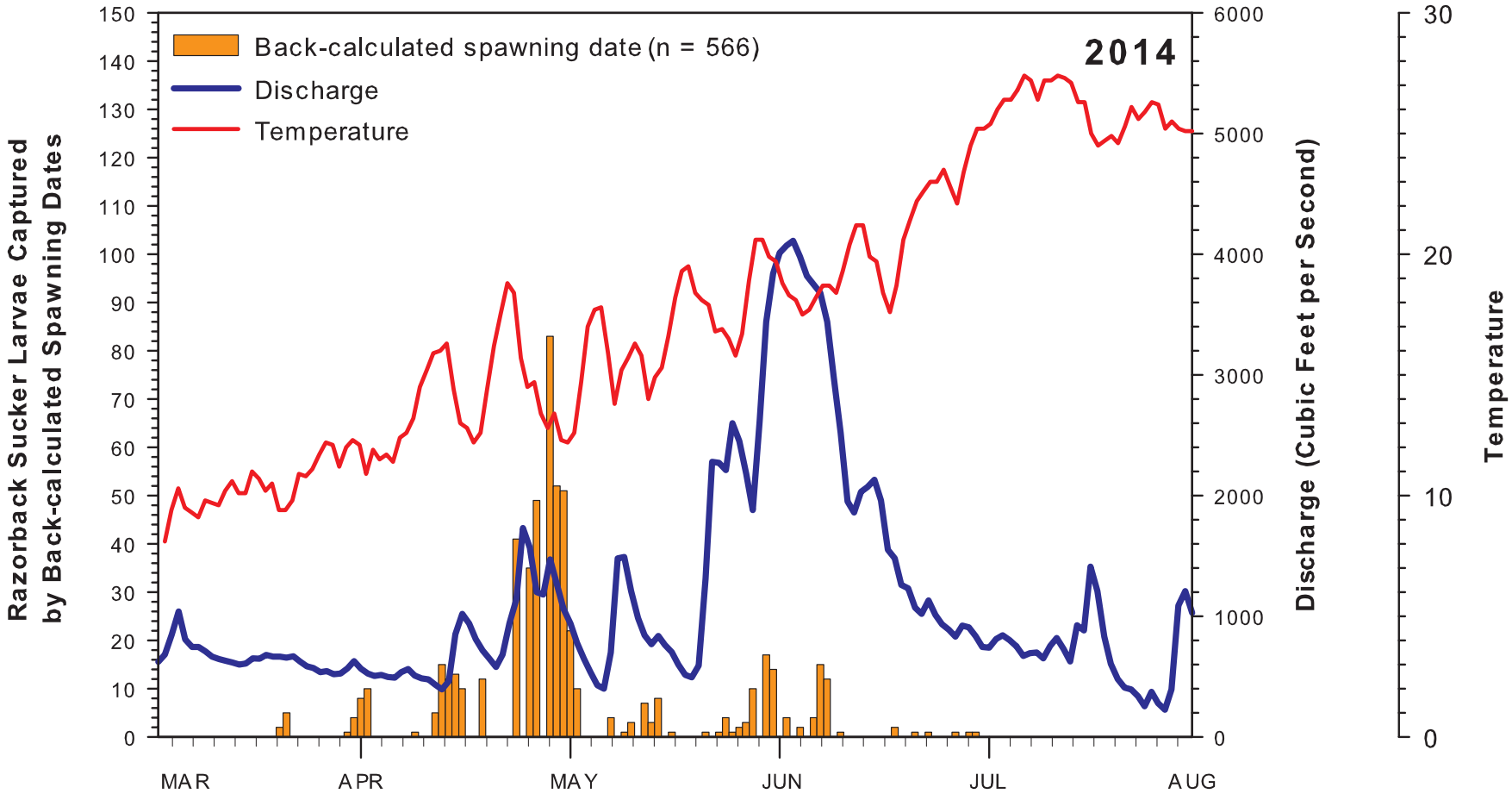
Back-calculated spawning dates for 2012

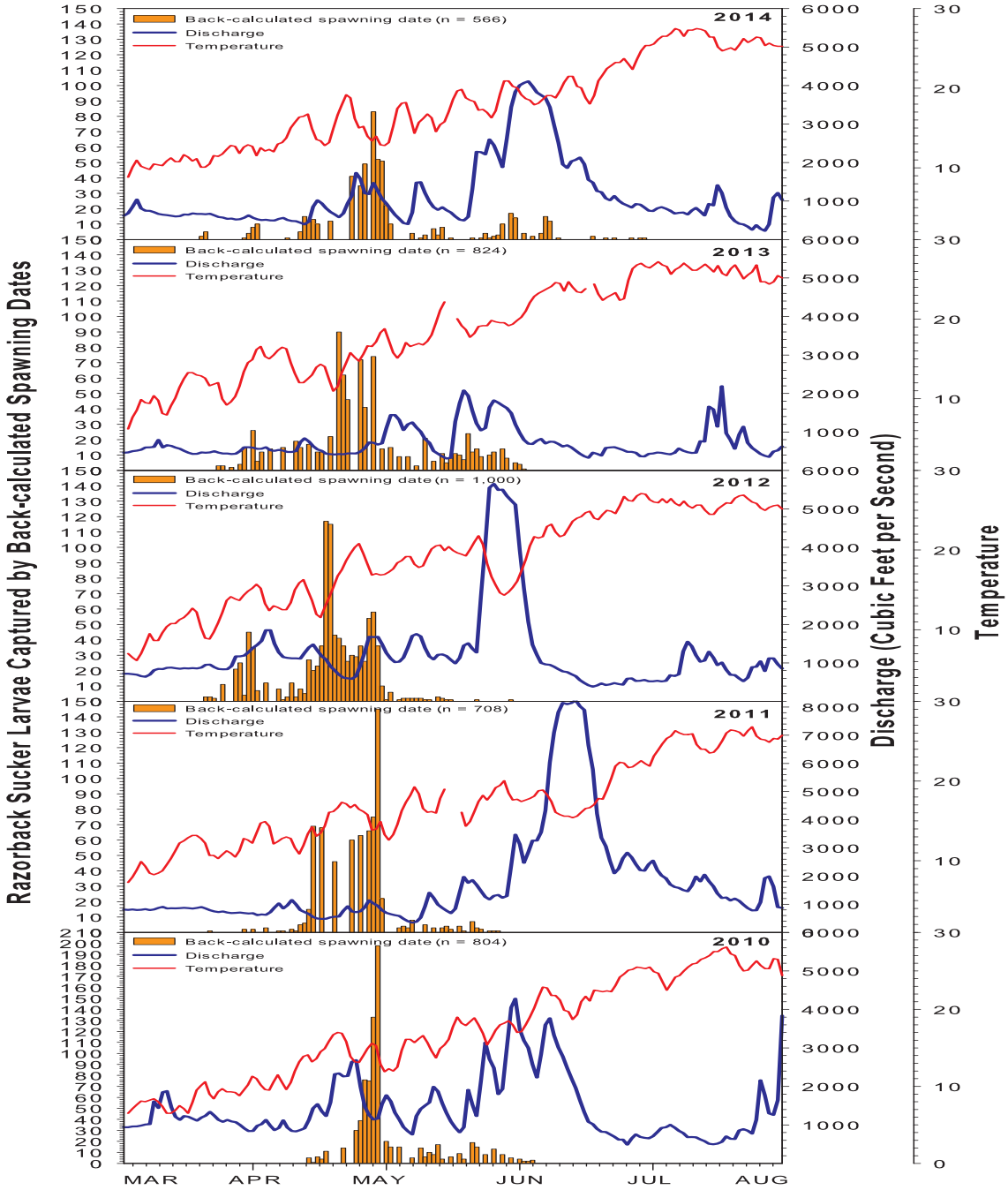


Back-calculated spawning dates for 2013



Back-calculated spawning dates for 2014

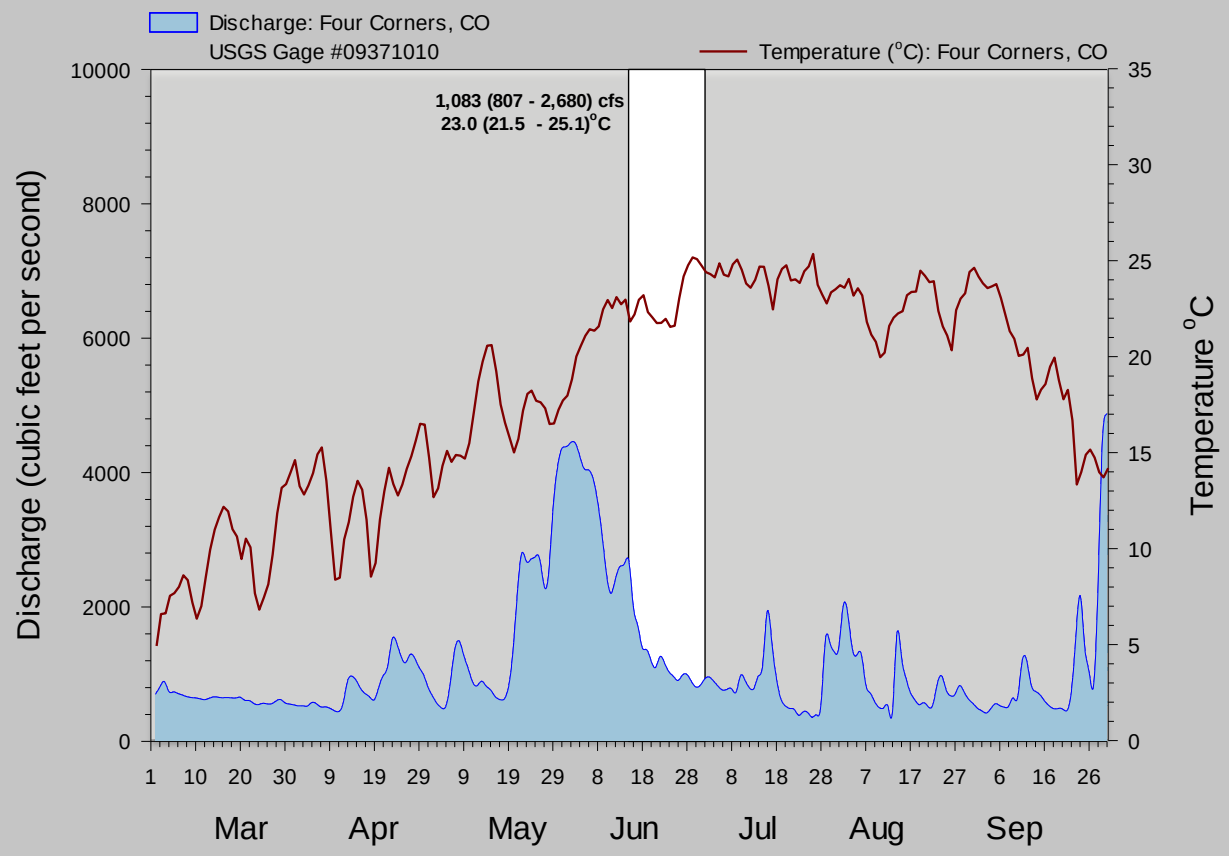
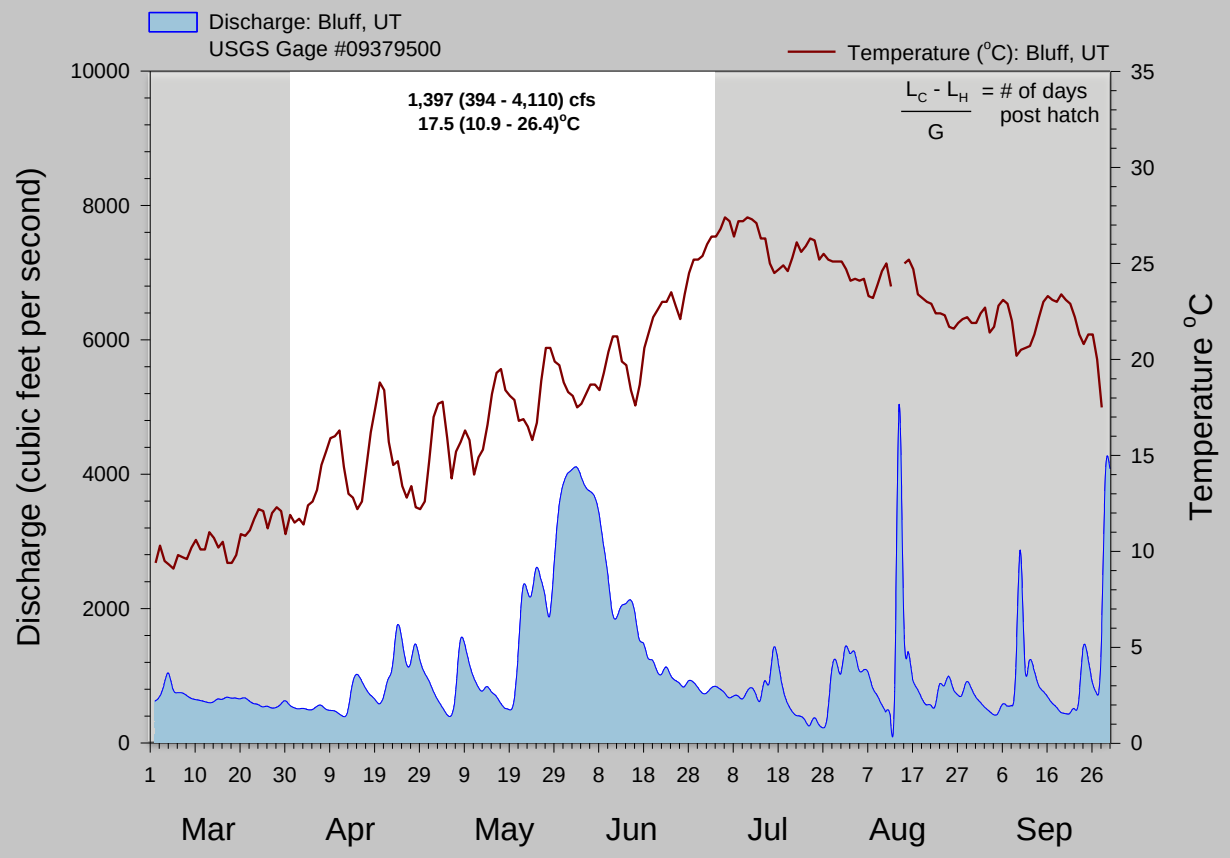



Razorback Sucker Larvae Captured by Back-calculated Spawning Dates
Discharge (Cubic Feet per Second)
Temperature
2014
Back-calculated spawning date (n = 566)
Discharge
Temperature
2013
Back-calculated spawning date (n = 824)
Discharge
Temperature
2012
Back-calculated spawning date (n = 1,000)
Discharge
Temperature
2011
Back-calculated spawning date (n = 708)
Discharge
Temperature
2010
Back-calculated spawning date (n = 804)
Discharge
Temperature
MAR
APR
MAY
JUN
JUL
AUG

General linear models of Colorado Pikeminnow mixture-model estimates Delta(δ) and Mu(μ)

Model	K	AIC_C	Weight AIC_C
δ(Year) μ(Monitor 450+mm TL)	16	414.61	0.491
δ(Year) μ(Monitor 300-449 mm TL)	16	416.82	0.163
δ(Year) μ(.)	14	417.46	0.118
δ(Year) μ(June flow)	**16**	**419.06**	**0.053**
δ(Year) μ(July temp.+random)	17	419.57	0.041
δ(Year) μ(June flow+random)	**17**	**419.71**	**0.038**
δ(Year) μ(Monitor 450+mm TL+random)	17	419.87	0.035
δ(Year) μ(Monitor 300-449 mm TL+random)	17	419.92	0.034
δ(Year) μ(July temp.)	16	420.60	0.025
δ(Monitor 450+mm TL+random) μ(Monitor 450+mm TL+random)	9	427.76	0.001

Back-calculated spawning dates
of larval Colorado Pikeminnow. 15 June - 2 July (18d)



Back-calculated hatching dates
of larval Razorback Sucker. 31 March – 4 July (96d)