Thermal Mitigation Experience Summers 2019 to 2020

For RFAC

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Disclaimers

This presentation represents my own views and analysis. Although I am a member of SEF, this is not a SEF report.

My purpose is to provide RFAC with an overview of how the FFMP 2017's Thermal Mitigation Program preformed in the summers of 2019 and 2020. This analysis uses daily data on temperatures, releases and discharges.

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I. Introduction and Background

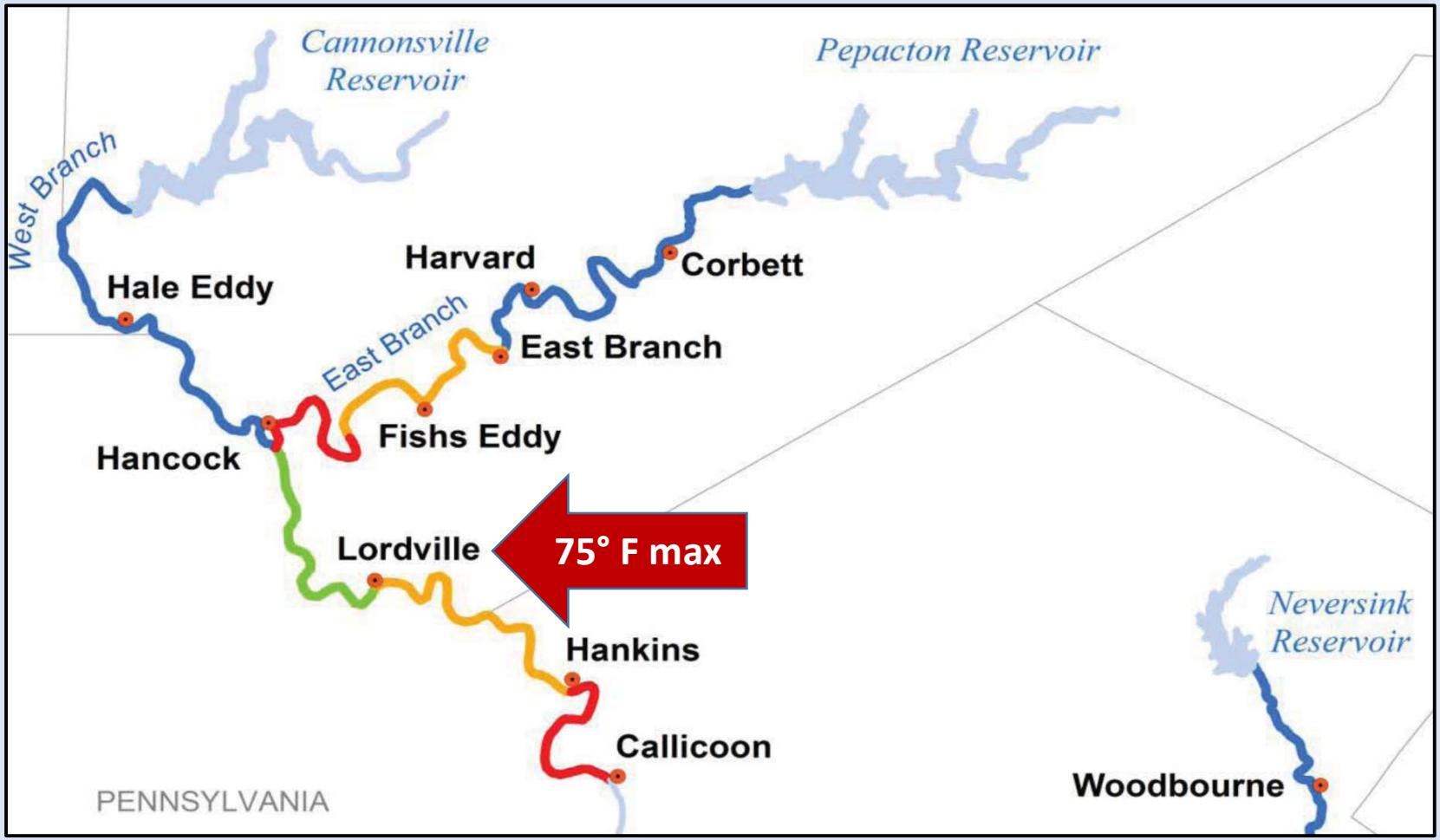
A Few Opening Observations

- It has at times been difficult to reconcile data available trough the ODRM, NYC-DEP, and USGS Gages.
- Research and monitoring of thermal releases and other FFMP polices is very dependent on the accuracy of the USGS Stilesville gage.
- Since there is a 12-hour, not a 24-hour time lag between Cannonsville and Lordville, more detailed analyses are possible and appropriate. I show one example

Thermal Mitigation Under FFMP 2017

- A thermal mitigation bank of 2,500 cfs days of water is included in FFMP 2017. The current objective is to keep summertime daily maximum temperatures at Lordville below 75 °F via timed pulses of cold water from Cannonsville when it is anticipated that temperatures there would otherwise exceed the 75 °F limit.
- The bank size is set to 2,500 cfs days on June 1, the start of the FFMP water year, and expires on May 31 of the following calendar year.
- The use of the bank is at the discretion of NYS-DEC.
- The DRBC's Subcommittee on Ecological Flows (SEF) has offered guidelines on protocols and use of the thermal bank.
- Other thermal metrics, e.g. two successive days at the 75°F max, a 68°F daily max, or a 72°F daily average have been considered by SEF and NYS-DEC, and may be addressed in the future.

The Focus: Mitigating Thermal Stress From Hancock to Lordville via Pulsed Releases from Cannonsville. Keep maximum river temperature below 75° F.



Source: Joint Fisheries White Paper, January 2010

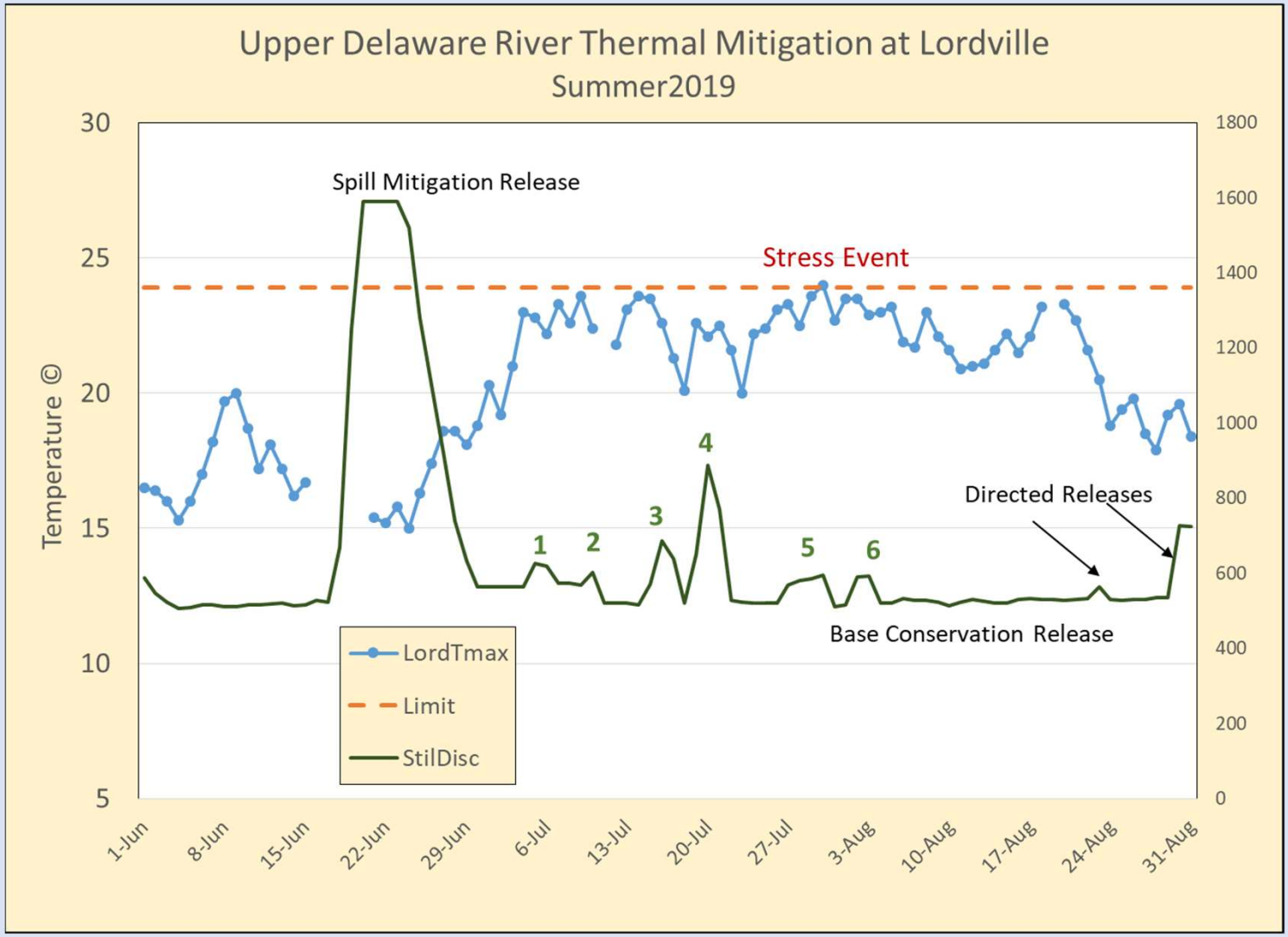
ll. Thermal Mitigation Experience Summer 2019

Thermal Mitigation Experience: Summer 2019

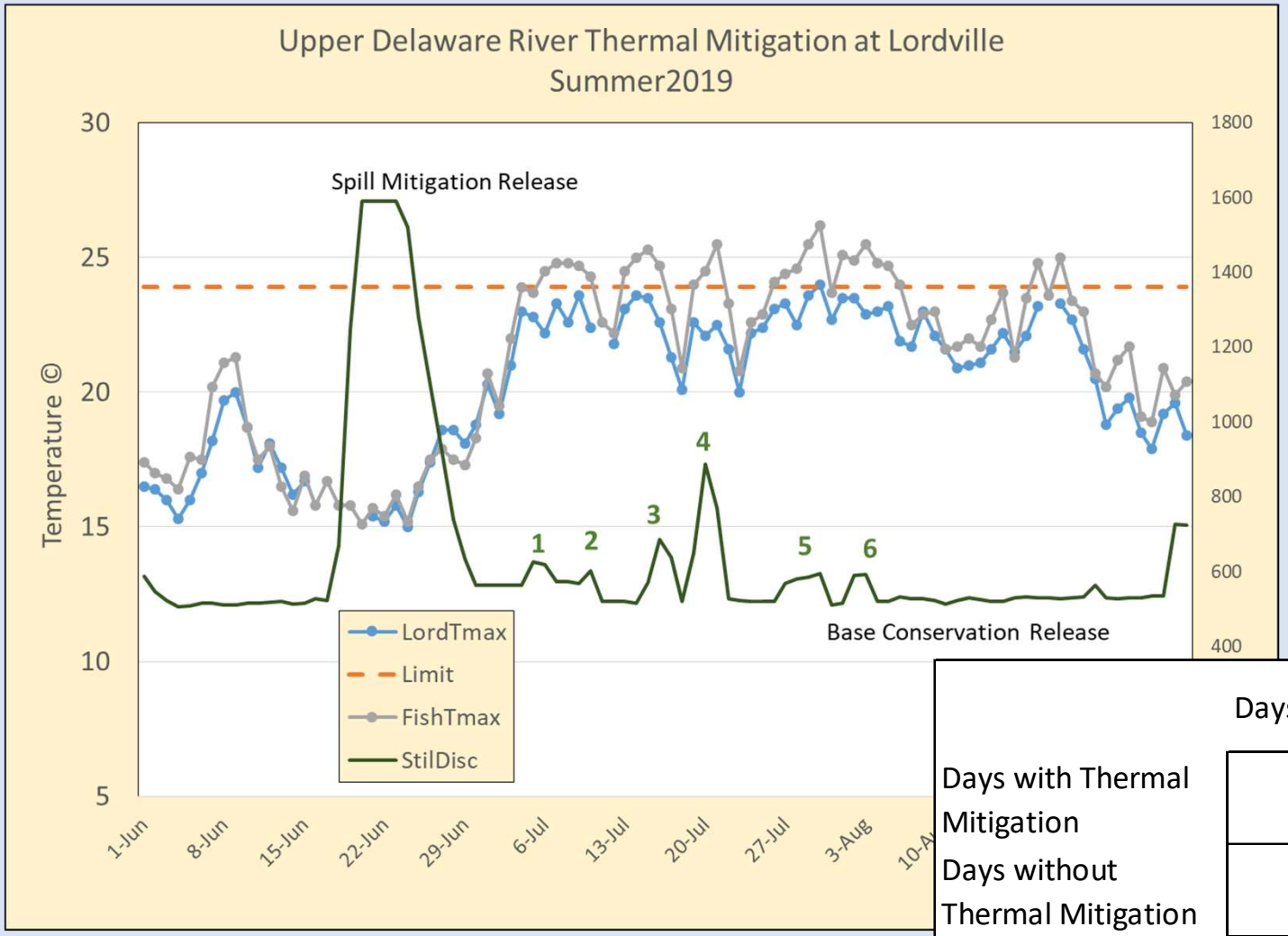
- 9 thermal relief requests were made by NYS-DEC and thermal releases were made over 17 days, using about 1,500 cfs-days of water. I grouped the releases into 6 thermal episodes.
- Lordville temperatures were kept below the 75°F stress threshold except on one day (75.2°F on July 30.)
- Using my regression-based calibration of the impact of Cannonsville releases on Lordville temperatures*, I estimate that had the thermal releases not been made, Lordville temperatures would have exceeded the 75 °F limit on two to four additional days, and the temperature on July 30 would have been about 0.2°F higher.

* Reported to RFAC via SEF, June 2019

Thermal Mitigation Experience: Summer 2019

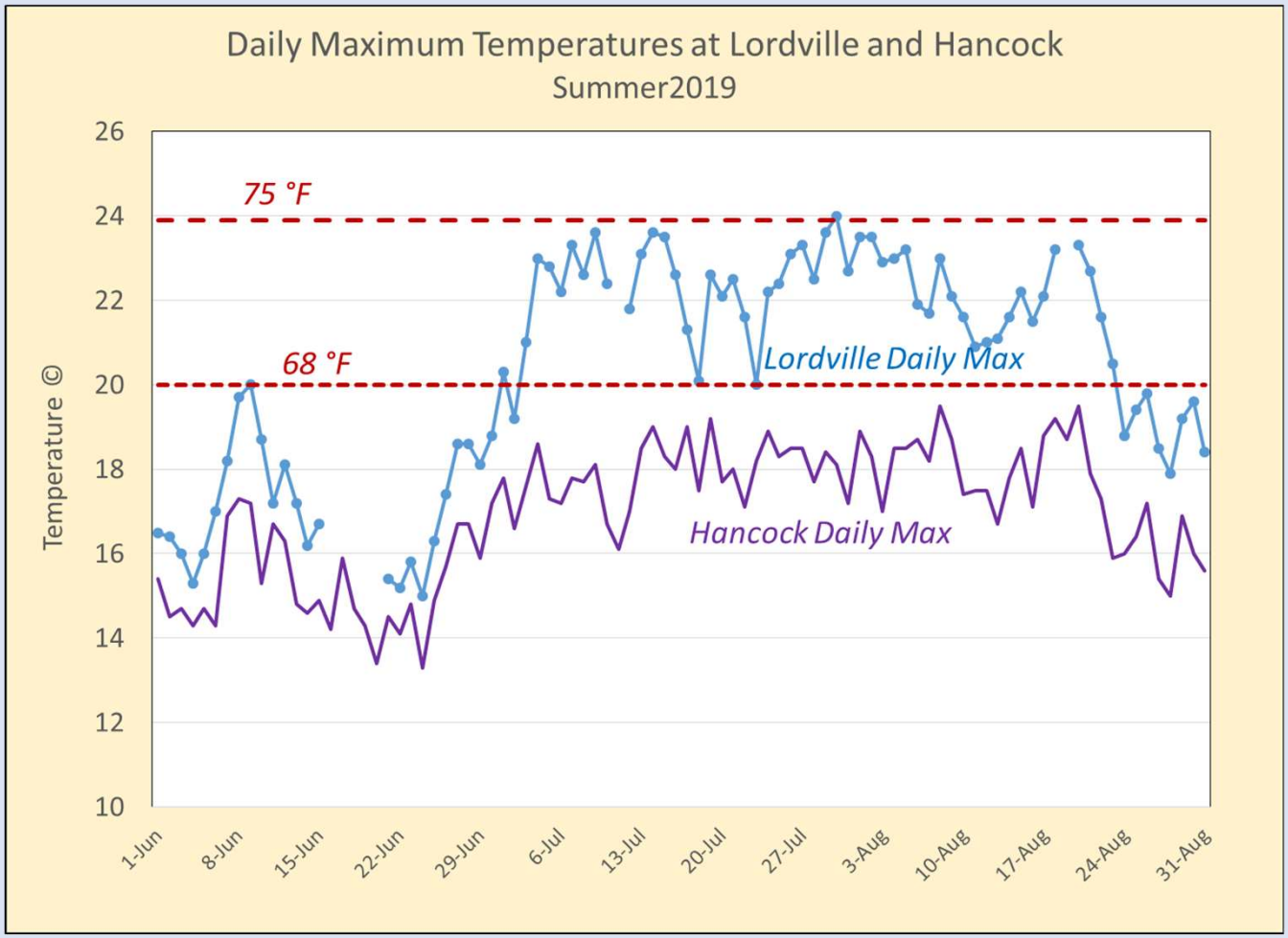


Comparing Lordville and Fishs Eddy: Summer 2019



	Days	Fishs - Lord Difference C
Days with Thermal Mitigation	17	1.77
Days without Thermal Mitigation	67	0.74
Mitigation Gain		1.03

Thermal Protection in the Hancock to Lordville Reach: Summer 2019



Keeping Lordville below 75°F, kept Hancock below 68 °F,

lll. Thermal Mitigation Experience Summer 2020

Thermal Mitigation Experience: Summer 2020

- 22 thermal relief requests were made by NYS-DEC. Thermal releases were made on 34 days using about 2,350 cfs days of water. I grouped the releases into 6 thermal episodes.

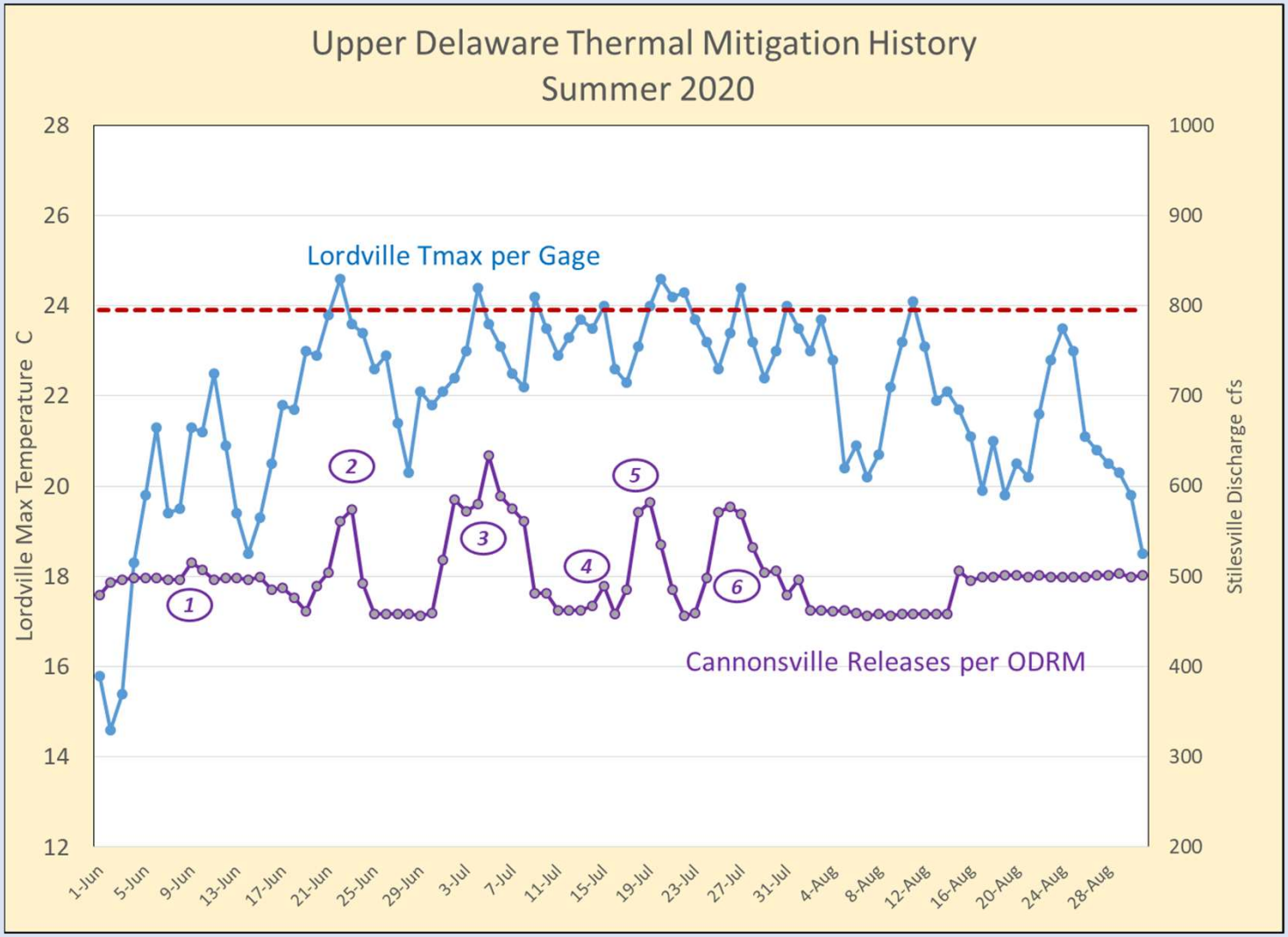
- Despite the releases, the 75°F limit was exceeded (slightly) on 11 days. The highest temperature was 76.3°F on July 20.

- Had the thermal releases not been made, I estimate that Lordville temperatures would have exceeded the thermal limit on 15 days and by bigger amounts --8.0 vs 3.9 stress degree-days.

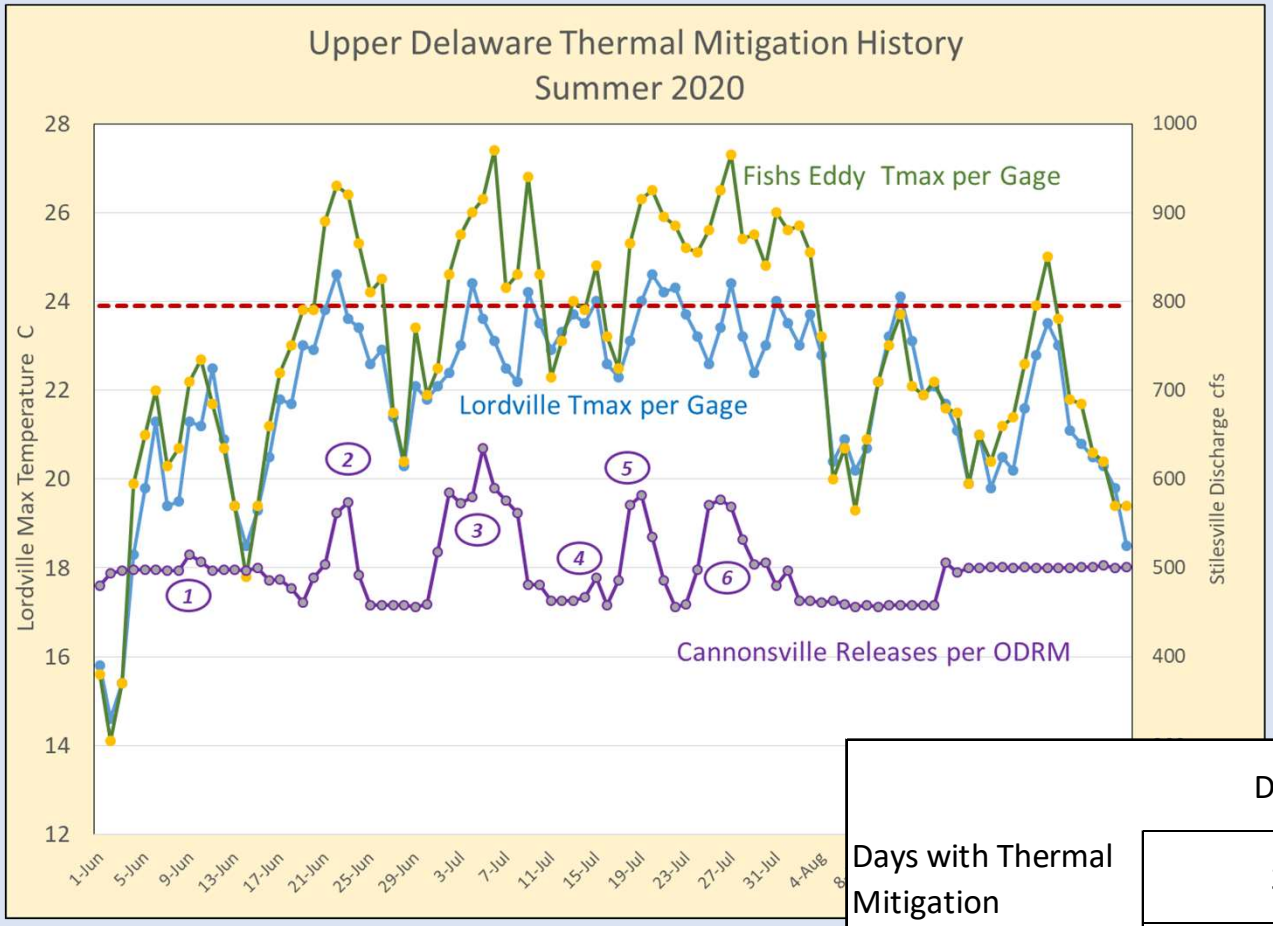
- Directed releases were made on two of the 11 stress days

- "Monday Morning Quarterbacking": With perfect forecasting, the 11 stress days experienced could have been avoided by making higher releases on those days. I estimate it would have taken about an additional 760 cfs-days of water to do this, a total of 3,110, exceeding the bank size of 2,500.

Thermal Mitigation Experience: Summer 2020

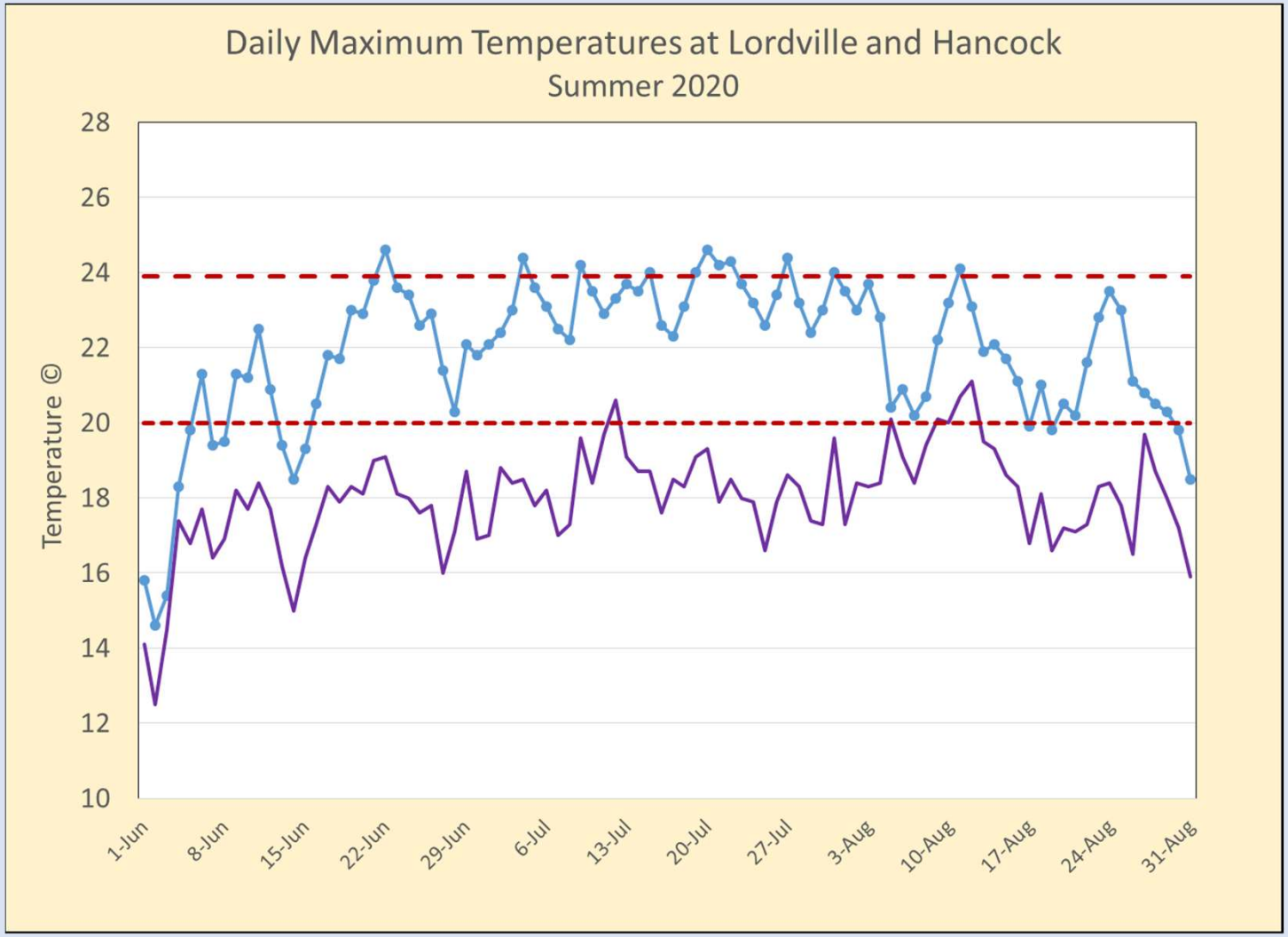


Comparing Lordville and Fishs Eddy: Summer 2020



	Days	Fishs - Lord Difference C
Days with Thermal Mitigation	34	1.92
Days without Thermal Mitigation	54	0.47
Mitigation Gain		1.45

Protection in the Hancock to Lordville Reach: Summer 2020



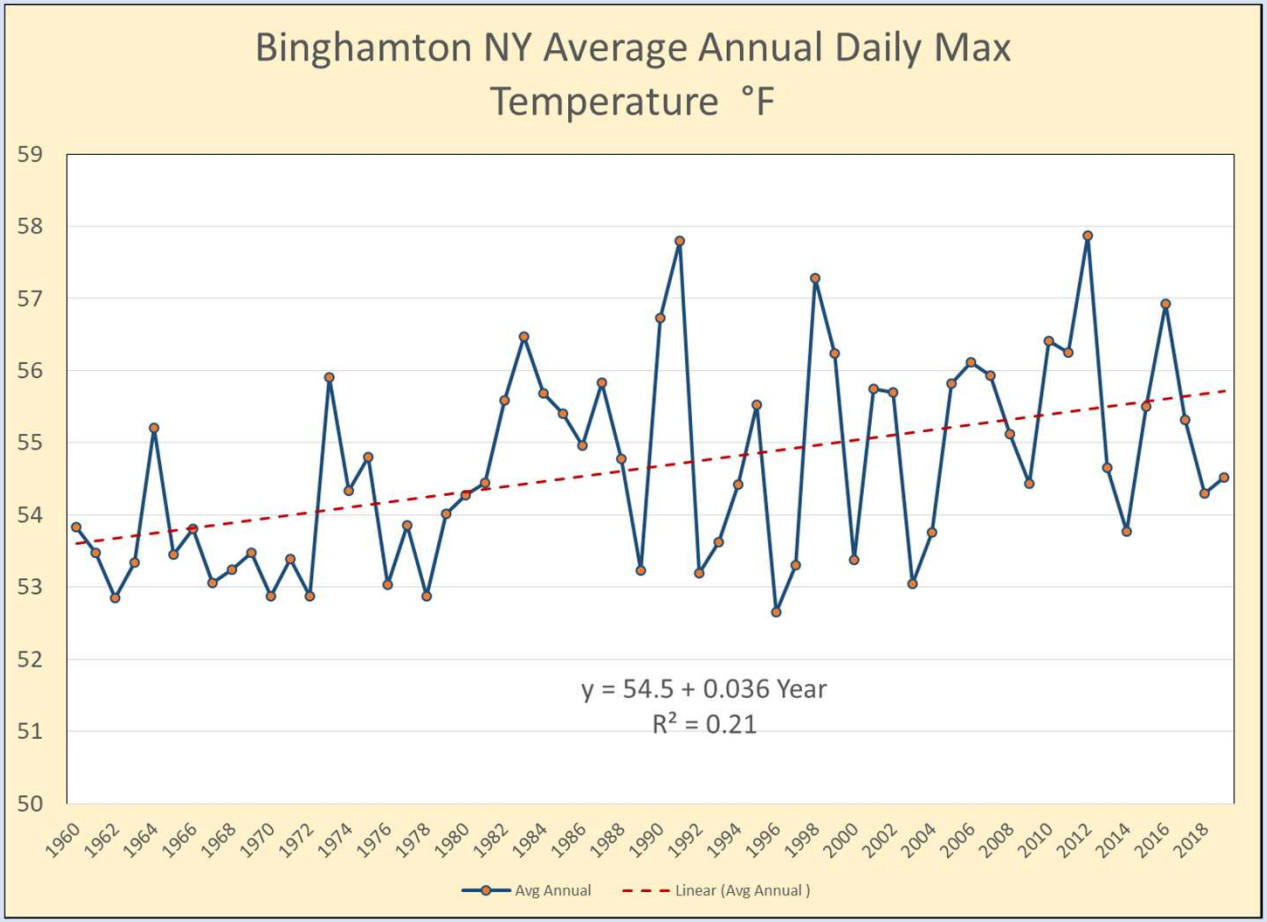
lV. Weather Effects and Trends

Weather as a driver of thermal stress:
(Binghamton Air Temperatures)

	Average Daily Maximum Temperature				Count of Days Over 80 F			
	Jun	Jul	Aug	Summer	Jun	Jul	Aug	Summer
2019	72.3	80.9	76.0	76.4	4	20	10	11.3
2020	75.6	**82.9**	78.9	79.1	11	**26**	17	18.0
Prior 20 Year Average	74.1	78.6	76.8	76.5	7.5	13.7	10.5	10.5

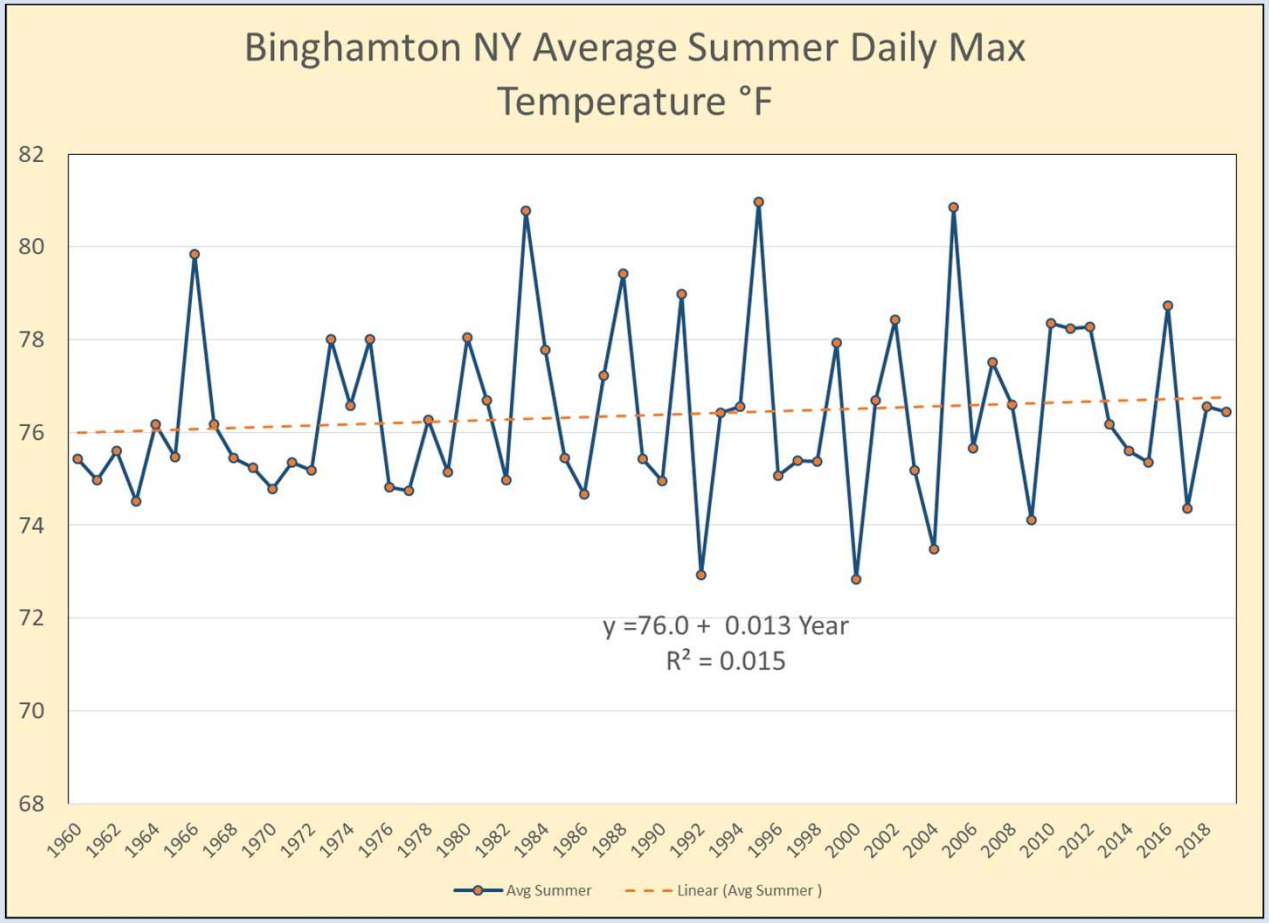
In the summer of 2019, the upper Delaware experienced essentially 'normal' air temperatures, while in 2020 temperatures were abnormally high.

Trend in Annual Average Daily Maximum Temperatures at Binghamton



About a 2°F increase over 60 years

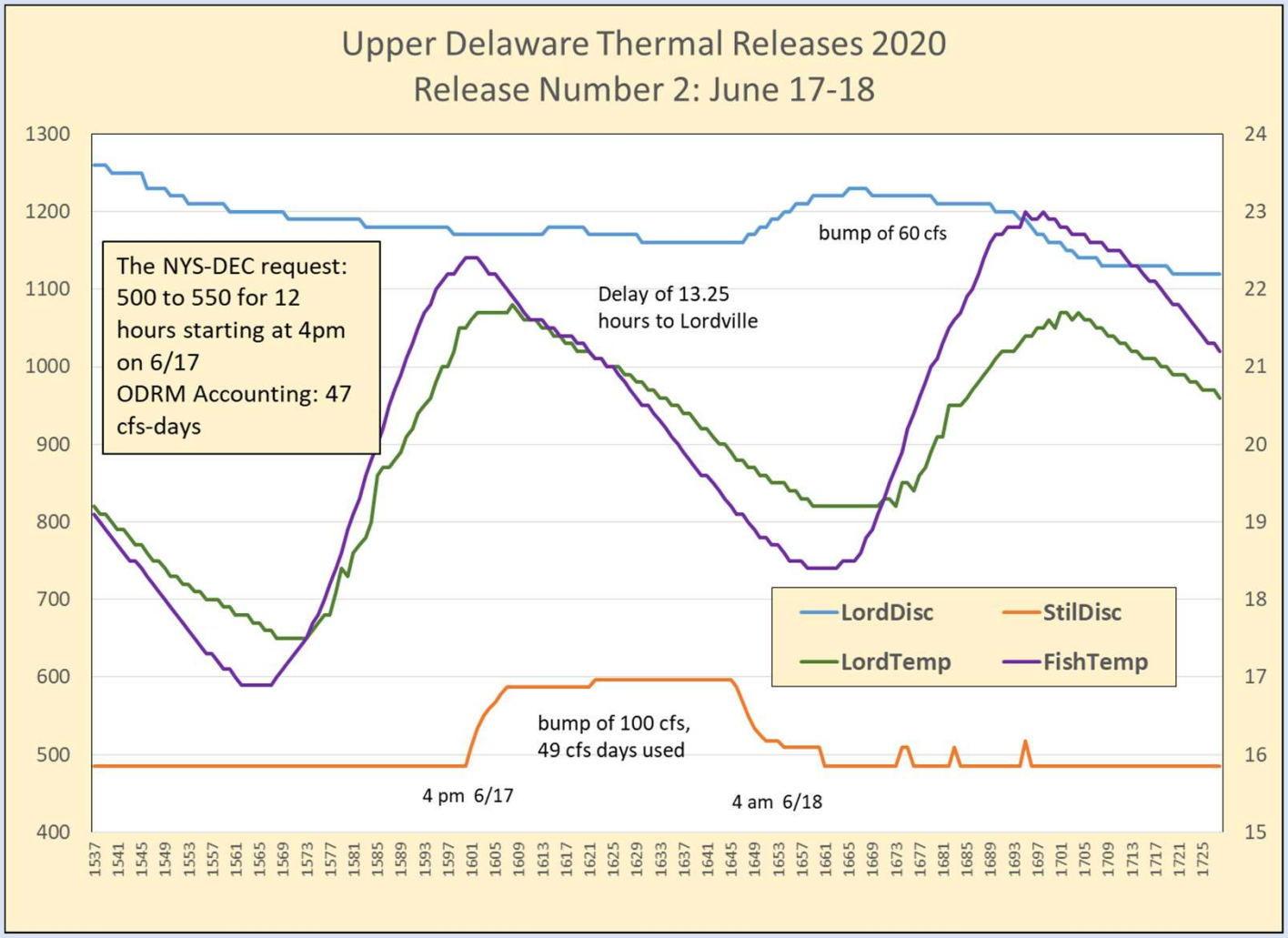
Trend in Summer Average Daily Maximum Temperatures at Binghamton



Summer = June, July, August

Summer temperatures have not increased as much as annual temperatures: About a 0.8°F increase over 60 years

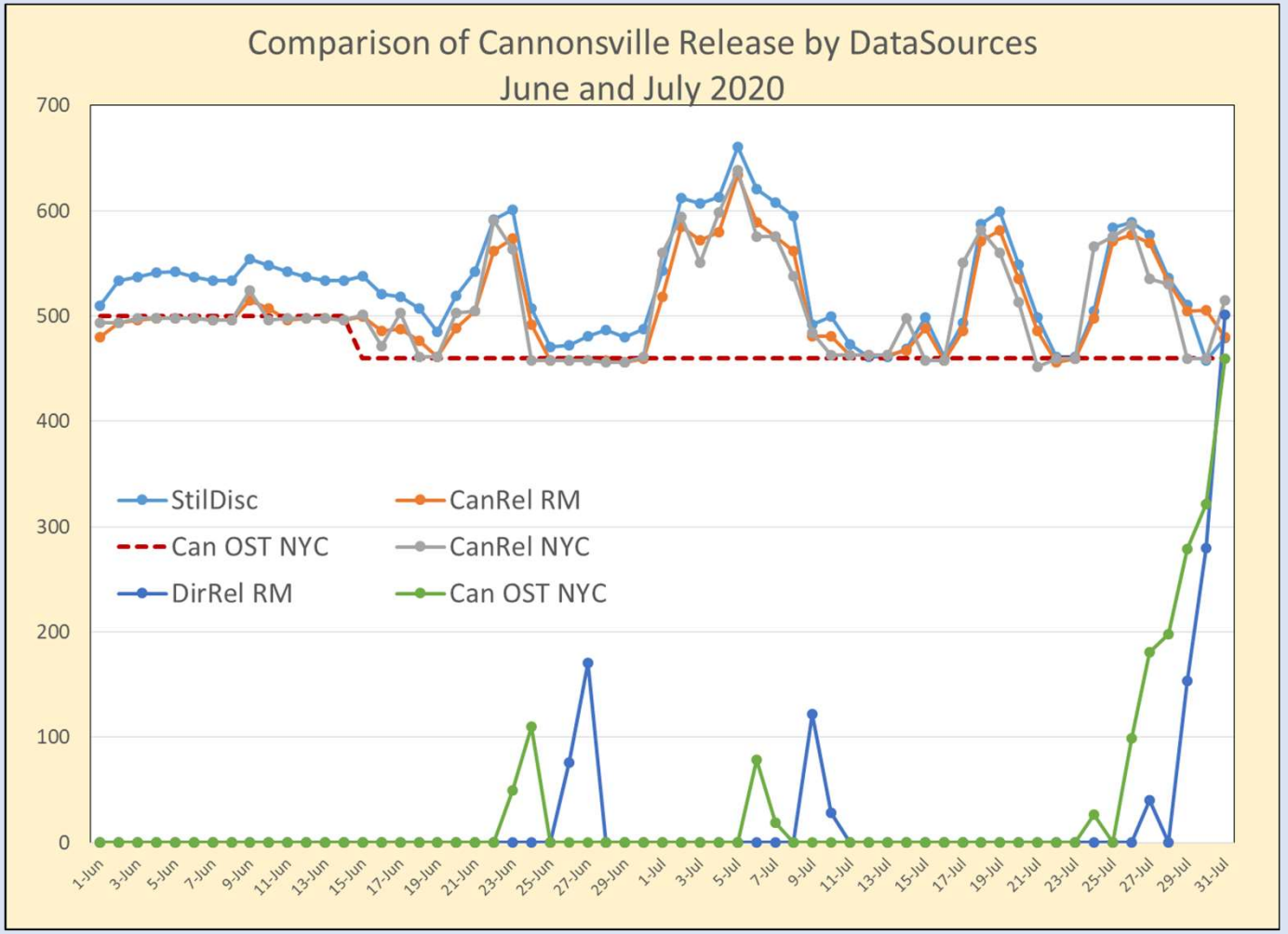
The Details on One Thermal Release: What actually happens.



Additional Research Suggested by/for SEF

- Evaluate the ability of the Thermal Mitigation Bank to prevent the average water temperatures at Lordville from exceeding 72˚F over a 24-hour period. Such criteria were included in earlier release policies, and short pulses from Cannonsville may not mitigate both metrics.
- Evaluate the adequacy of the size of the Thermal Mitigation Bank for protecting the upper main-stem Delaware River in a manner consistent with the goals identified in the FFMP.
- Develop and evaluate thermodynamic models of the impact of reservoir releases on downstream temperatures, as complementary to the current statistical probability model.
- Evaluate the impact, if any, of the thermal mitigation protocol on shad and warm water species such as smallmouth bass.
- Evaluate the feasibility of other more protective temperature triggers or targets such as a 68˚F daily maximum.

End
Questions


Comparison of Cannonsville Release by DataSources
June and July 2020
700
600
500
400
300
200
100
0
StilDisc
CanRel RM
Can OST NYC
CanRel NYC
DirRel RM
Can OST NYC
1-Jun
3-Jun
5-Jun
7-Jun
9-Jun
11-Jun
13-Jun
15-Jun
17-Jun
19-Jun
21-Jun
23-Jun
25-Jun
27-Jun
29-Jun
1-Jul
3-Jul
5-Jul
7-Jul
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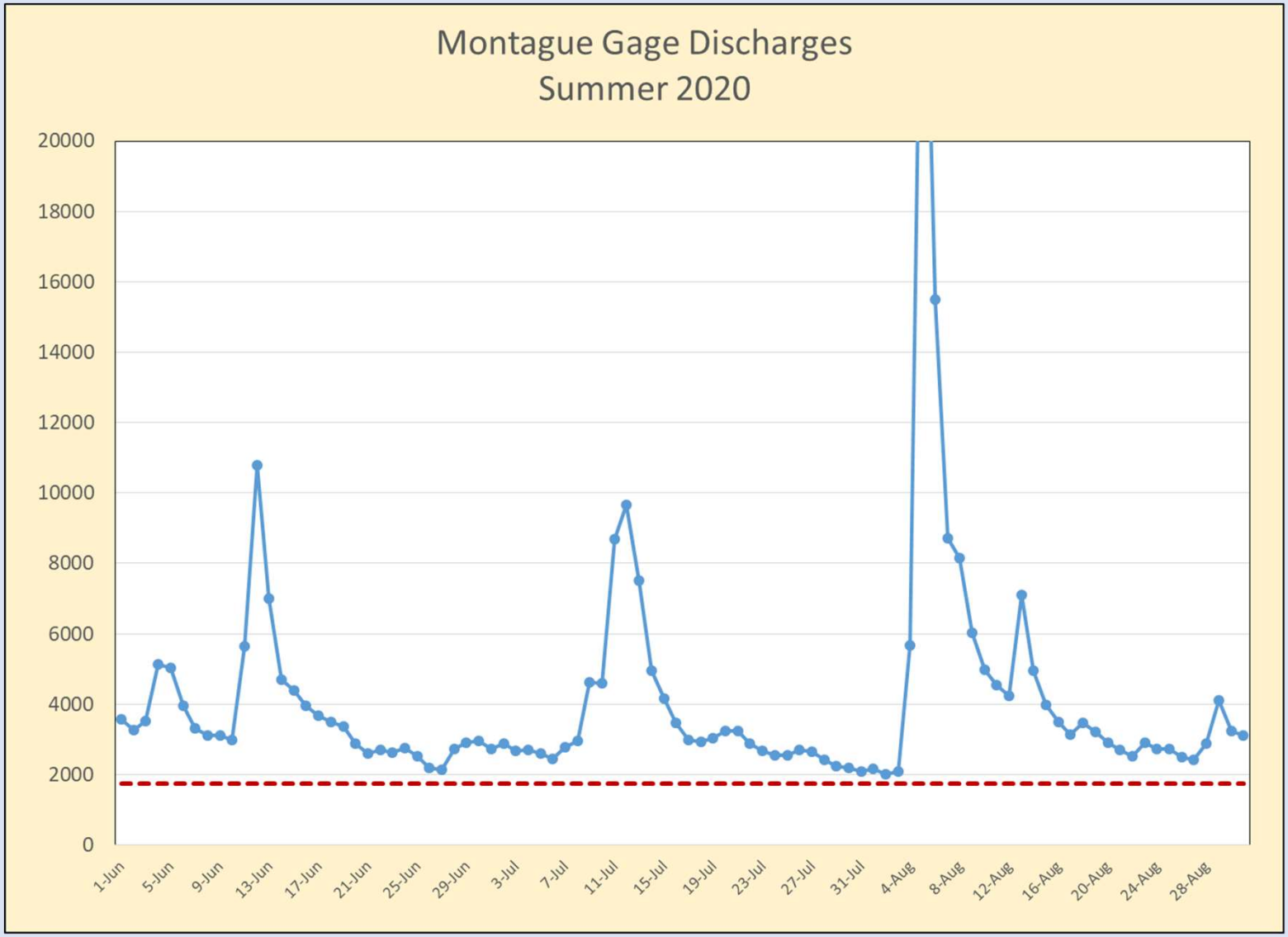
23-Jul
25-Jul
27-Jul
29-Jul
31-Jul


Montague Gage Discharges
Summer 2020
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1-Jun
5-Jun
9-Jun
13-Jun
17-Jun
21-Jun
25-Jun
29-Jun
3-Jul
7-Jul
11-Jul
15-Jul
19-Jul
23-Jul
27-Jul
31-Jul
4-Aug
8-Aug
12-Aug
16-Aug
20-Aug
24-Aug
28-Aug

The Need for Thermal Mitigation: A Decade of Struggle

- The releases of previous release policies (Rev 1, Rev 7, etc.) and of the FFMP up to 2017 were inadequate to protect the trout during summer heat waves. There were 59 “thermal stress” events between 2008 and 2012 alone –each provoking a crisis-like situation for the fishing community -- and hence for the decree parties to respond to.
- From the start of the FFMP in 2008 until 2018, before the thermal mitigation protocol was implemented, there have been at least 78 such stress days with one event lasting 12 days and with one day reaching 81.3˚F.
- Until FFMP 2017, the decree parties declined to include a thermal mitigation procedure into the FFMP – treating each impending thermal stress event in an ad hoc manner – if at all.
- Meanwhile, analyses at Columbia, at NYS-DEC and PA F&BC showed that thermal mitigation via calibrated pulses of cold water was feasible.