BASKING PATTERNS AND THERMAL REGULATORY BEHAVIORS OF WESTERN POND TURTLES (*CLEMMYS MARMORATA*): COMPARING RESPONSES TO THERMAL REGIMES IN DAMMED AND UNDAMMED TRIBUTARIES OF THE TRINITY RIVER

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Overview

- Background on Size Differences
- Methods
- Basking differences
- Conclusions

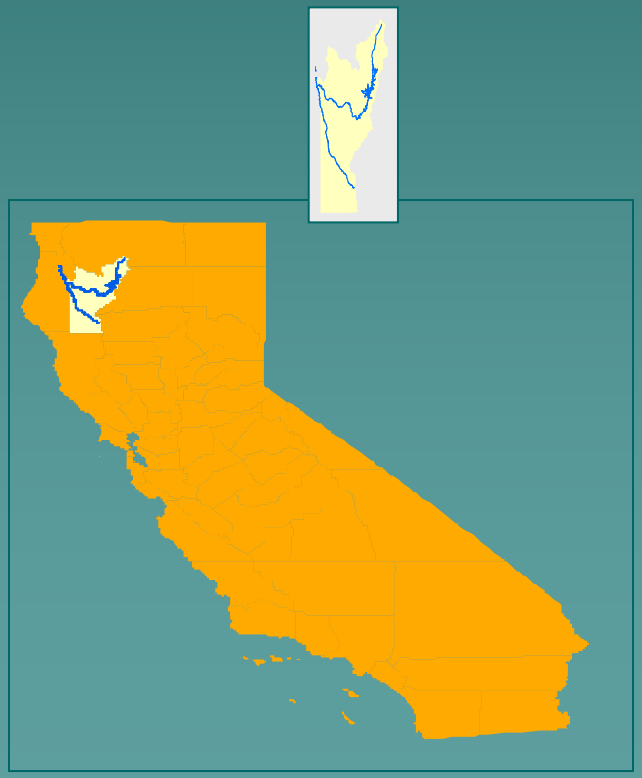
WHY TURTLES?

Long-lived Species

Year-round Residents

High Site Fidelity

Trinity River



- Mainstem Trinity River
  - Highly impacted by the dam
- South Fork Trinity
  - Undammed

THANKS JOSEE ROUSSEAU

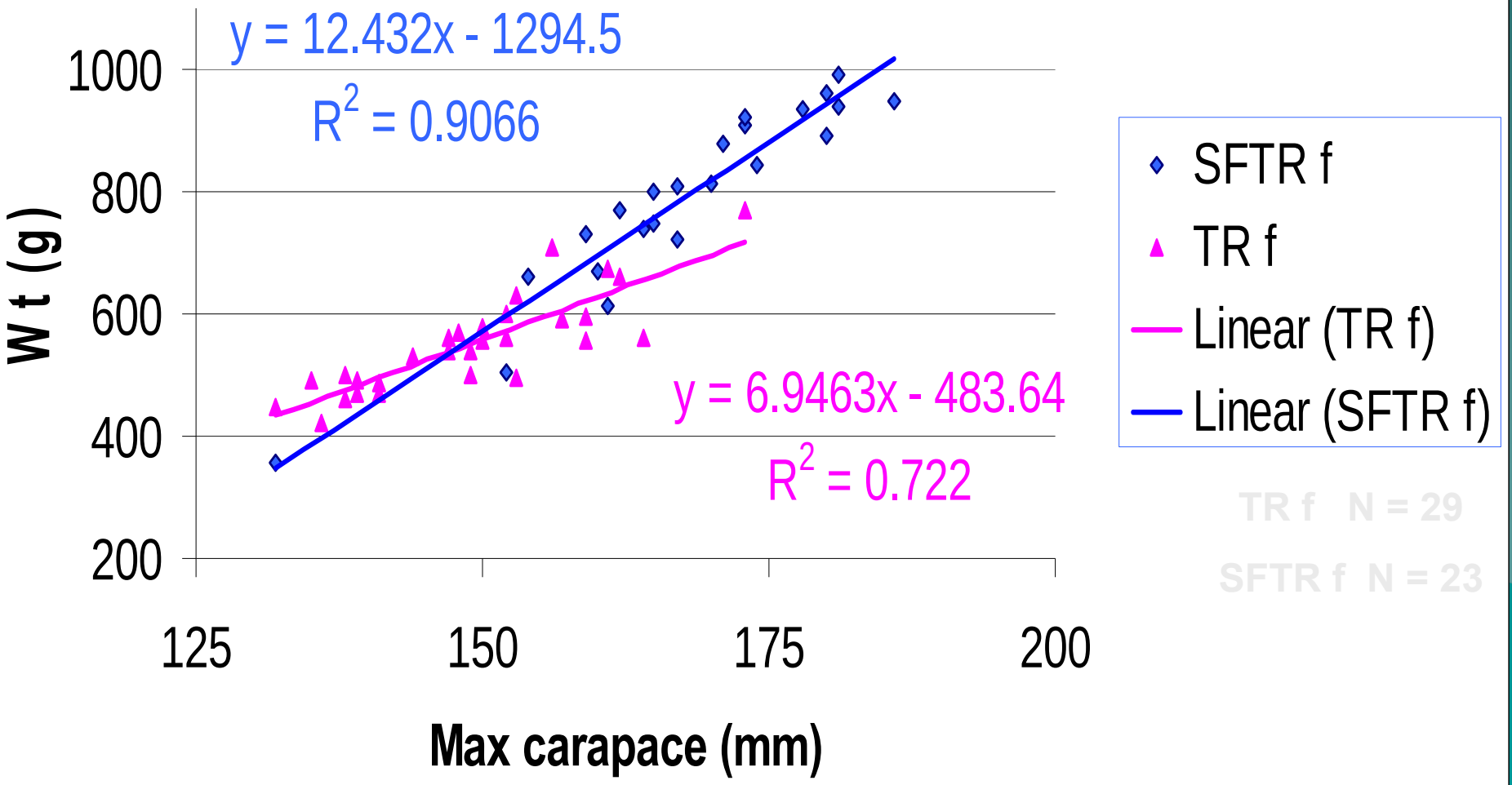
Results: Turtle 5023

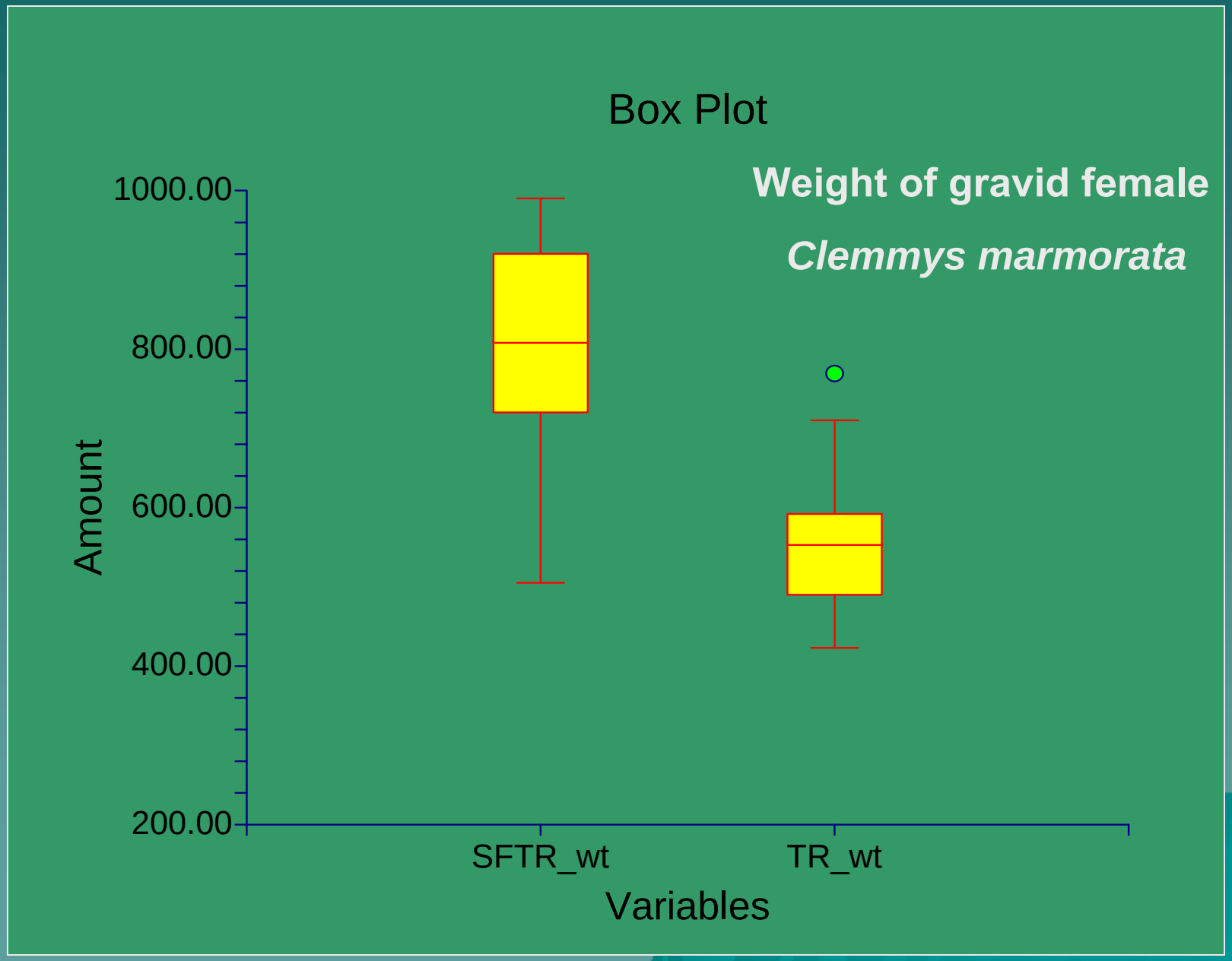
OBJECTID*	RiverID	LocAlongRv	Distance	Date	Mark	Sex	Age
46	1	85.107	-14.658722	8/30/2006	5023.000000	F	20
328	1	84.974000	15.210093	7/6/2006	5023.000000	F	20
387	1	85.026000	-11.137983	8/24/2005	5023.000000	F	0
403	1	85.059680	-12.751769	8/18/2005	5023.000000	F	20
509	1	85.026000	-11.137983	8/5/2005	5023.000000	F	20
563	1	85.006000	-12.889502	8/2/2005	5023.000000	F	20
809	1	85.111000	-7.860512	7/11/1991	5023.000000	F	0

Results: Turtle 5105

OBJECTID*	RiverID	LocAlongRv	Distance	Date	Mark	Sex	Age
163	1	86.141000	-11.182452	8/2/2006	5105	F	20
234	1	86.049	-5.768394	7/19/2006	5105	F	20
335	1	86.147000	-14.119377	7/5/2006	5105	F	99
660	1	86.037	-4.762354	7/21/2005	5105	F	99
530	1	86.071000	-4.425357	8/4/2005	5105	F	99
944	1	86.130000	-3.219640	7/18/1991	5105	F	0
945	1	86.086	-1.887393	5/24/1993	5105	F	99

Gravid females on Mainstem Trinity and South Fork Trinity River




Box Plot
Weight of gravid female
Clemmys marmorata
1000.00
800.00
600.00
400.00
200.00
Amount
SFTR_wt
TR_wt
Variables

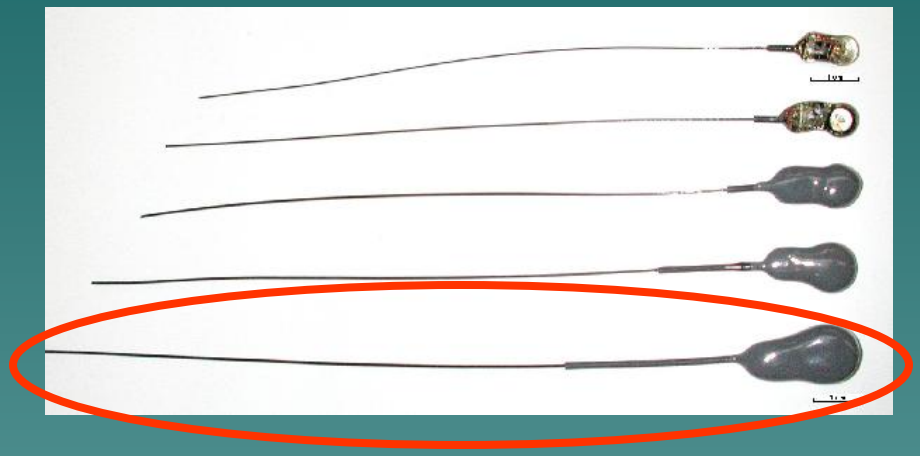
Methods: Snorkel Dives

Methods: Locate Turtles in Aquatic Environment

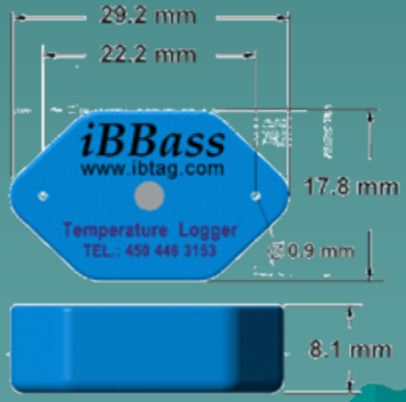
Methods: Attach Transmitters and iButton Temperature Loggers

Gear for the Year

- Holohil Systems Ltd.
- PD-2 transmitters
- Dry wt = 3.8 g
- 6 months
- *www.holohil.com*



- Alpha Mach Inc.
- iBass temp loggers
- Dry wt = 4.7 g
- Submerged wt= -1.0g
- 2048 datapoints collected
- *www.ibtag.com*



iBass Temp-logger Settings

Placement of iBass temp-loggers were on left posterio-lateral portion of the carapace

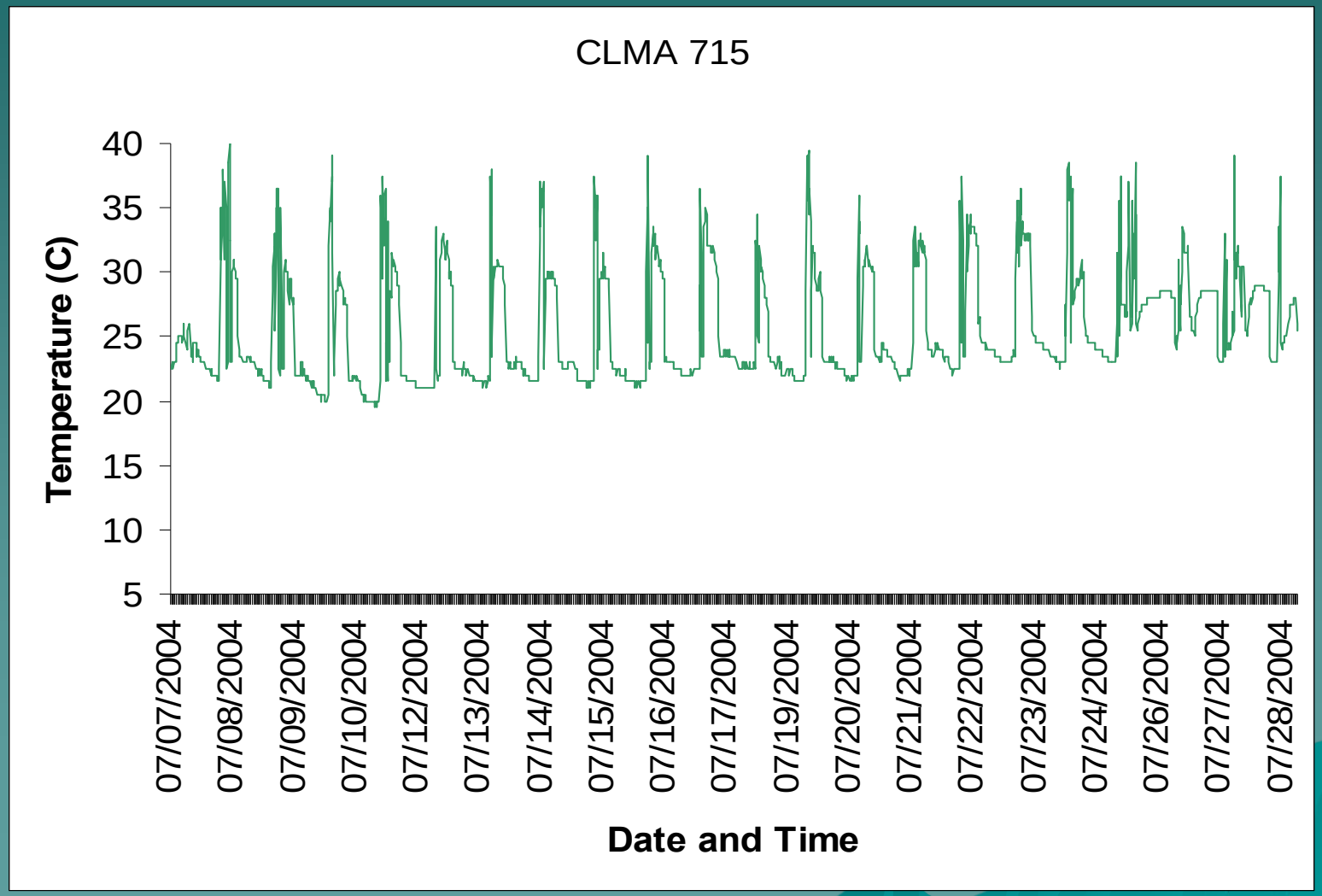
Recording were made every :15 minutes in 2004 and every hour in 2005

Data loggers ran for 21.7 days in 2004 and 85.3 days in 2005

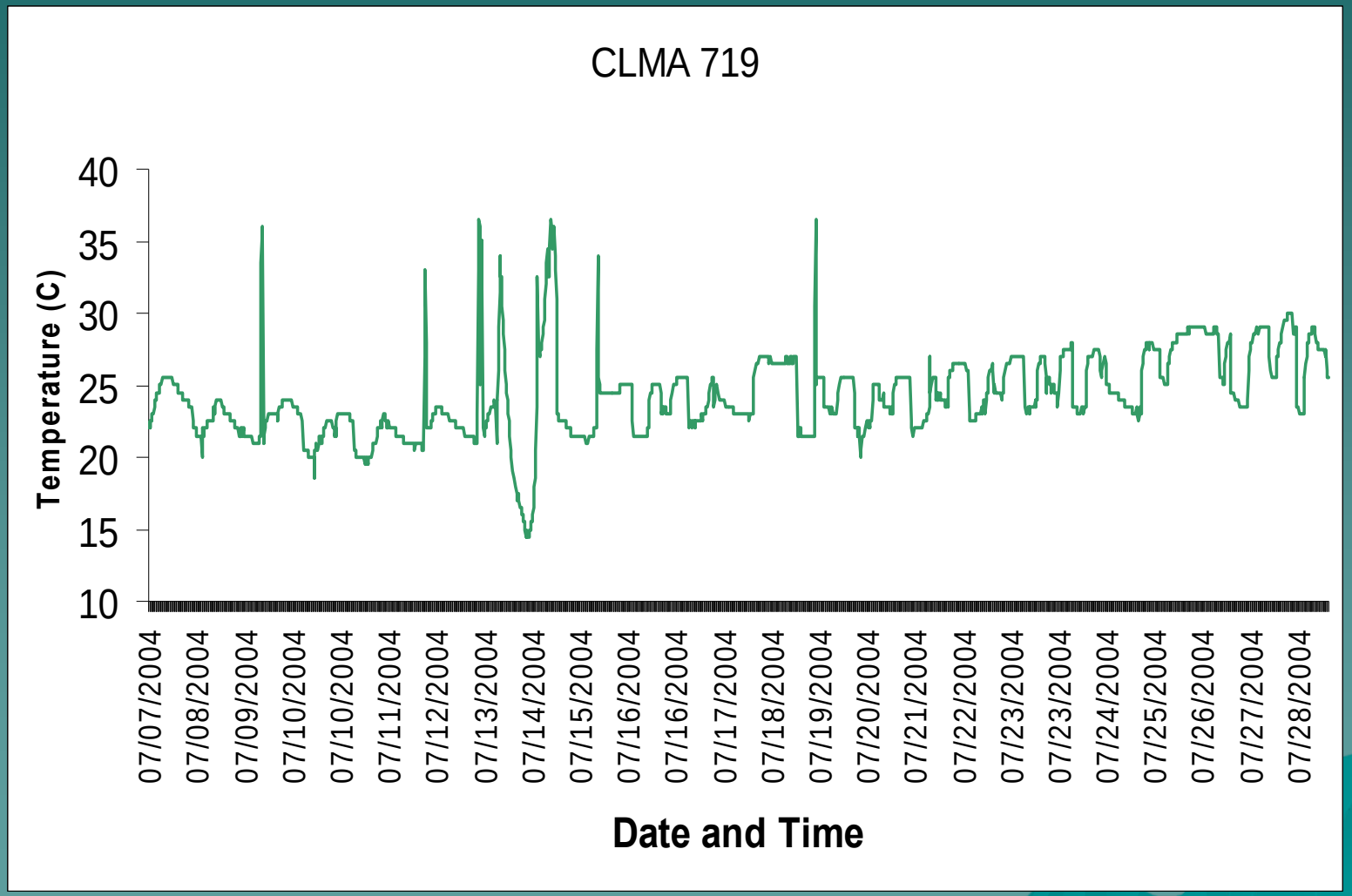
Radio-tracking to retrieve turtles

Basking differences

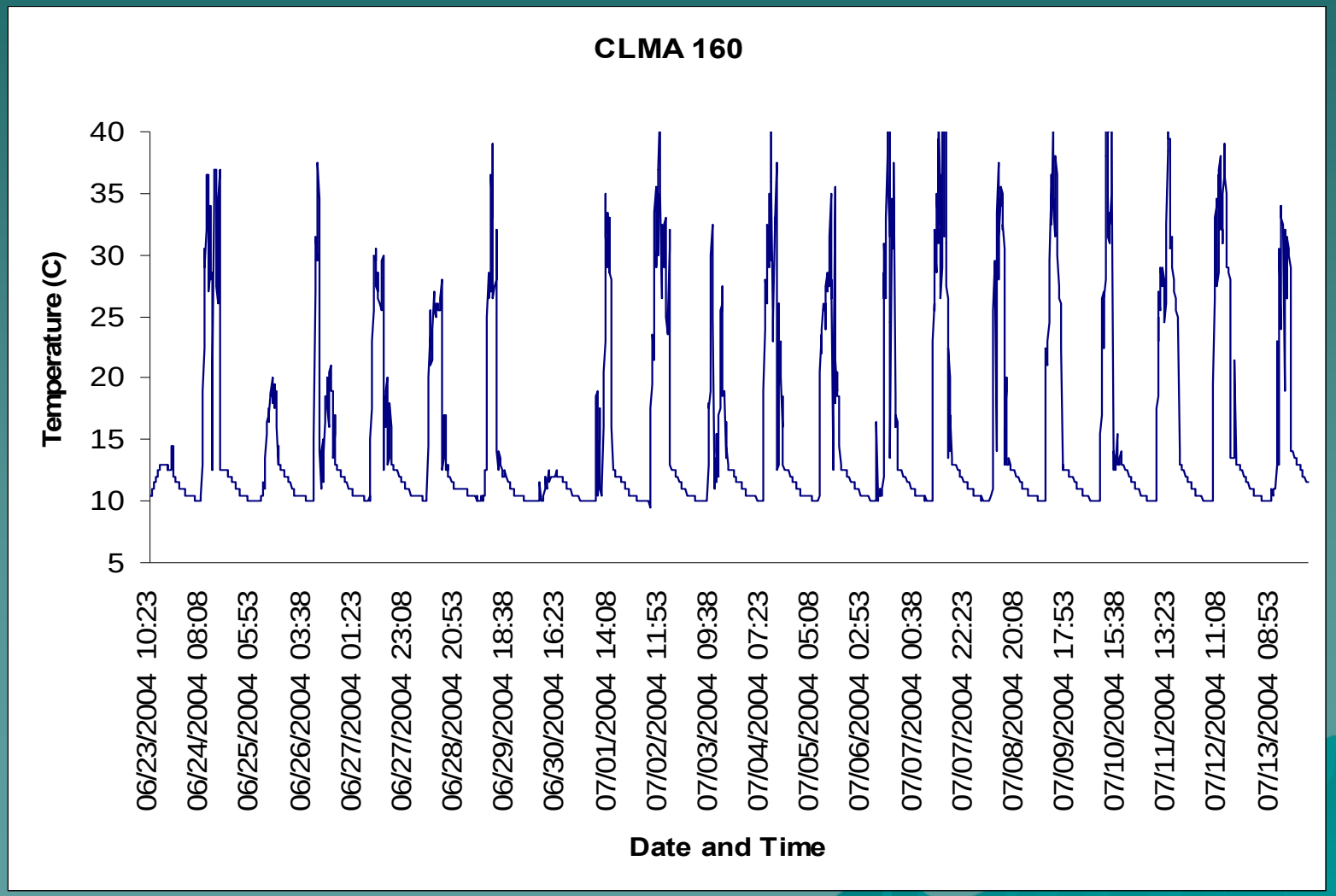
South Fork Trinity River

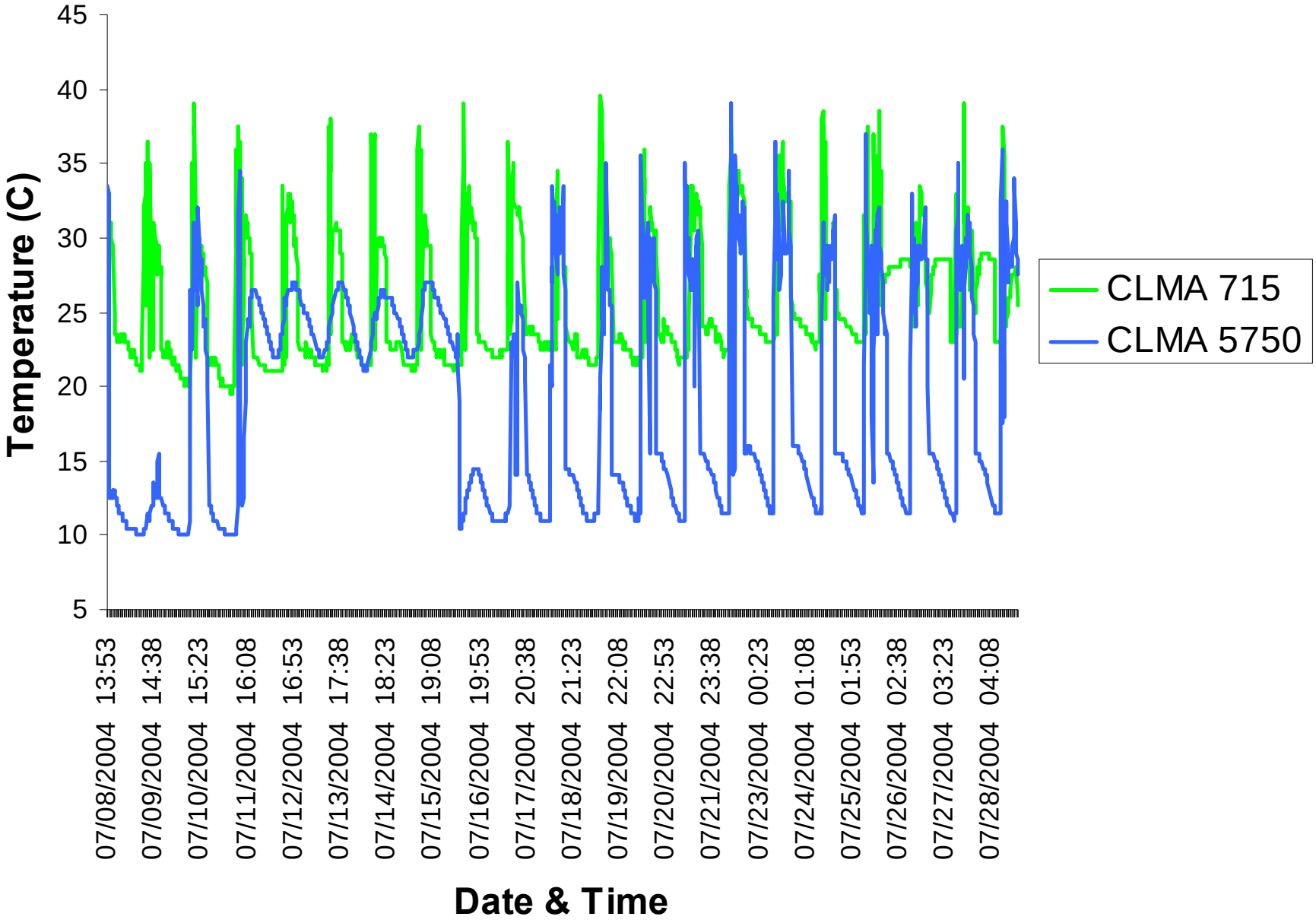


South Fork Trinity River

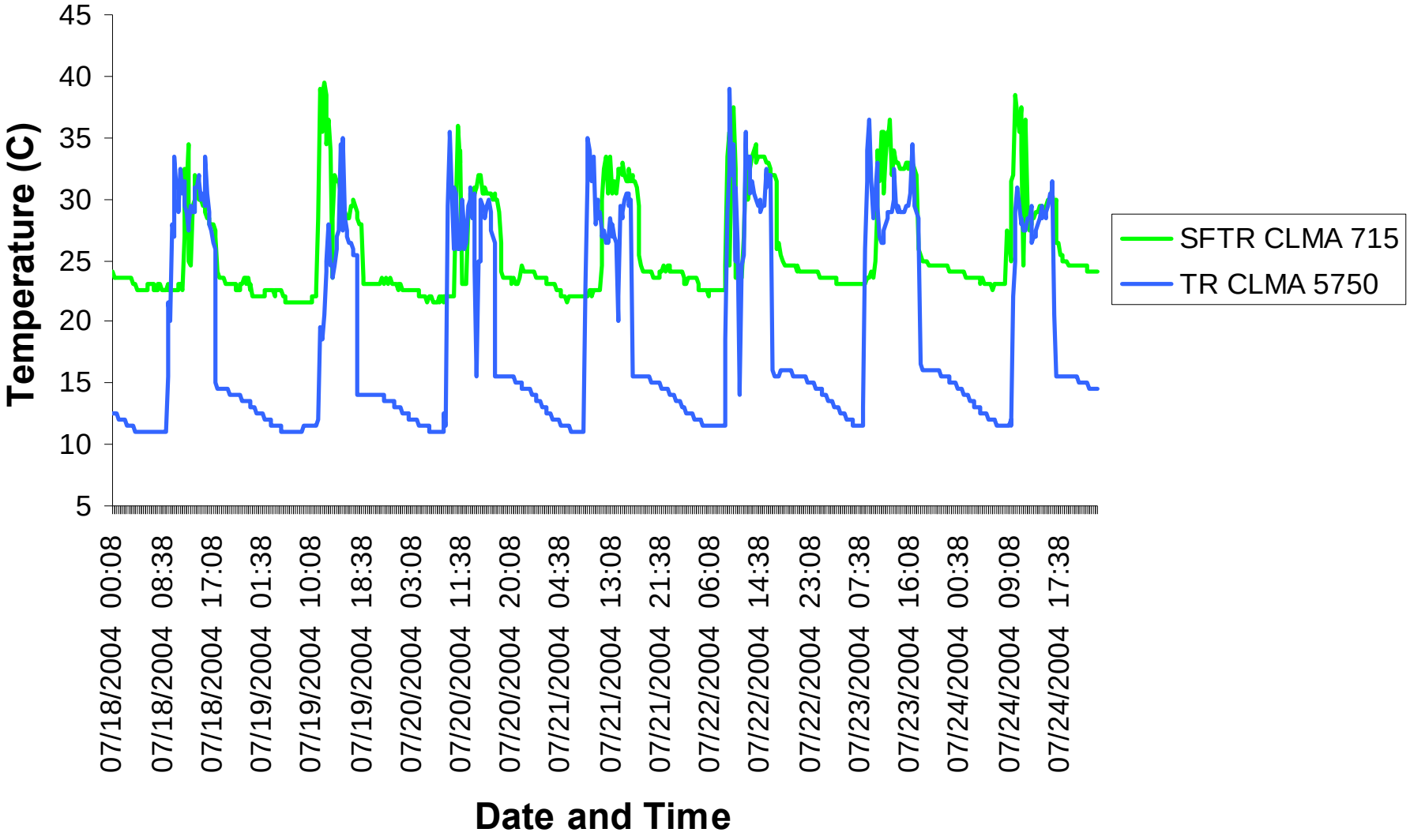


Mainstem Trinity River



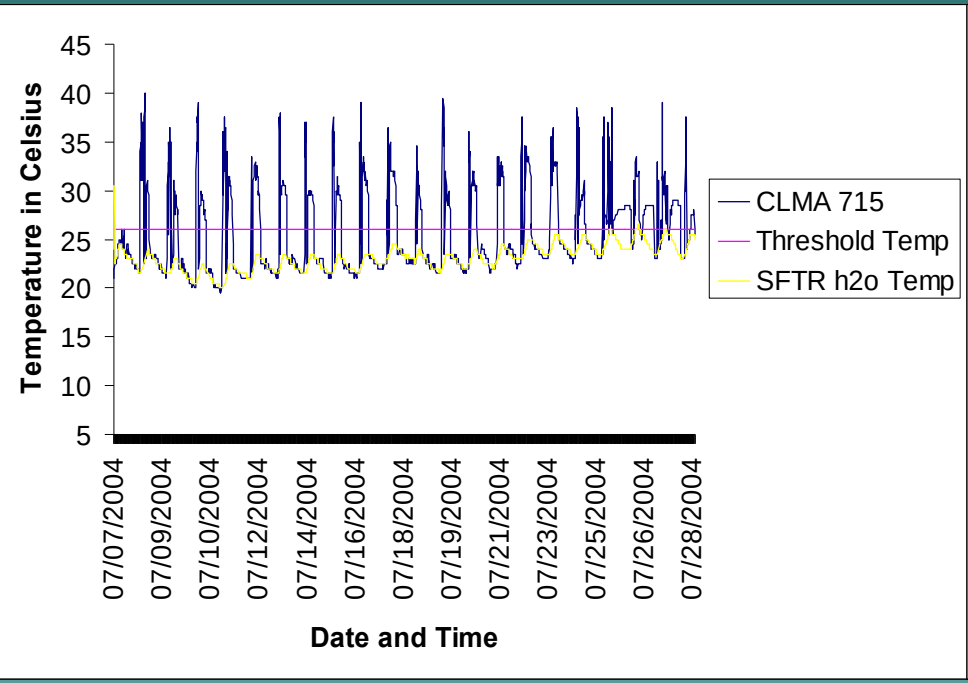

Temperature (C)
45
40
35
30
25
20
15
10
5
07/08/2004 13:53
07/09/2004 14:38
07/10/2004 15:23
07/11/2004 16:08
07/12/2004 16:53
07/13/2004 17:38
07/14/2004 18:23
07/15/2004 19:08
07/16/2004 19:53
07/17/2004 20:38
07/18/2004 21:23
07/19/2004 22:08
07/20/2004 22:53
07/21/2004 23:38
07/23/2004 00:23
07/24/2004 01:08
07/25/2004 01:53
07/26/2004 02:38
07/27/2004 03:23
07/28/2004 04:08
Date & Time
CLMA 715
CLMA 5750

SFTR *Clemmys marmorata* 715 shell temperature compared to TR *Clemmys marmorata* 5750 shell temperature



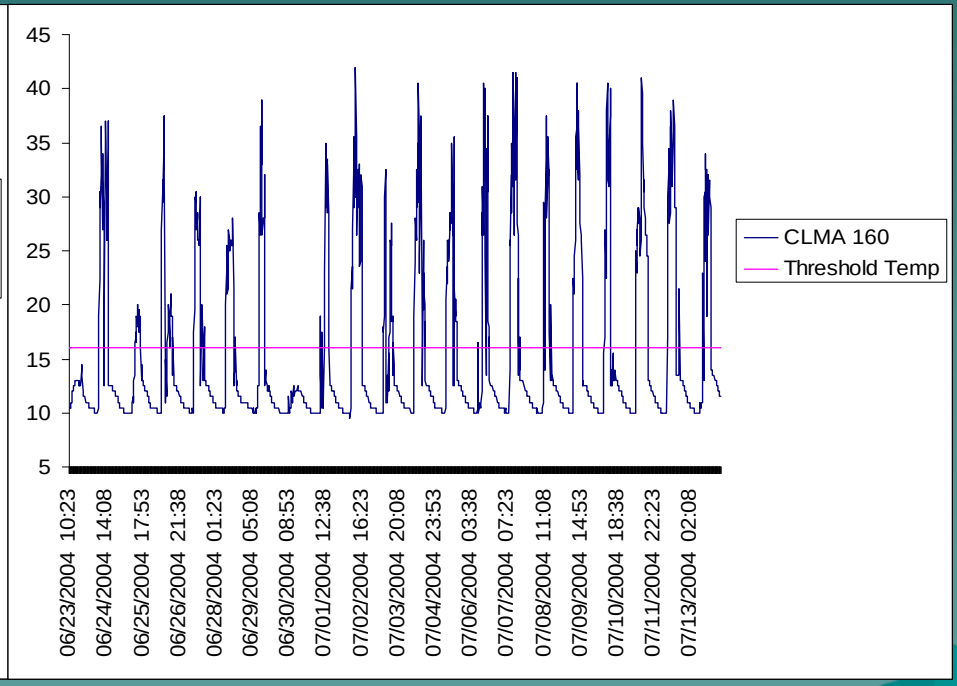
Temperature Threshold Criteria

South Fork Trinity River



Threshold Temp = 26 (C)

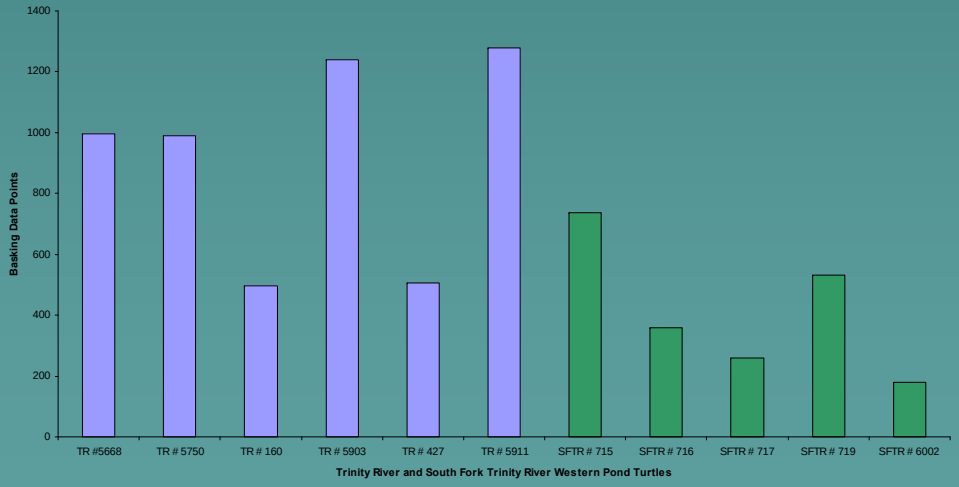
Mainstem Trinity River

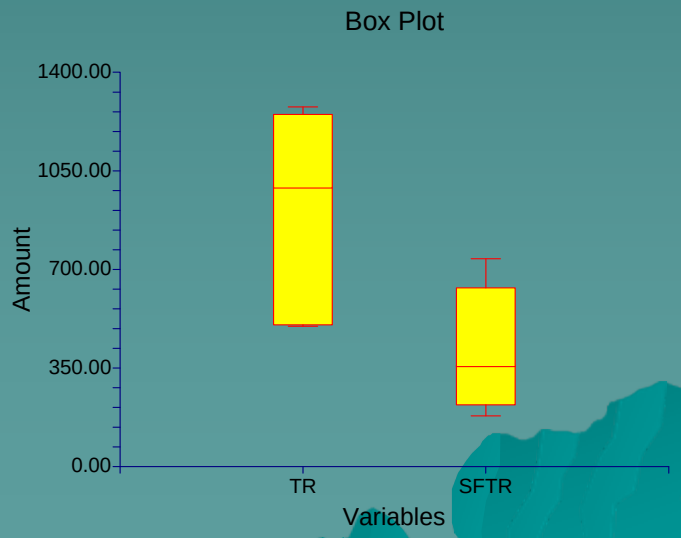


Threshold Temp = 16 (C)

Hypothesis

- Ho: Turtles bask for the same amount of time on both rivers
- Reject Ho: T-value =-2.8 $p < 0.01$





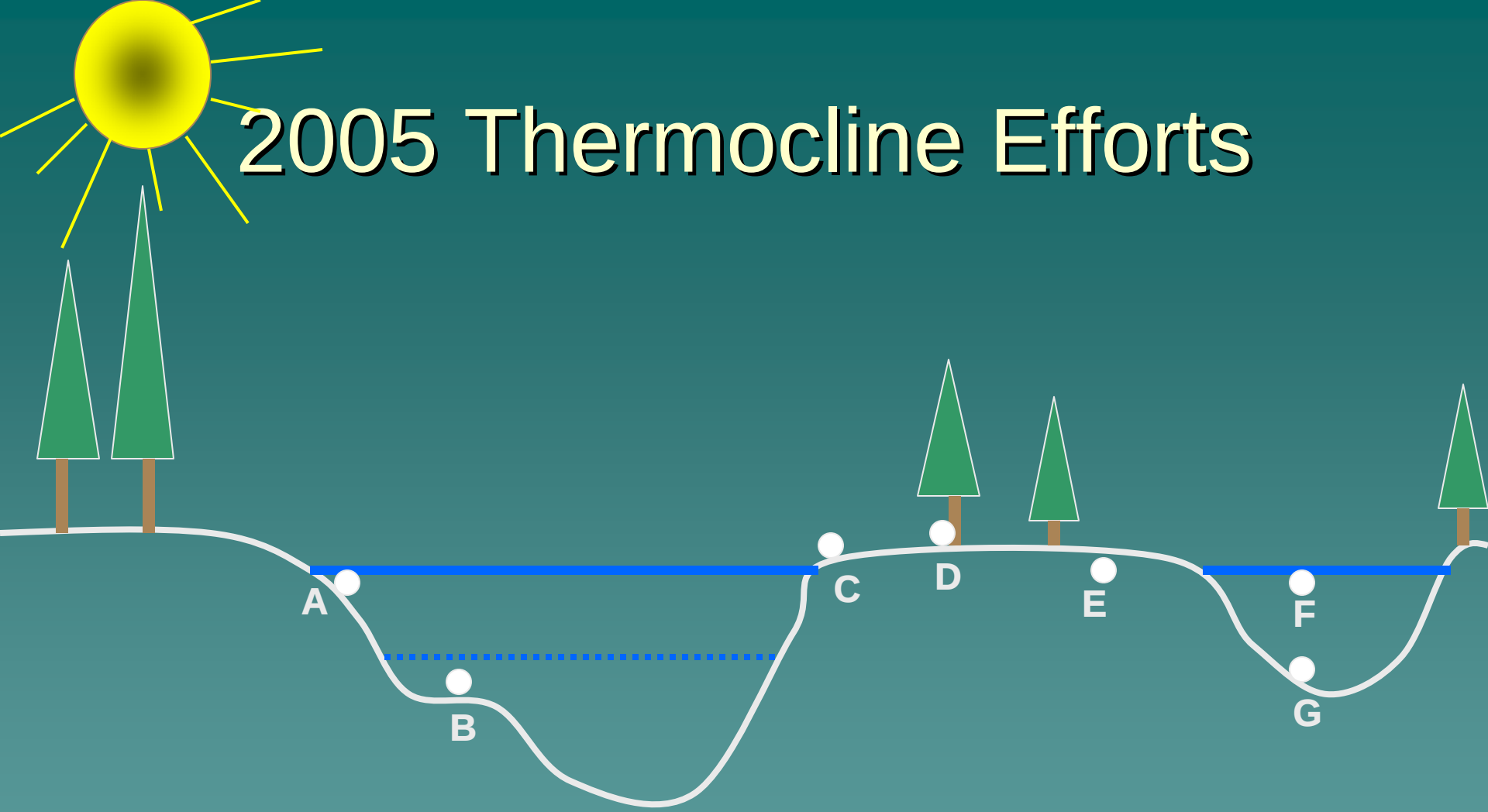
Sample Size 2005

- 10 turtles from the Mainstem of the Trinity River (MSTR)
- 14 turtles from the South Fork of the Trinity River (SFTR)

MSTR turtle capture dates 14, 21, 26-27APR; 29JUN and 7JUL05

SFTR turtle capture dates 20 & 30JUN05

2005 Thermocline Efforts



A = edge water

B = thalwag

C = direct sun

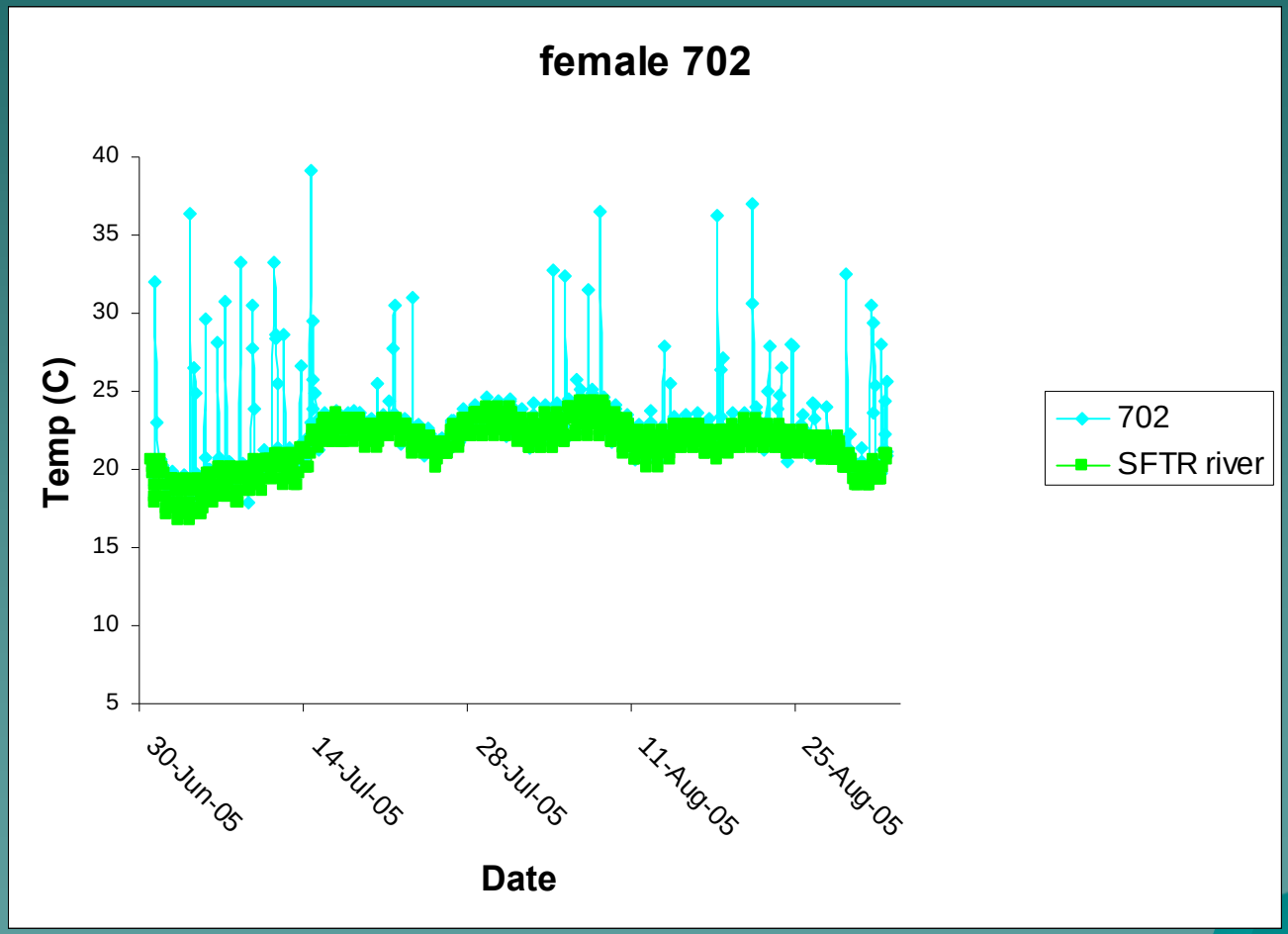
D = shaded land

E = duff layer

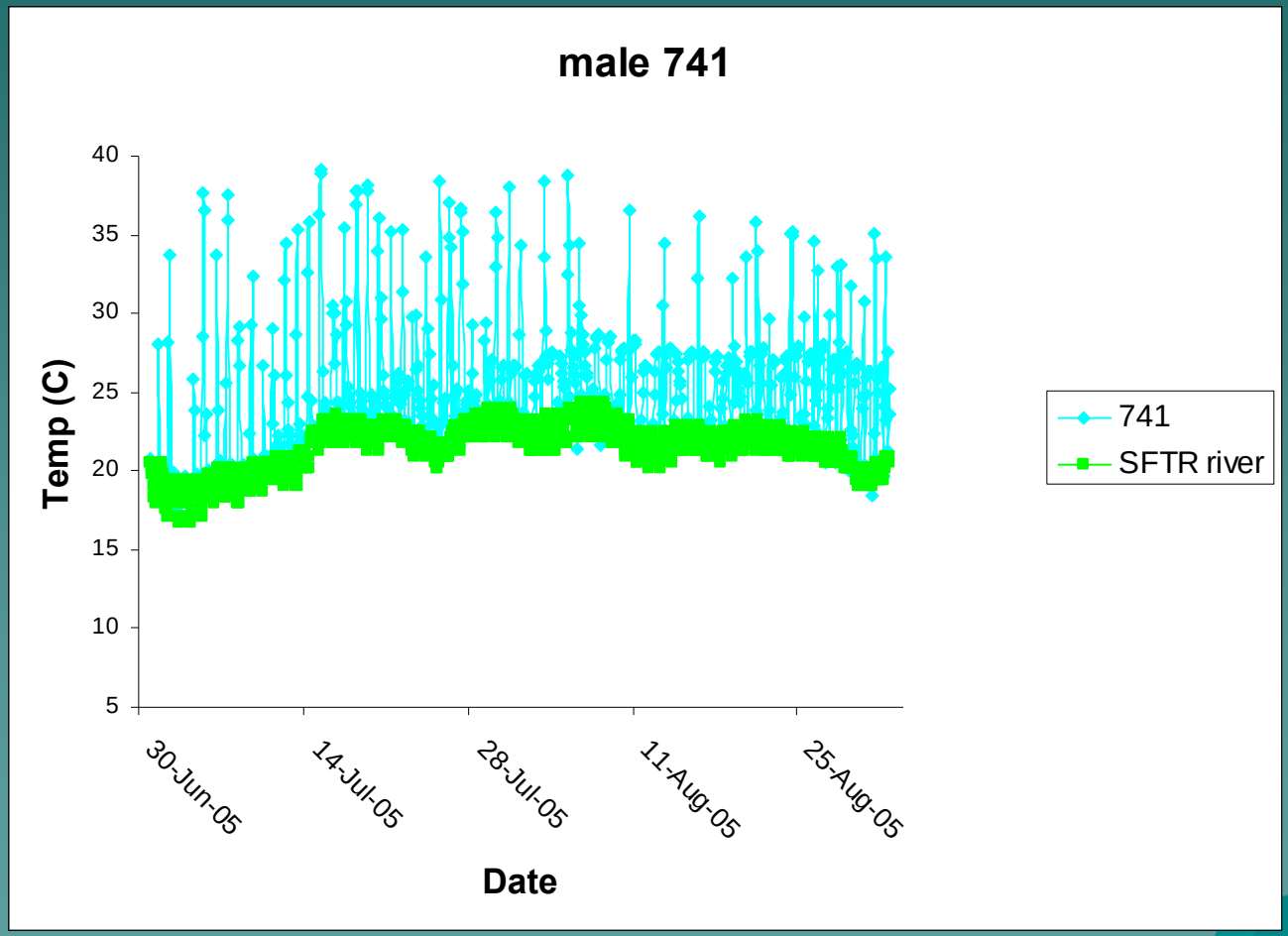
F = surface pond

G = sunken pond

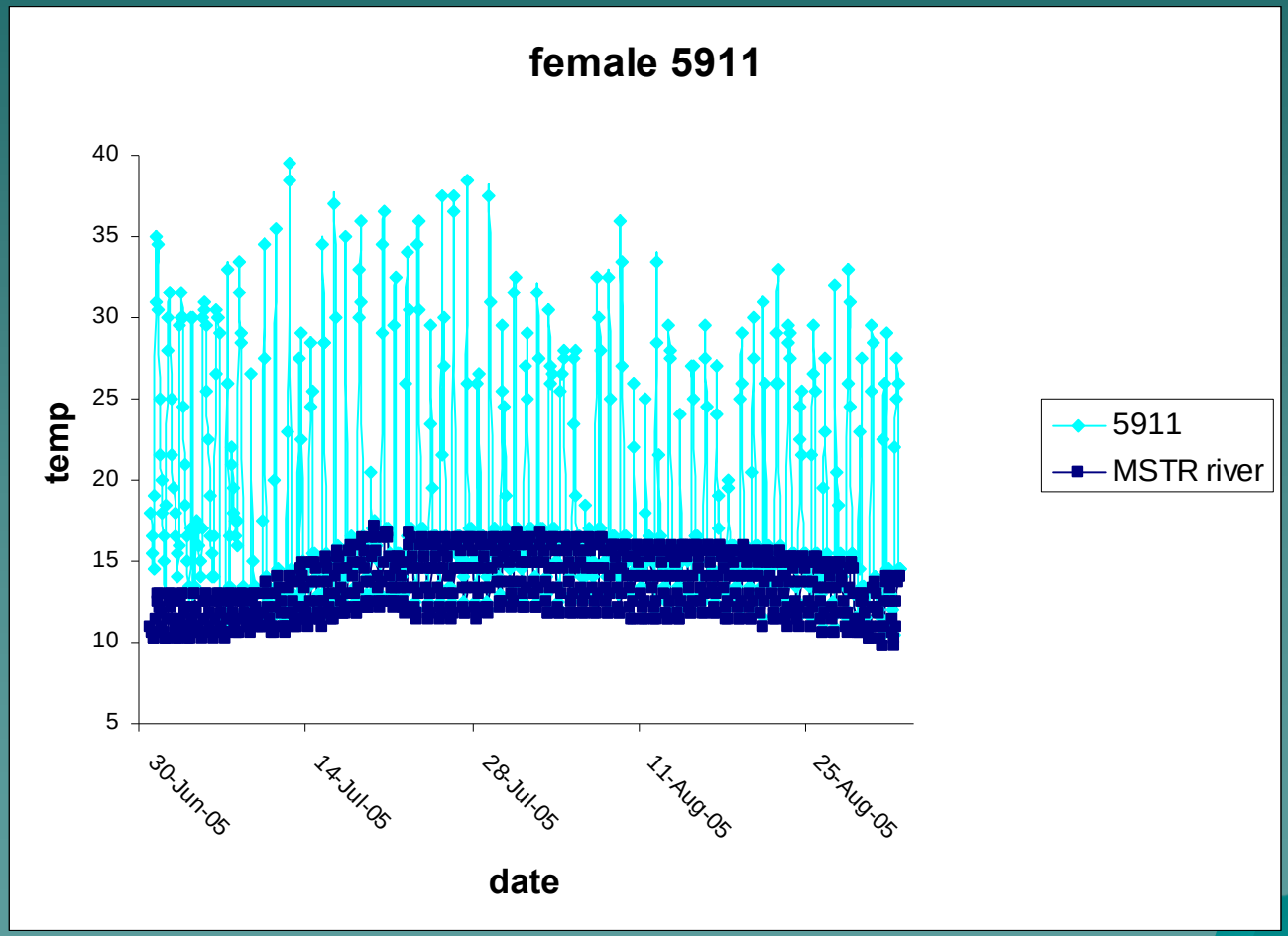
South Fork Trinity River



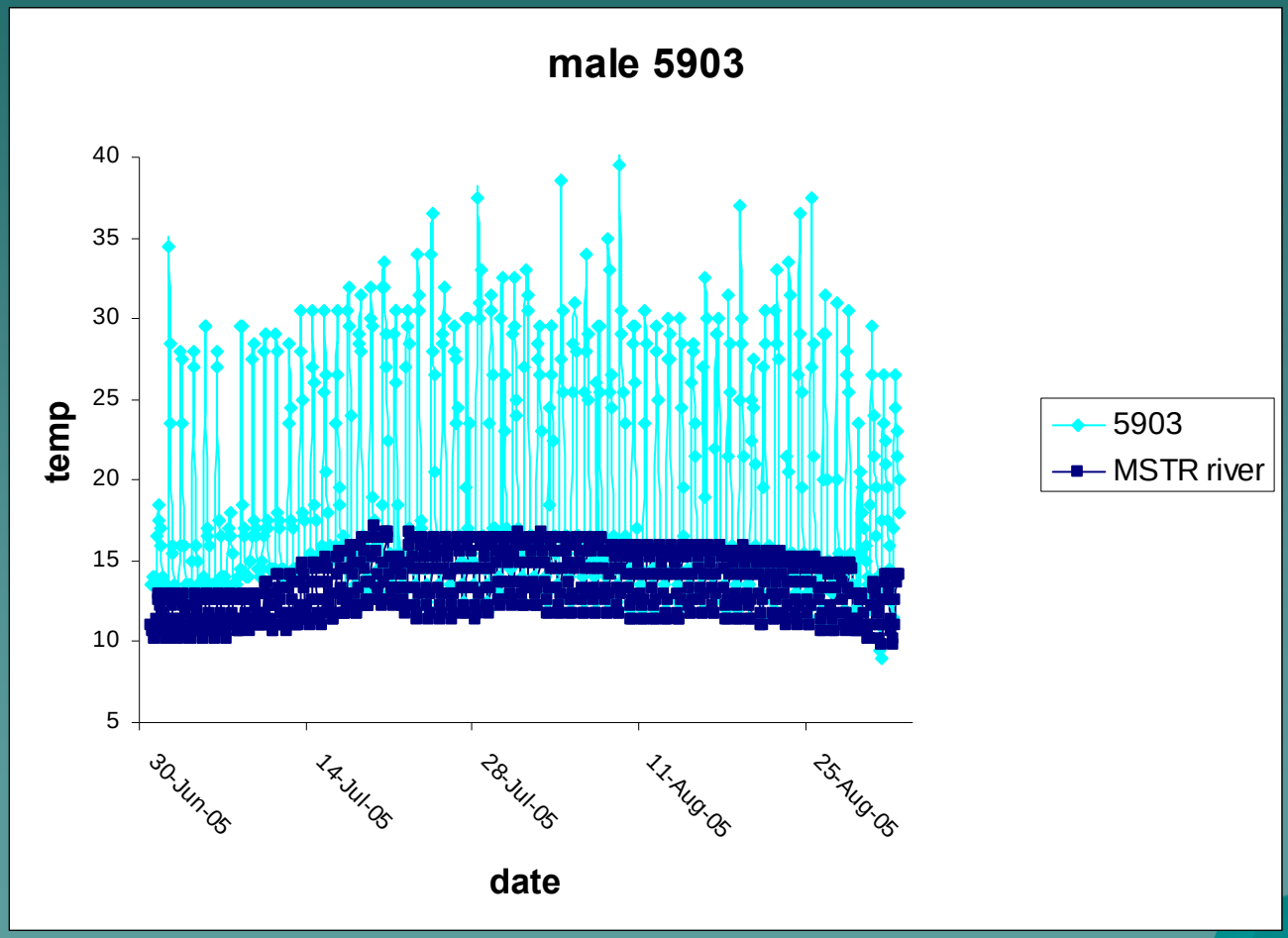
South Fork Trinity River



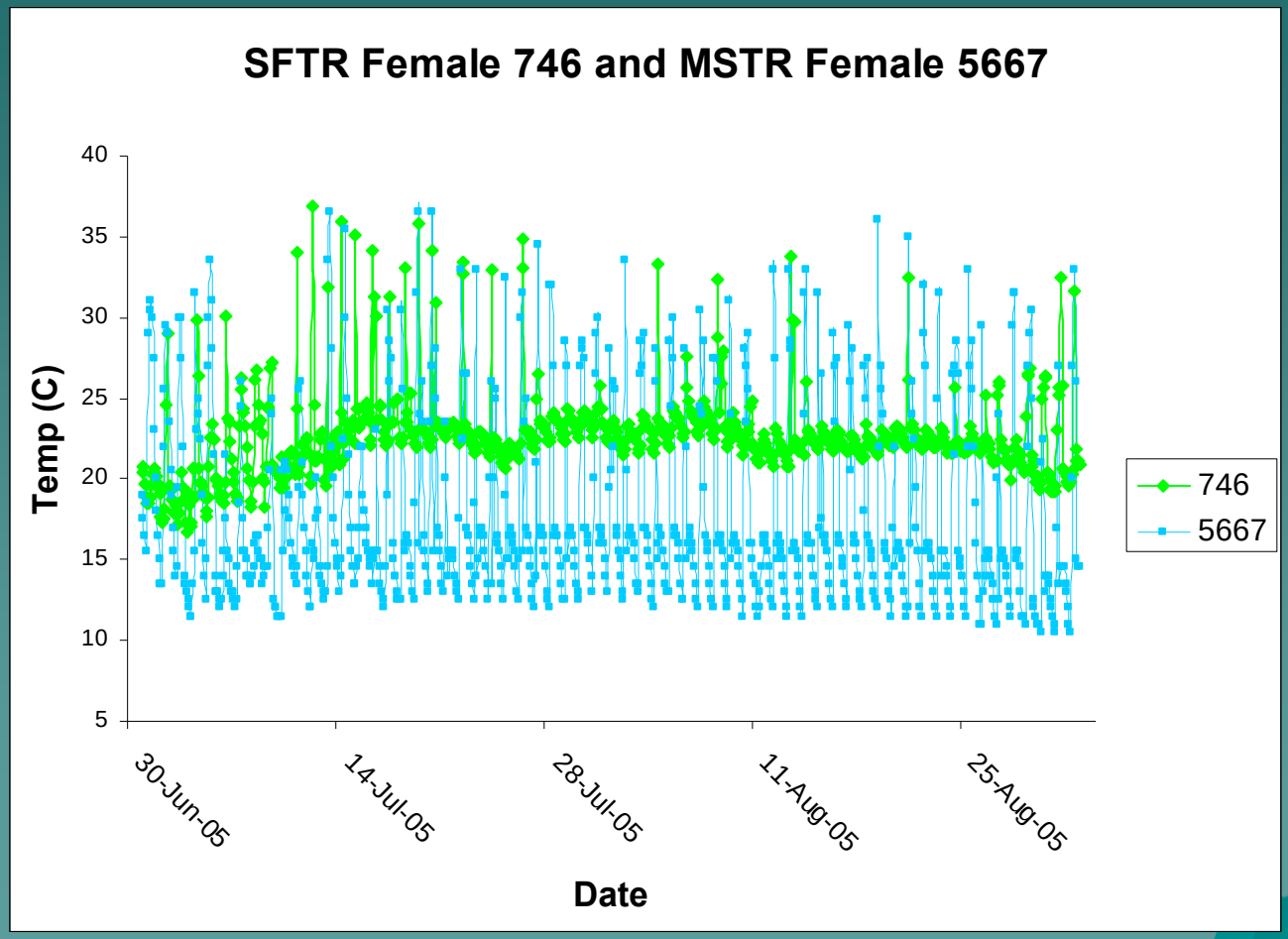
Mainstem Trinity River



Mainstem Trinity River

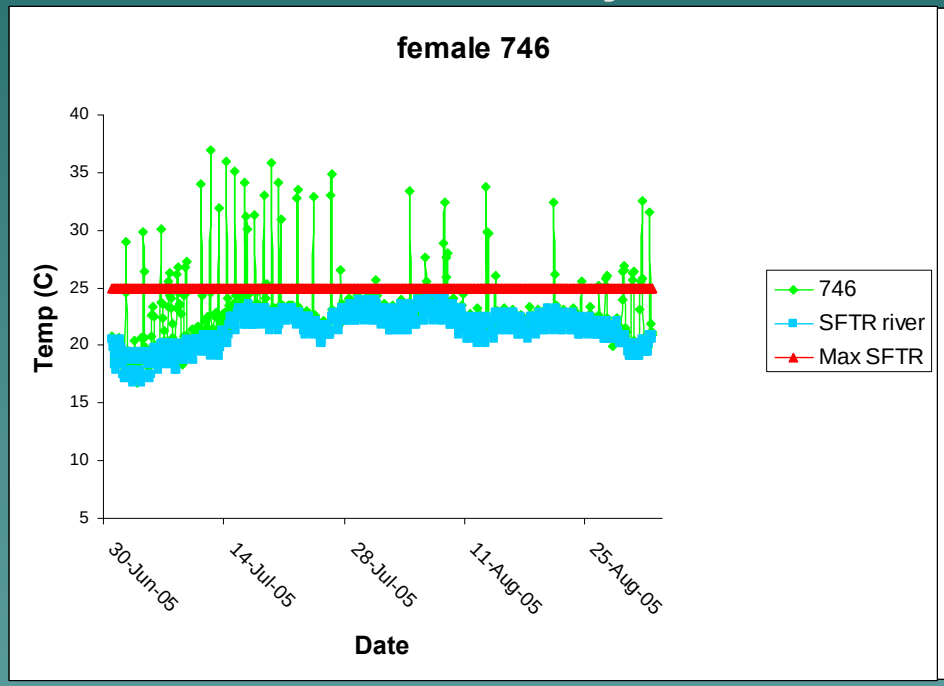


Mainstem Trinity River & South Fork Trinity River



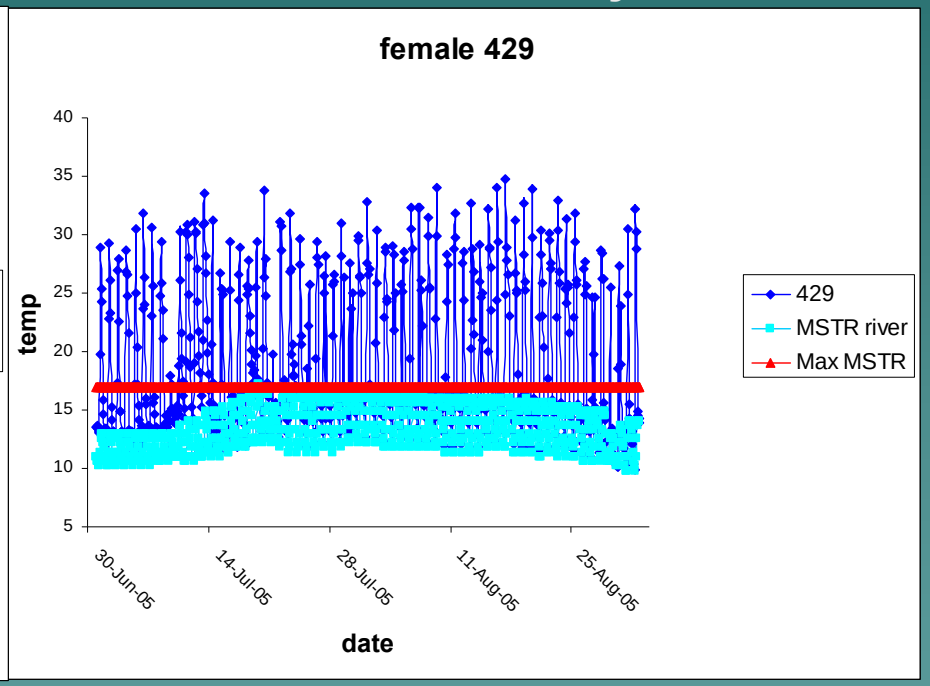
Temperature Threshold Criteria

South Fork Trinity River



Threshold Temp = 25 (C)

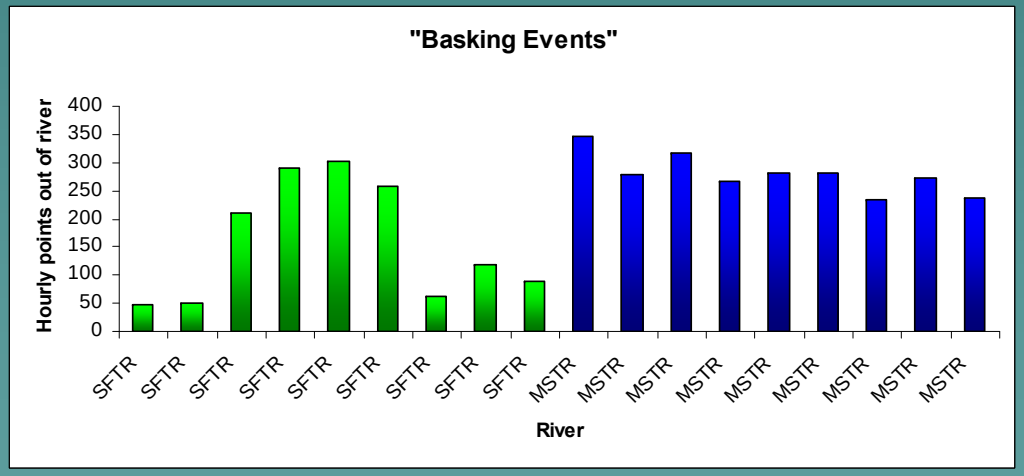
Mainstem Trinity River

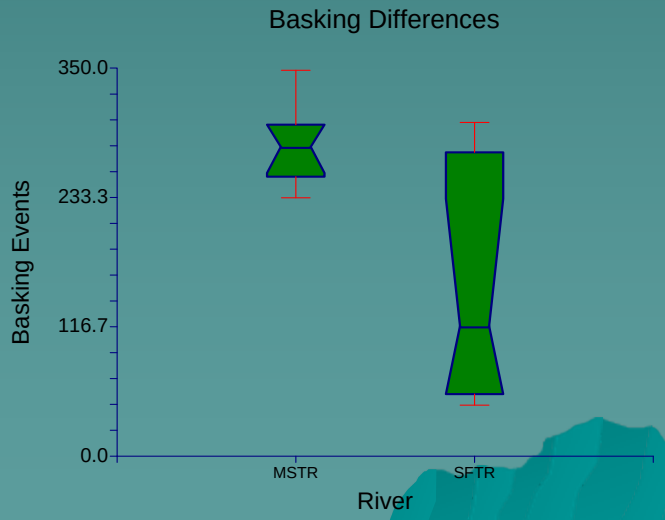


Threshold Temp = 17 (C)

Hypothesis

- Ho: Turtles bask for the same amount of time on both rivers
- Aspin-Welch Unequal Variance Test
- Reject Ho: T-value =3.24 $p < 0.005$



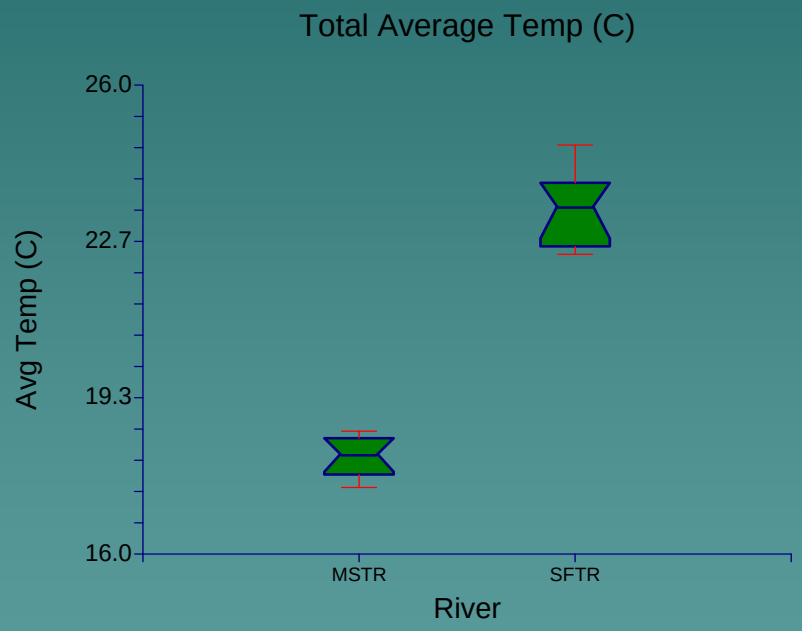


Hypothesis

- Ho: Turtles have a total average summer temperature for the same amount of time on both rivers
- Reject Ho:

T-value =-17.54

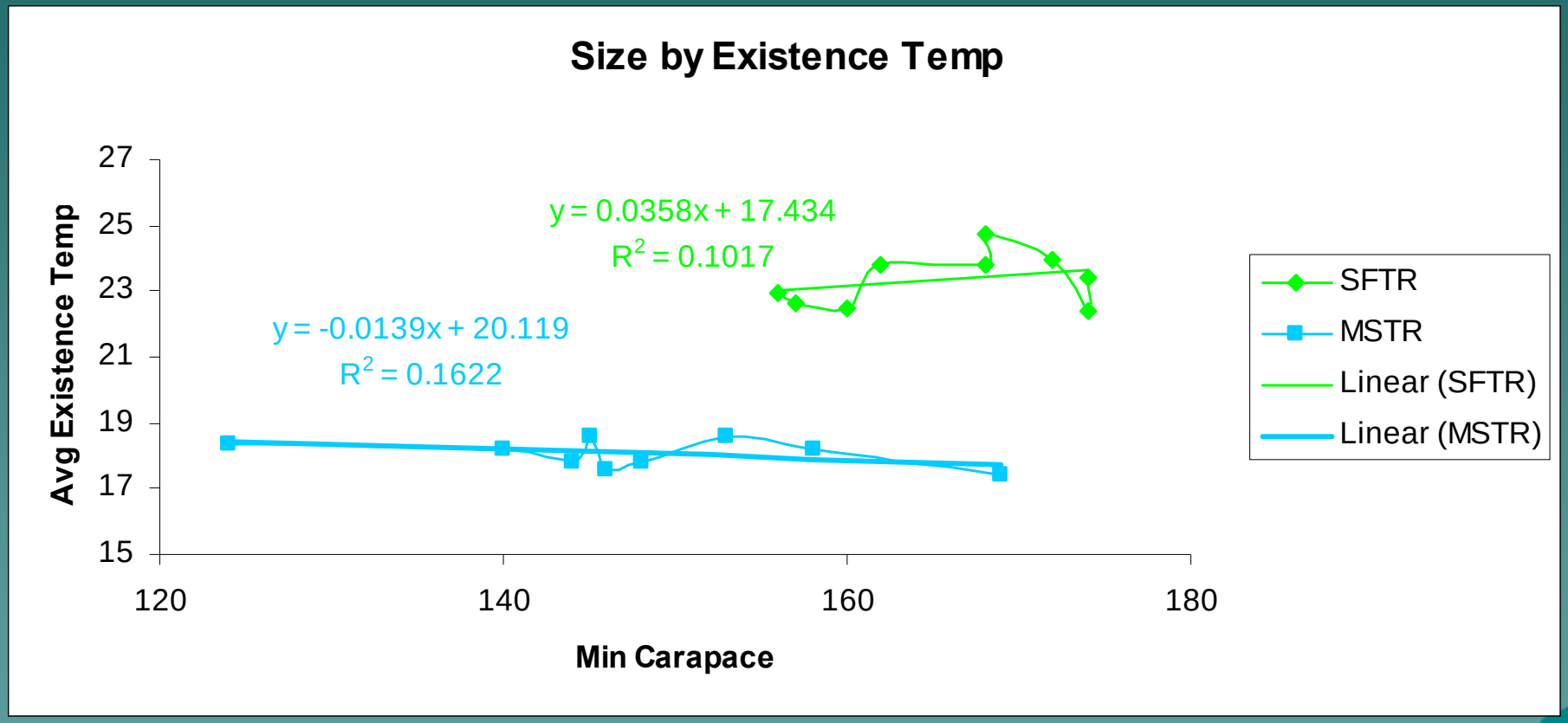
$p < 0.000$



Average Existence Temperature

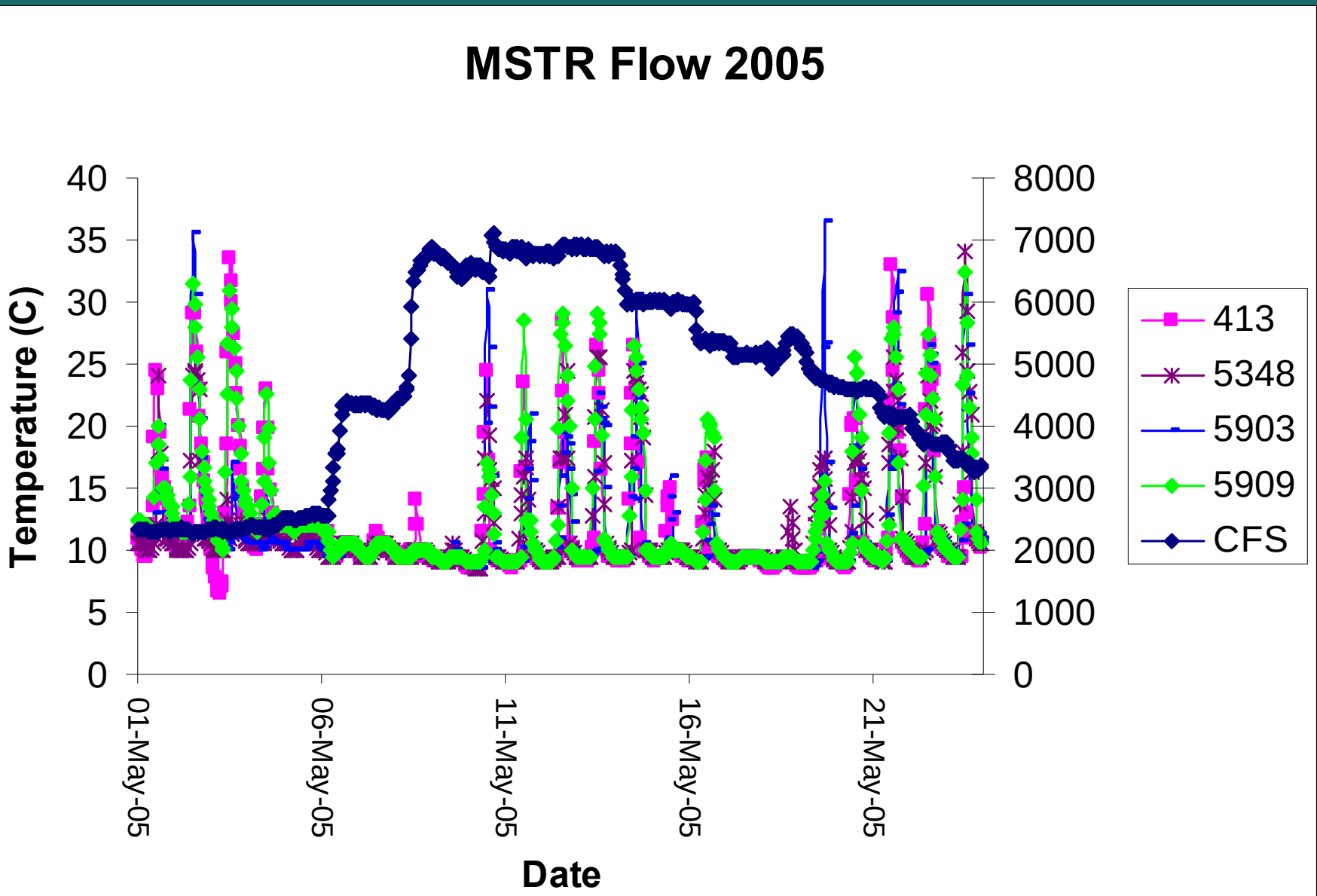
RIVER	MEAN AVG	Upper CI	Lower CI
SFTR	23.26	22.7	23.9
MSTR	18.06	17.73	18.36

Regression on Size and Temperature

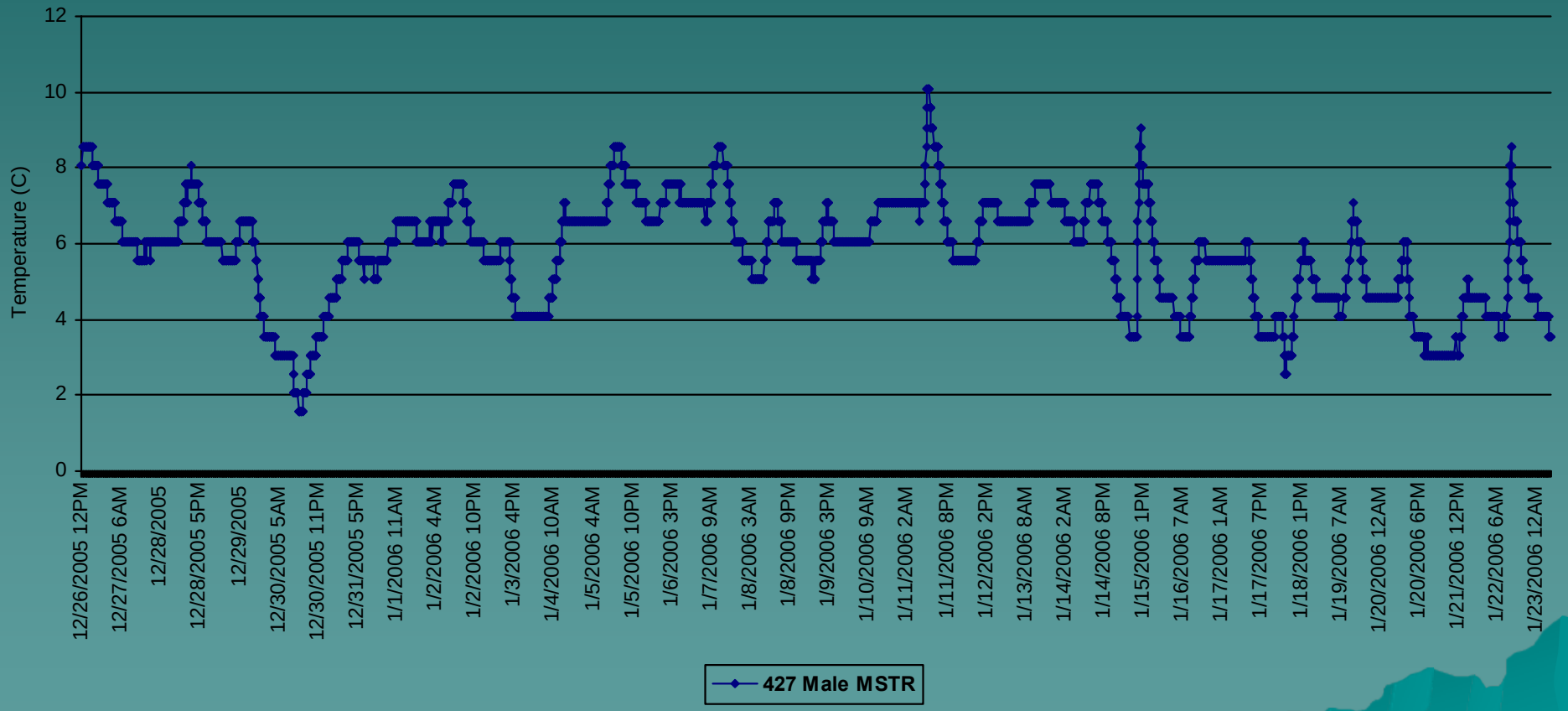


Over-wintering Habitat

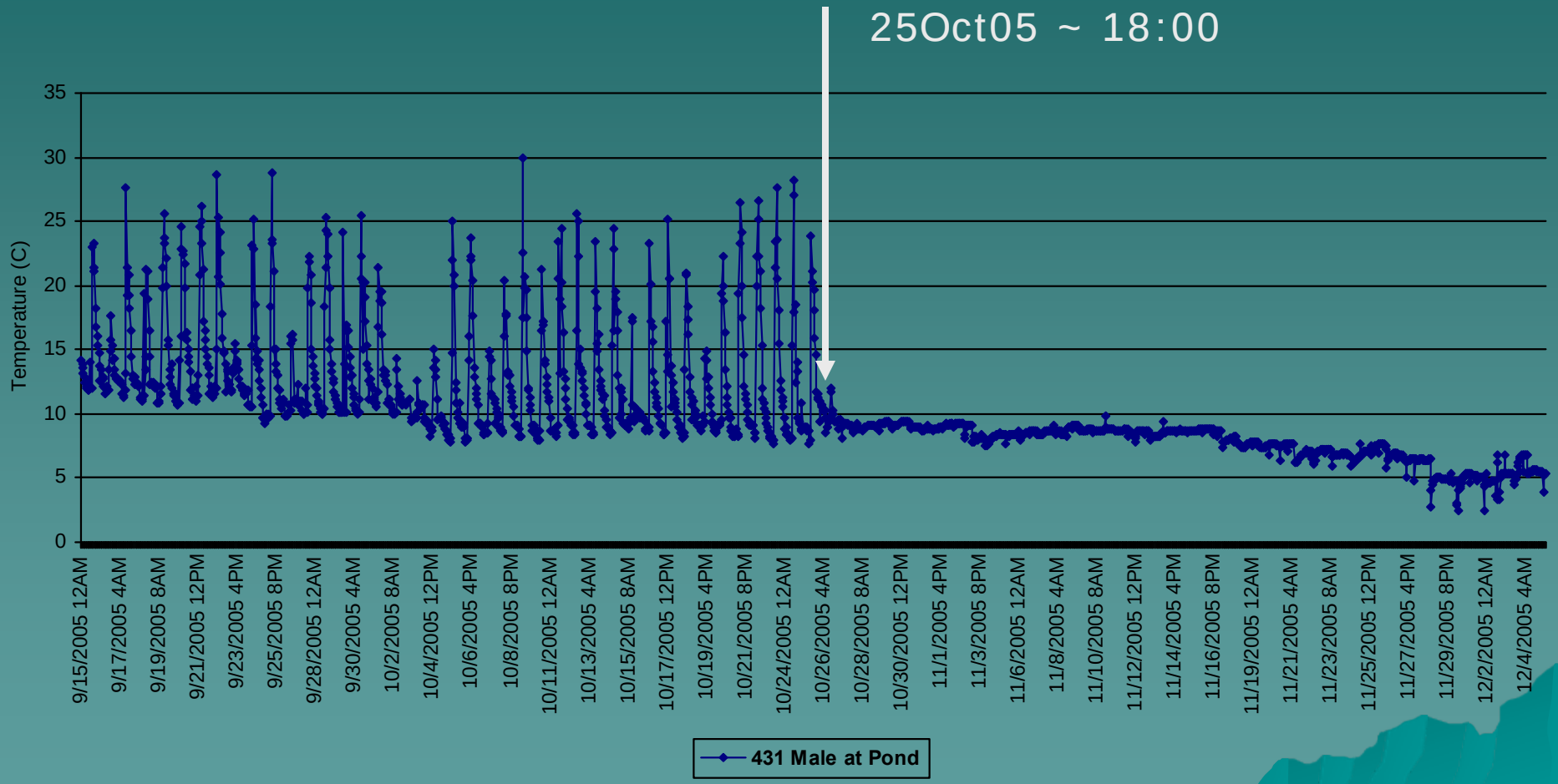
Behavior during Pulse Flows



Over-wintering on Land



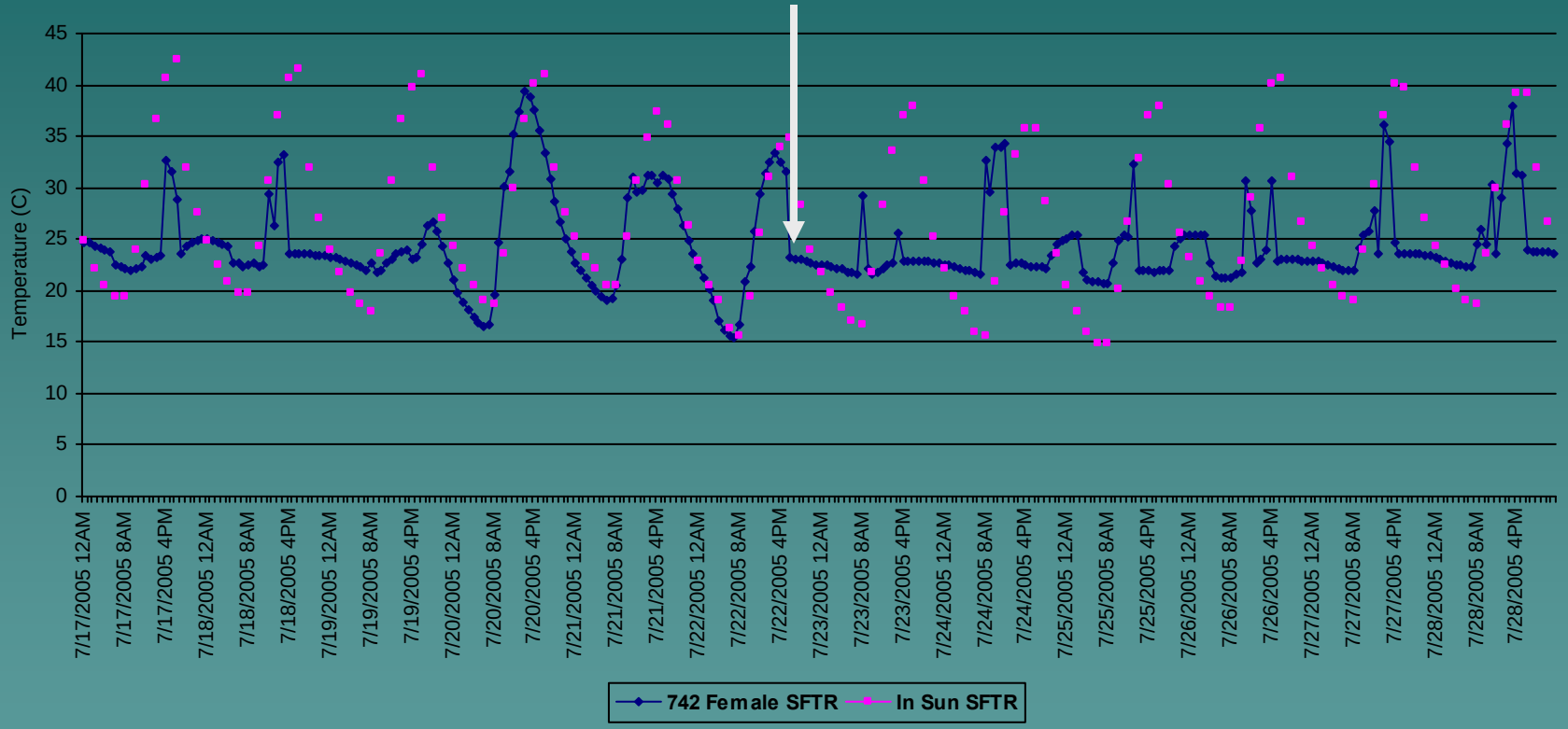
Over-wintering in a Pond



Mean Existence Temp = 23.28°C

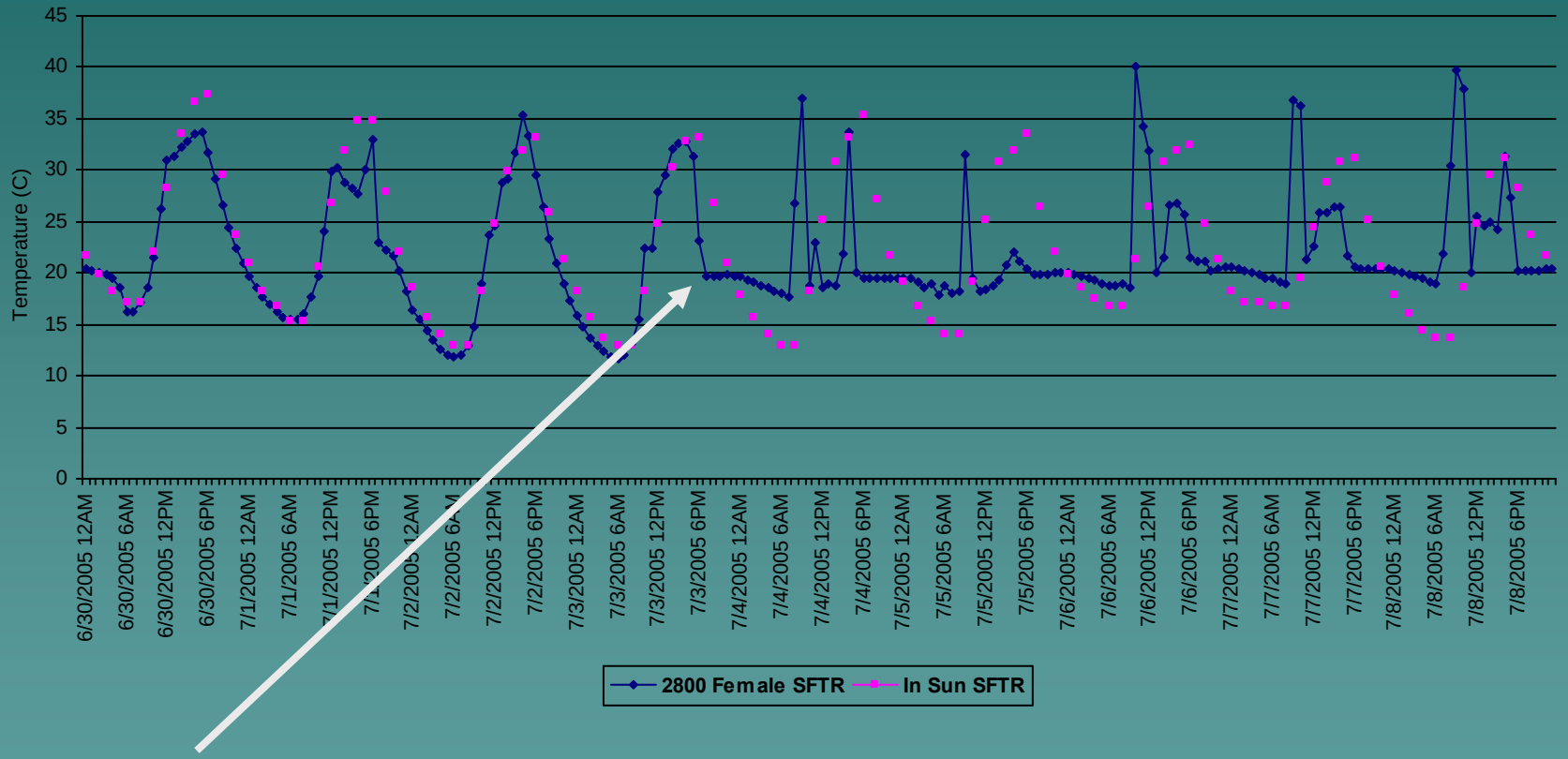
Possible nesting foray

Enters river at ~19:00 hours on 22July06.



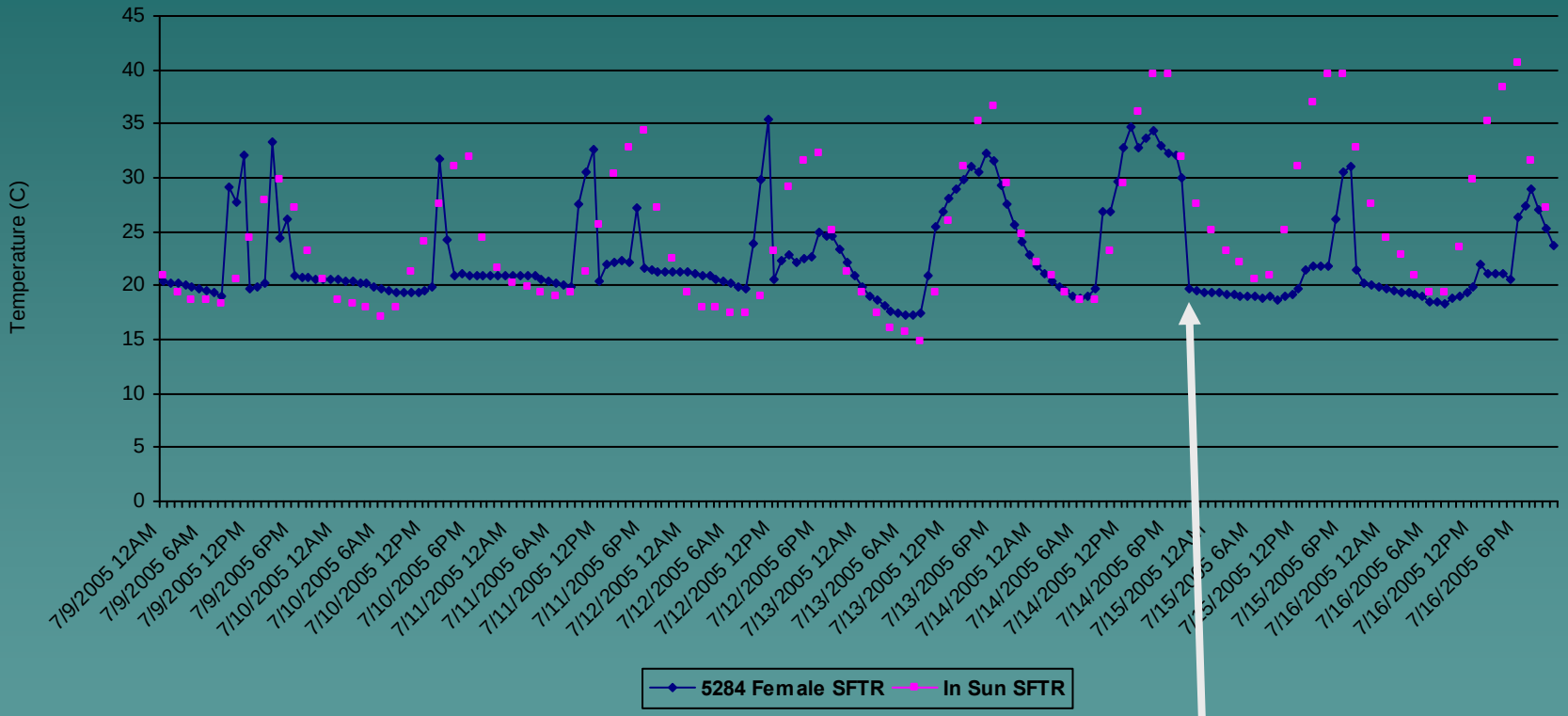
Female 742 on the SFTR: possible nesting foray. Dates that match sun temp logger are for 20jul-late 22jul05. This may extend our perception of breeding on this fork

Possible nesting foray



Female 2800 potential nesting foray: air temps match from 30jun-3july06 (~19:00 returns to river) ☺

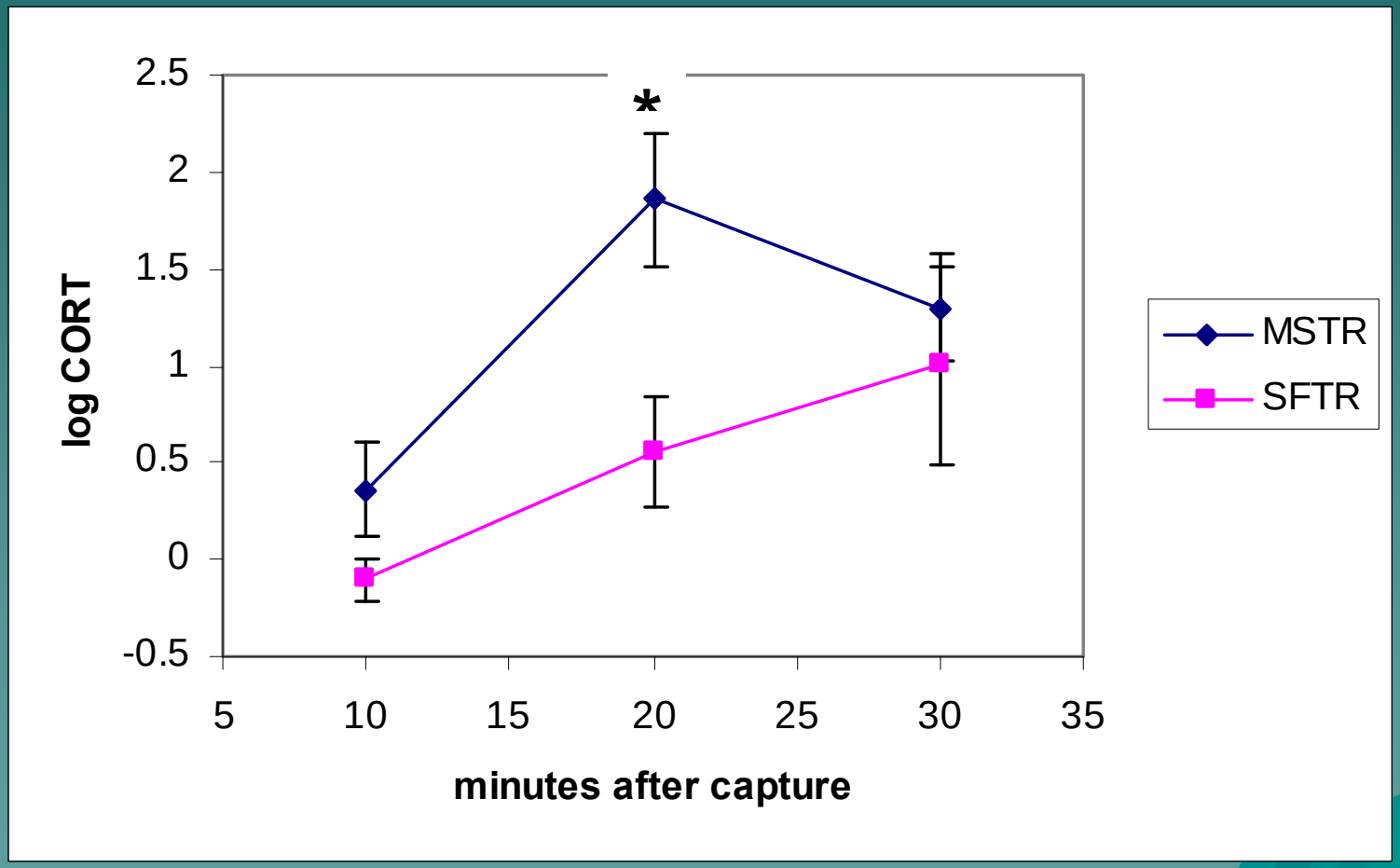
Possible nesting foray



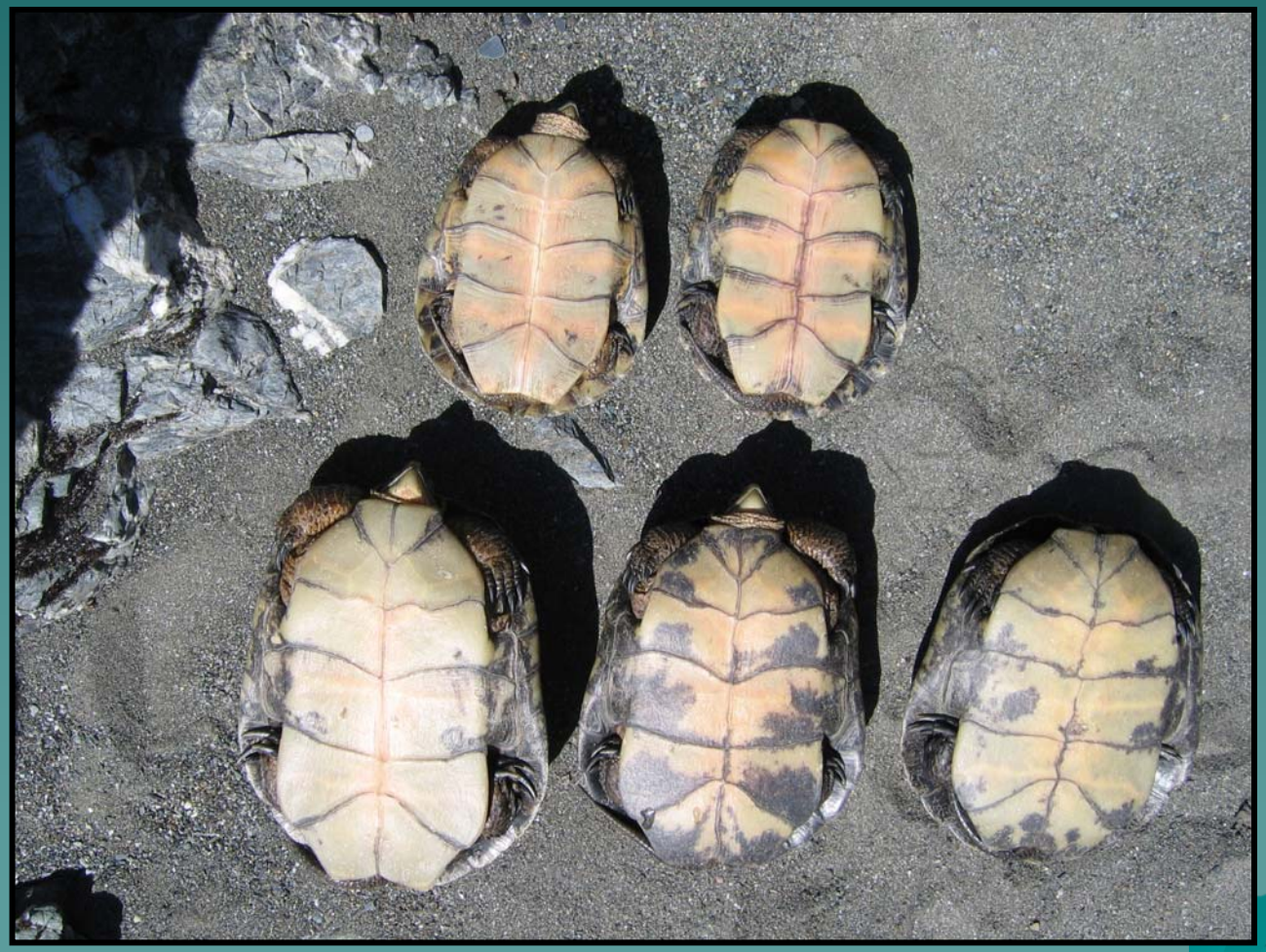
Female 5284 from SFTR possible nesting foray: air temps match 13july-14july06 [returns to river at ~21:00] ☺

Blood work for Corticosterone

Corticosterone Levels



Ghost Population



Bradley W. Compton's "coined term"

Conclusions

Potential mechanisms to cause smaller size by change in behavior

- ↓ time seasonally in water (↑ time on land or decreased activity in water due to flow management)
- ↑ basking = ↓ time in water foraging
- ↓ water temp = ↓ physiological capabilities of turtles
- ↓ food productivity

Adaptive Management Implications & Research Opportunities

- Follow turtles response to early and late summer flows with radios and temp loggers
- Follow turtles basking activity over entire summer with increased “n” and time to hibernation
- Environmental chamber to better understand bioenergetics under different thermal regimes
- Prey use vs. availability?

Acknowledgements

- U. S. Fish & Wildlife Service
  (Charlie Chamberlain, Joe Polos, Nick Hetrick)
- Don Ashton & Hart Welsh, Redwood Sciences Laboratory
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- Field Assistance: Ryan Bourque, Ernie Garcia, Justin Garwood, Damon Goodman, Brandt Gutermuth, Mike Halket, Amy Johnson & Monty Larson
- Statistical Advice: Deborah Hudman & Christy McCain
- Technical Assistance: David Hines, Jason Ogawa, Michael Cunnanon, Clara Wheeler,, Bill Pinnix, Greg Gray, Tim Meehan & Ruthie Smith

THE END

My lovely friend, the end

Questions?