

Native-nonnative Interactions; Factors Influencing Predation and Competition



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Project G: Trout/chub interactions

- Effects of competition between rainbow and brown trout and humpback chub

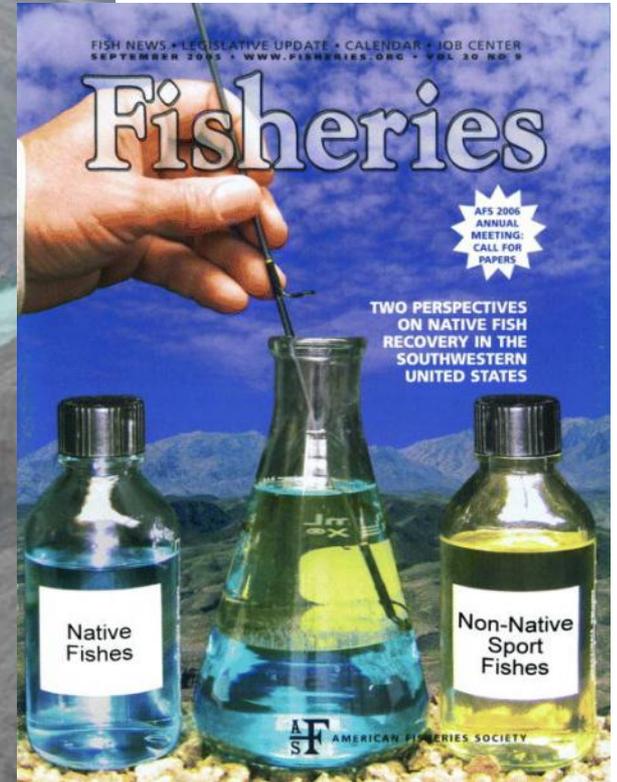


- Relative predation vulnerability of juvenile chub to adult conspecifics and to rainbow and brown trout

- Effects of water temperature, fish size and turbidity on predation vulnerability to rainbow and brown trout



Confluence of the Colorado River and Little Colorado Rivers in Grand Canyon



Rainbow and brown trout do consume native fish in Grand Canyon

Yard et al. 2011. Transactions of the American Fisheries Society 140: 471-486



but population level impacts are difficult to assess because predation vulnerability is highly variable depending on the sizes of the prey and predators and physical conditions under which the predation interactions take place

Predation Methods



Rocky
Mountain
Research
Station

- 4 trout predators per tank
- 12 chub prey per tank (in baskets)
- Allowed to acclimate for 24- h
- Baskets tipped – Live fish counted 24 h later

How can lab data tell us anything useful?

Lab data does **not** tell us what humpback chub predation vulnerability is in the mainstem Colorado River

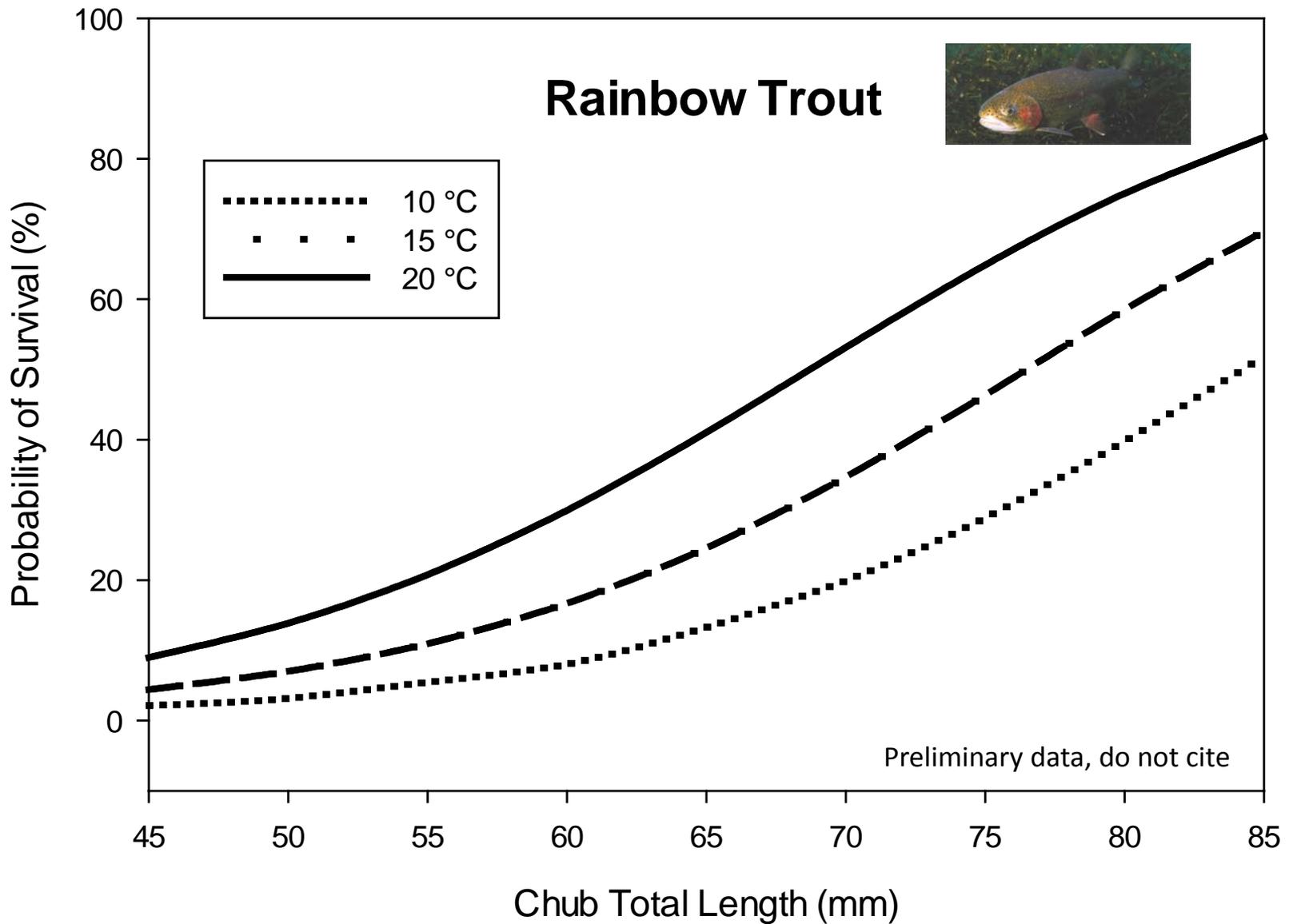
- but it can tell us what environmental factors are most important and how relationships are likely to change



Number and sizes of fish used to evaluate the relationship between water temperature, fish size, turbidity and predation vulnerability

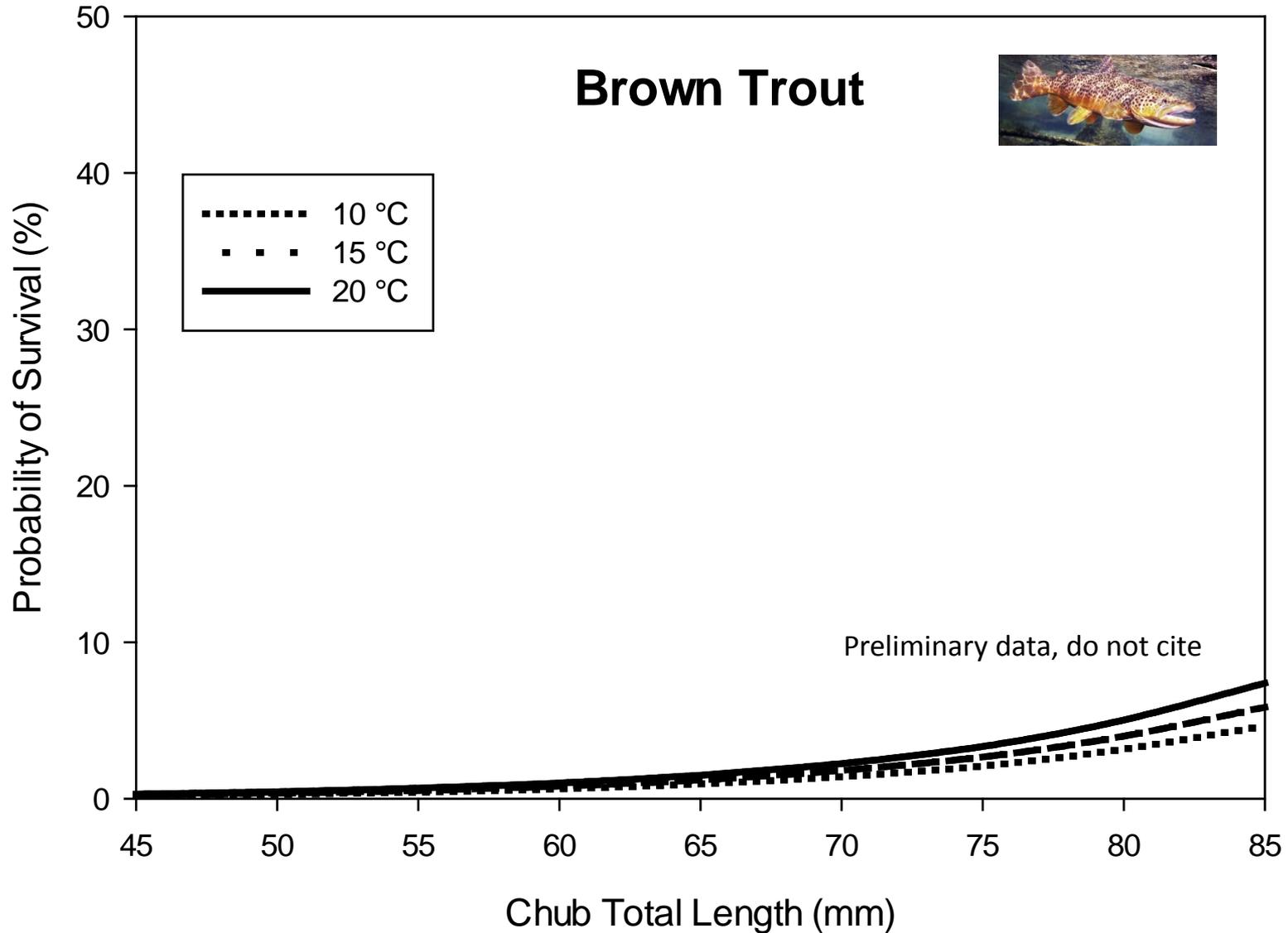
	Number of Replicates	Number of Trout	Trout Total Length (mm) Mean (Range)	Prey Species *(All captive reared)	Number of Chub	Chub Total Length (mm) Mean (Range)
Rainbow Trout	12	48	299 (283 - 319)	Bonytail	144	77 (70 - 85)
	24	96	275 (261 - 291)	Humpback chub	288	65 (45 - 87)
	12	48	305 (281 - 324)	Roundtail chub	144	63 (47 - 71)
	24	96	288 (260 - 330)	Bonytail	288	66 (60 - 70)
	80	320	289 (261 - 321)	Bonytail	960	66 (60 - 70)
Brown Trout	12	48	246 (230 - 273)	Bonytail chub	144	77 (67 - 90)
	36	144	263 (218 - 341)	Humpback chub	432	70 (45 - 91)
	12	48	231 (214 - 245)	Roundtail chub	144	58 (44 - 67)
	24	96	288 (260 - 330)	Bonytail	288	66 (60 - 70)
	64	256	260 (210 - 399)	Bonytail	786	67 (60 - 70)
Totals	300	1152			2658	

Preliminary data, do not cite



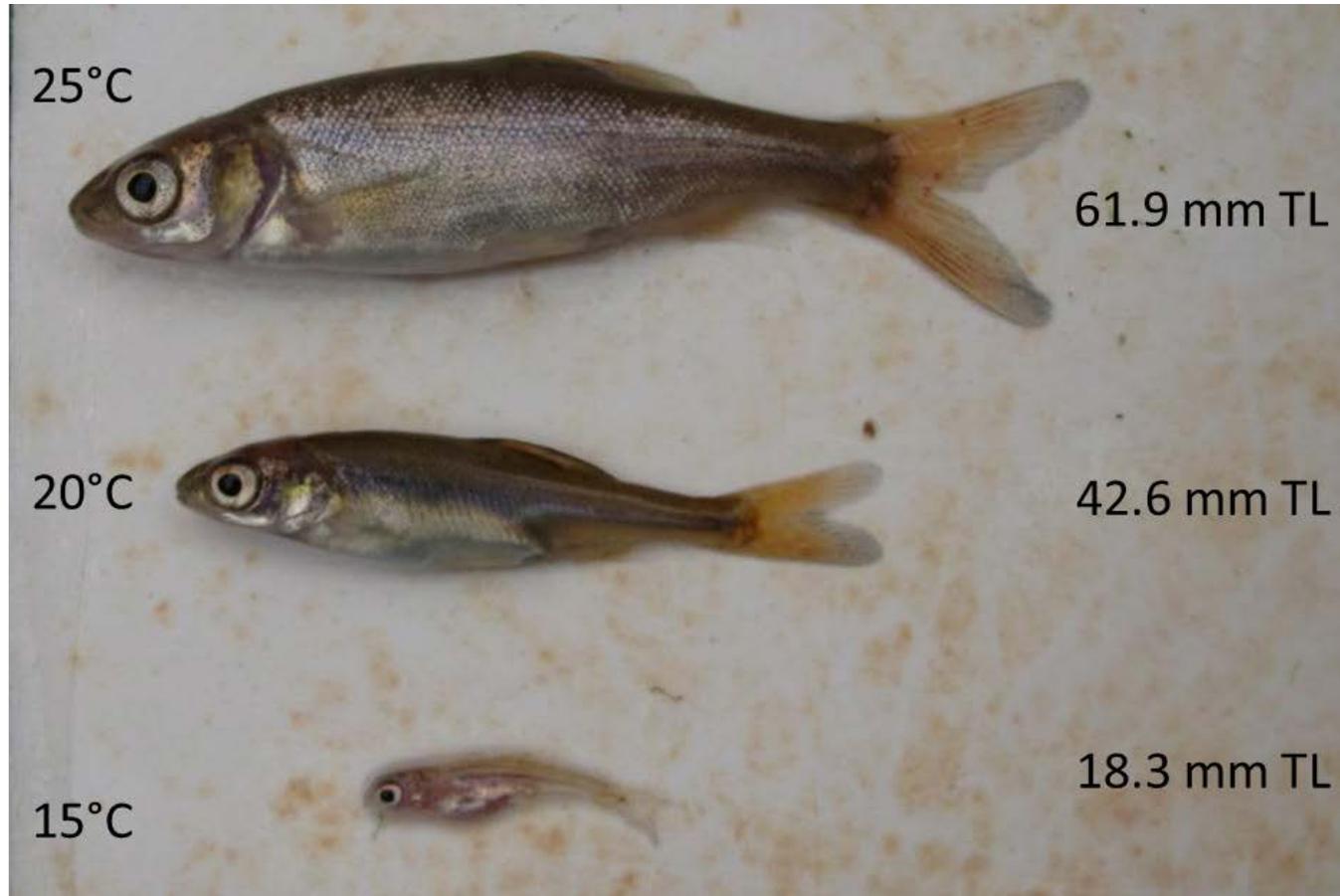
Percent (%) probability that a juvenile chub will survive predation by a 285 mm rainbow trout as chub size increases from 45-85 mm TL at 10, 15 and 20 °C, with trout size held constant at 285 mm TL.

Brown Trout



Percent (%) probability that a juvenile chub will survive predation by a 285 mm brown trout as chub size increases from 45-85 mm TL at 10, 15 and 20 °C, with trout size held constant at 285 mm TL. Note that the y-axis on the brown trout is reduced by half.

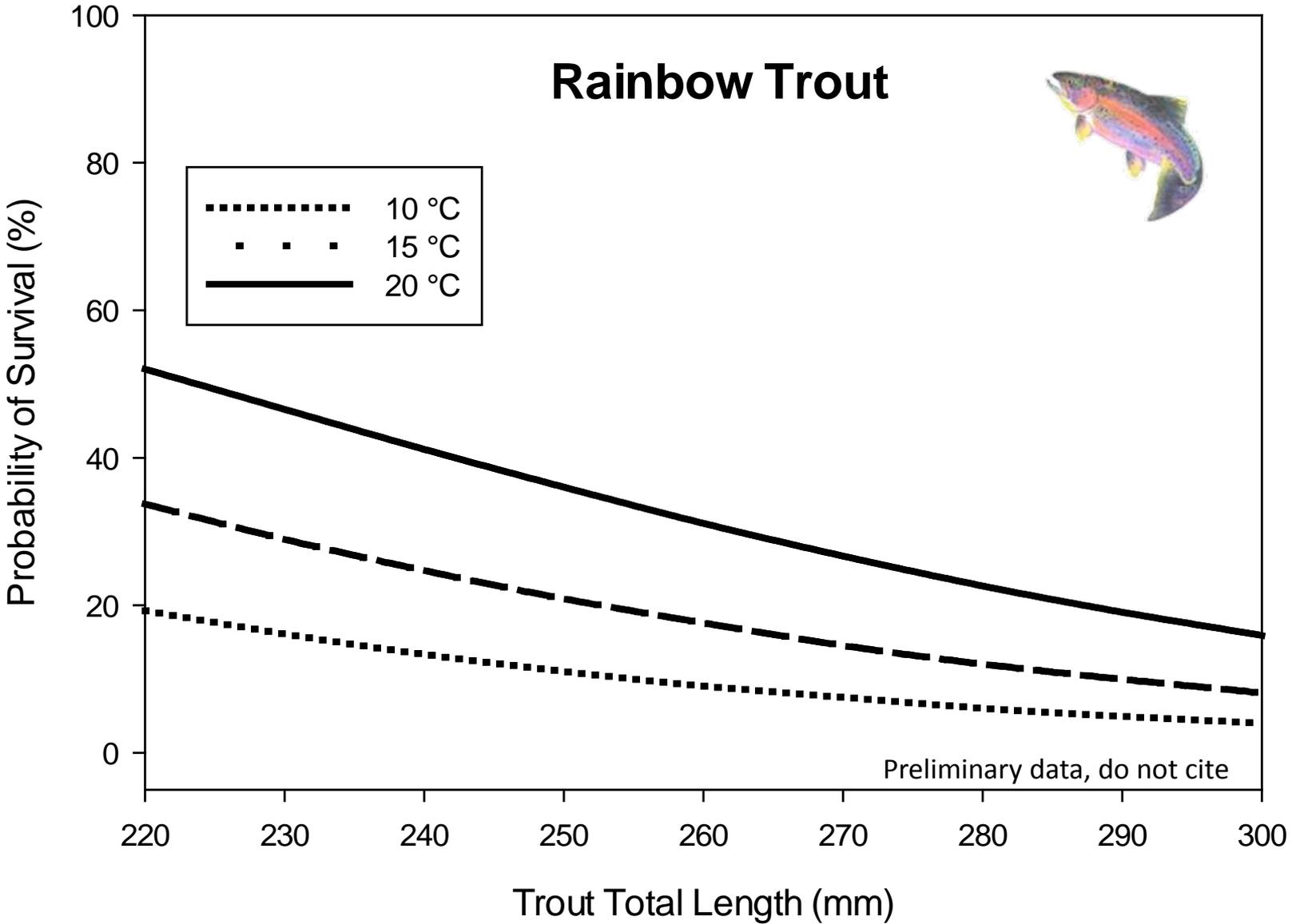
Roundtail chub grown at three water temperatures in the laboratory for 9 months



C. Moran – PhD Student at NAU – 2013 unpublished data

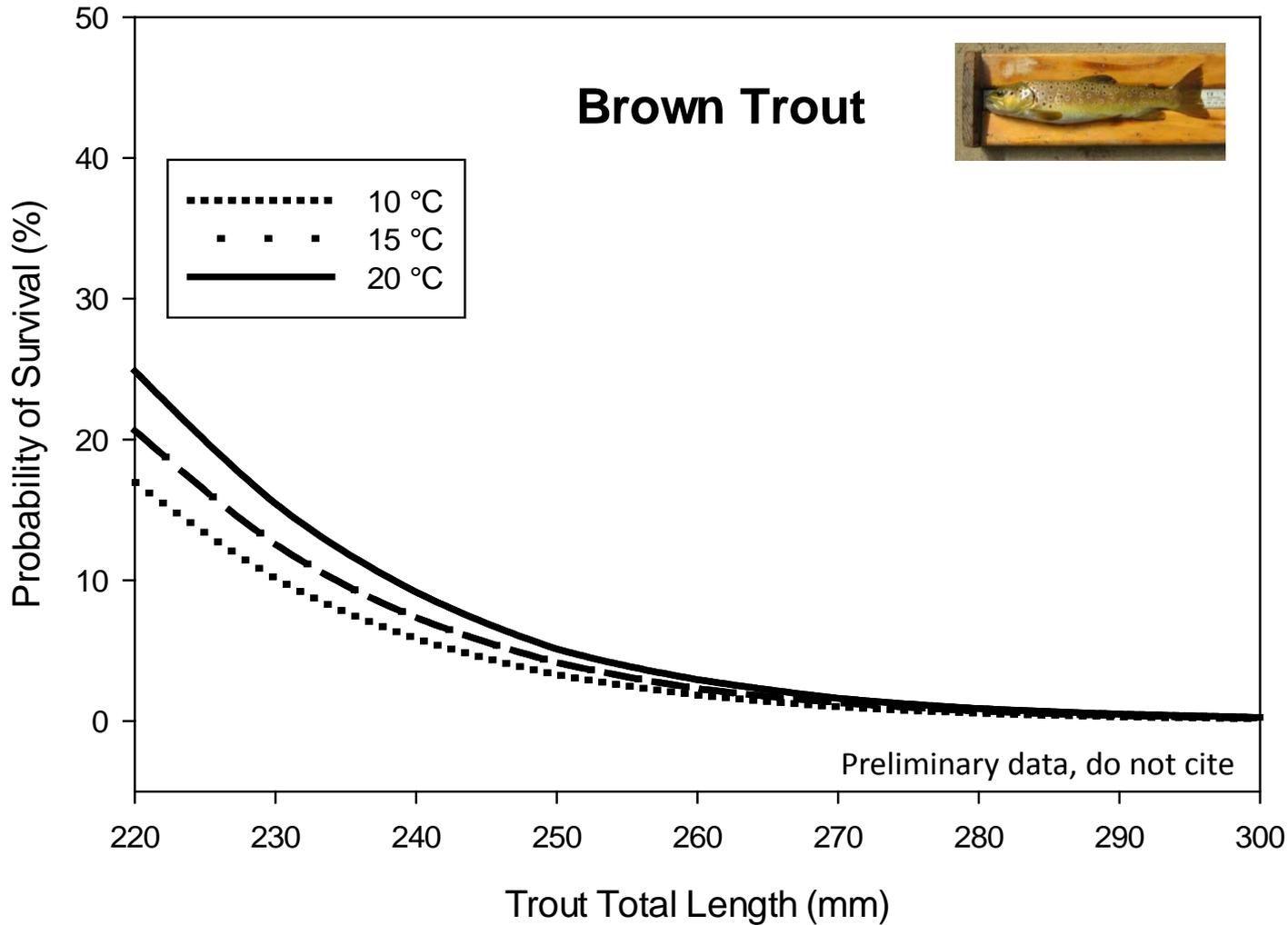
**Its not just about instantaneous predation vulnerability
its also about growth!**

Rainbow Trout



Preliminary data, do not cite

Percent (%) probability that a juvenile chub at 55 mm TL will survive predation by rainbow trout as trout size increases from 220 – 300 mm TL at 10, 15 and 20 °C, with chub size held constant at 55 mm TL.



Percent (%) probability that a juvenile chub at 55 mm TL will survive predation by brown trout as trout size increases from 220 – 300 mm TL at 10, 15 and 20 °C, with chub size held constant at 55 mm TL. Note that the y-axis on the brown trout is reduced by half.

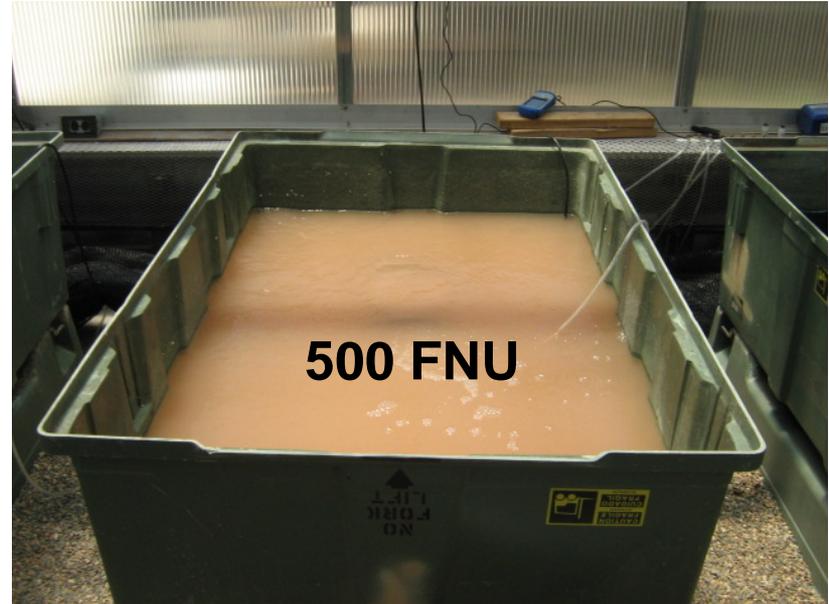
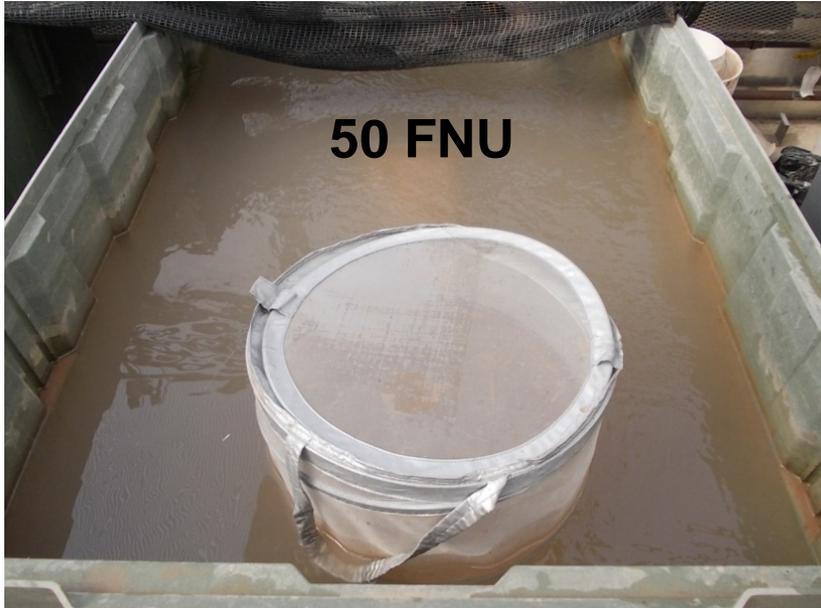


Turbidity



Sifted mud down to <63 microns and blended before mixing in trial tanks

Preliminary trails



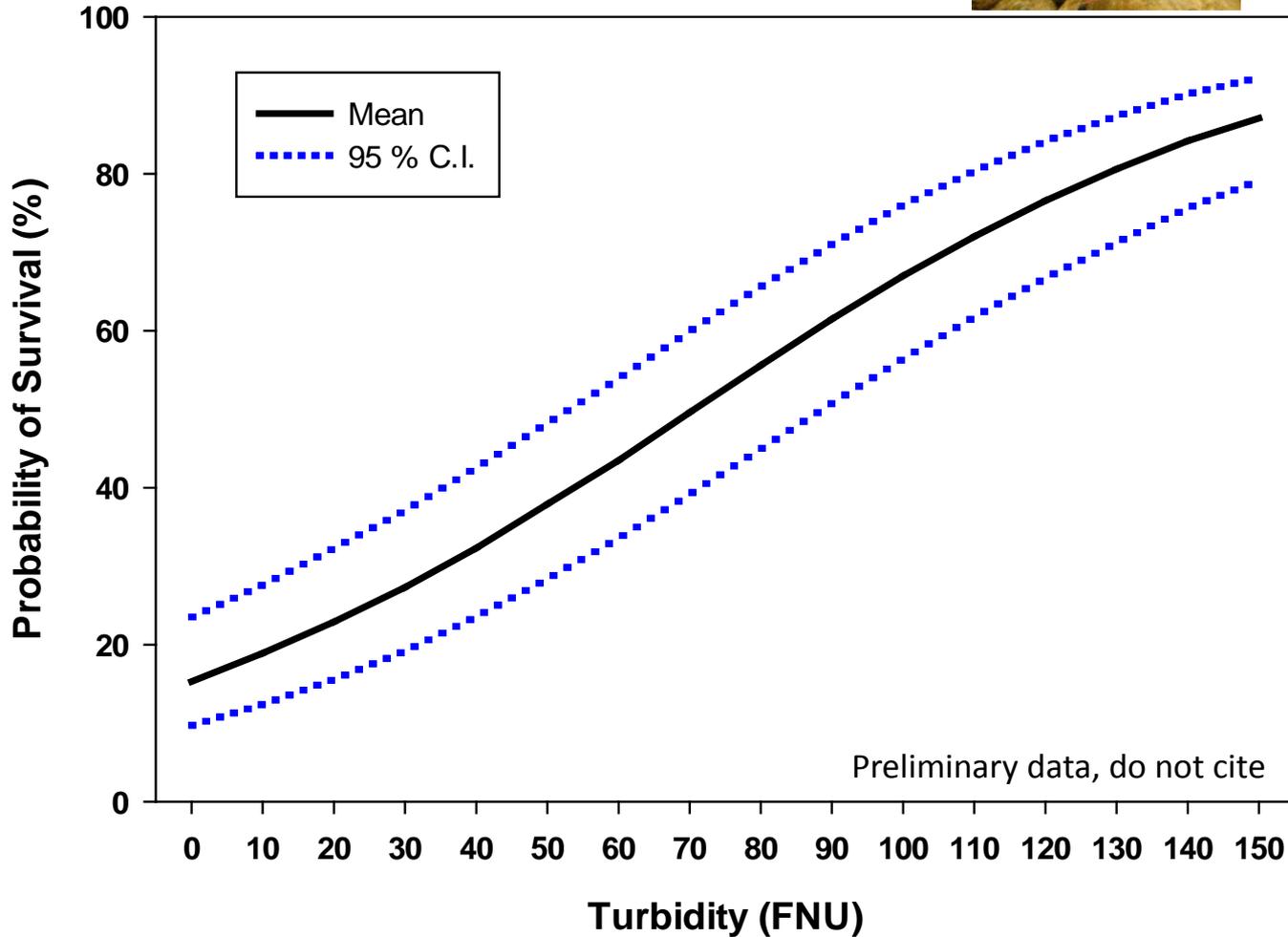
50 FNU

200 FNU

500 FNU

1000 FNU

Rainbow trout



Percent probability of survival for juvenile humpback chub (60 mm TL) exposed to predation by rainbow trout (285 mm TL) as turbidity increases from 0 – 150 FNU at 15° C.

Rainbow Trout Summary

25 NTU

50 NTU

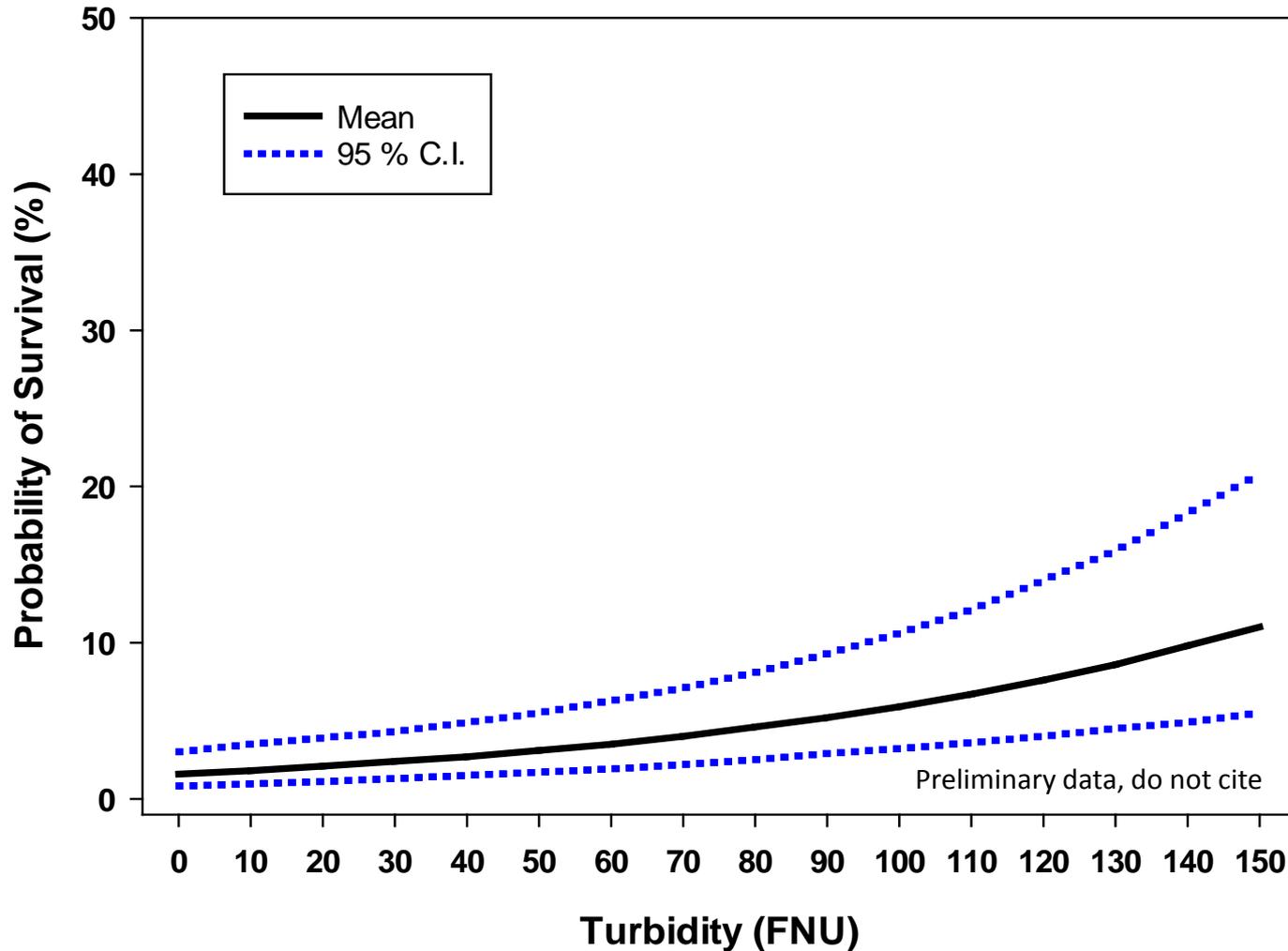
75 NTU

100
NTU

150
NTU

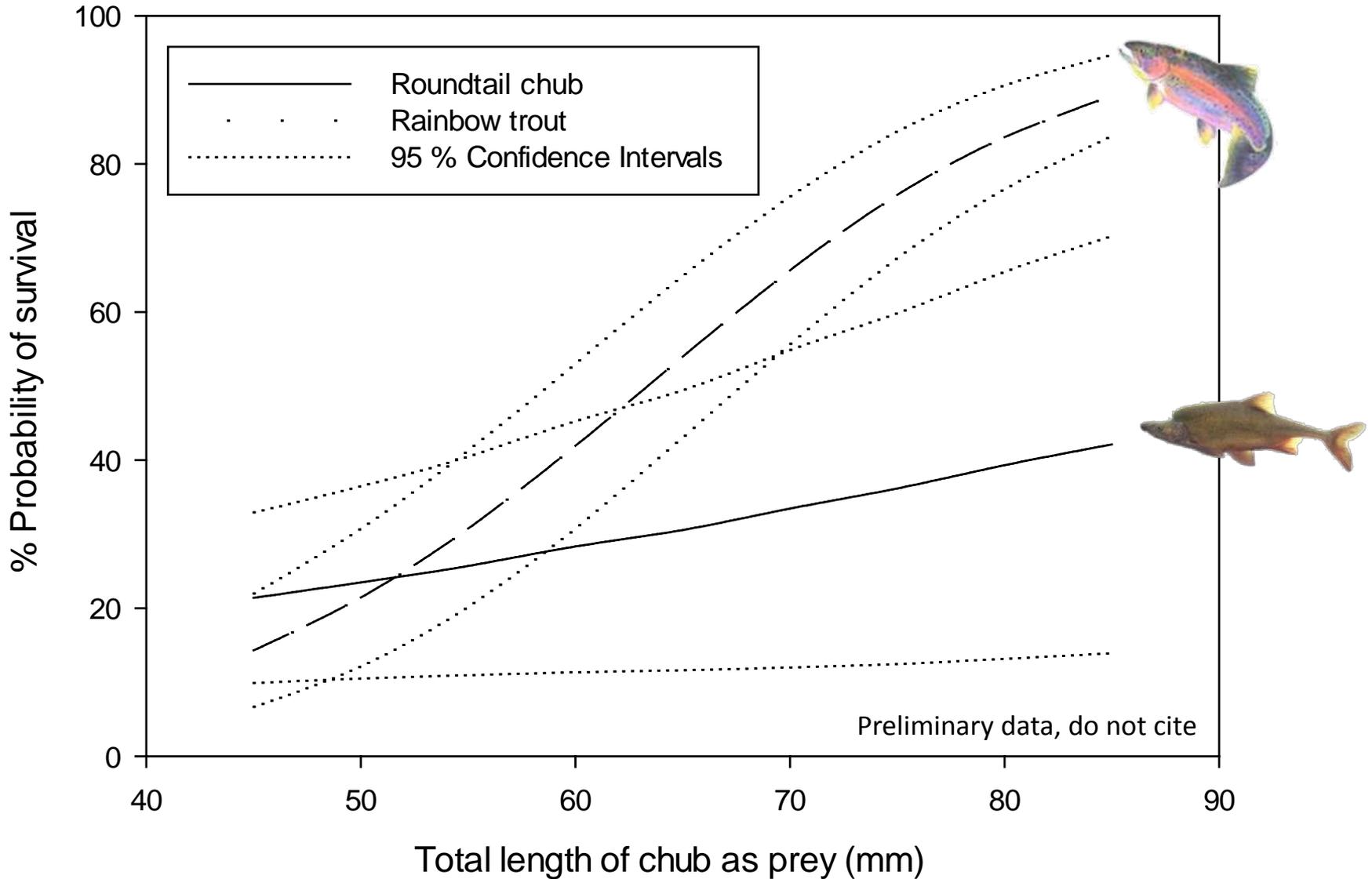


Brown trout

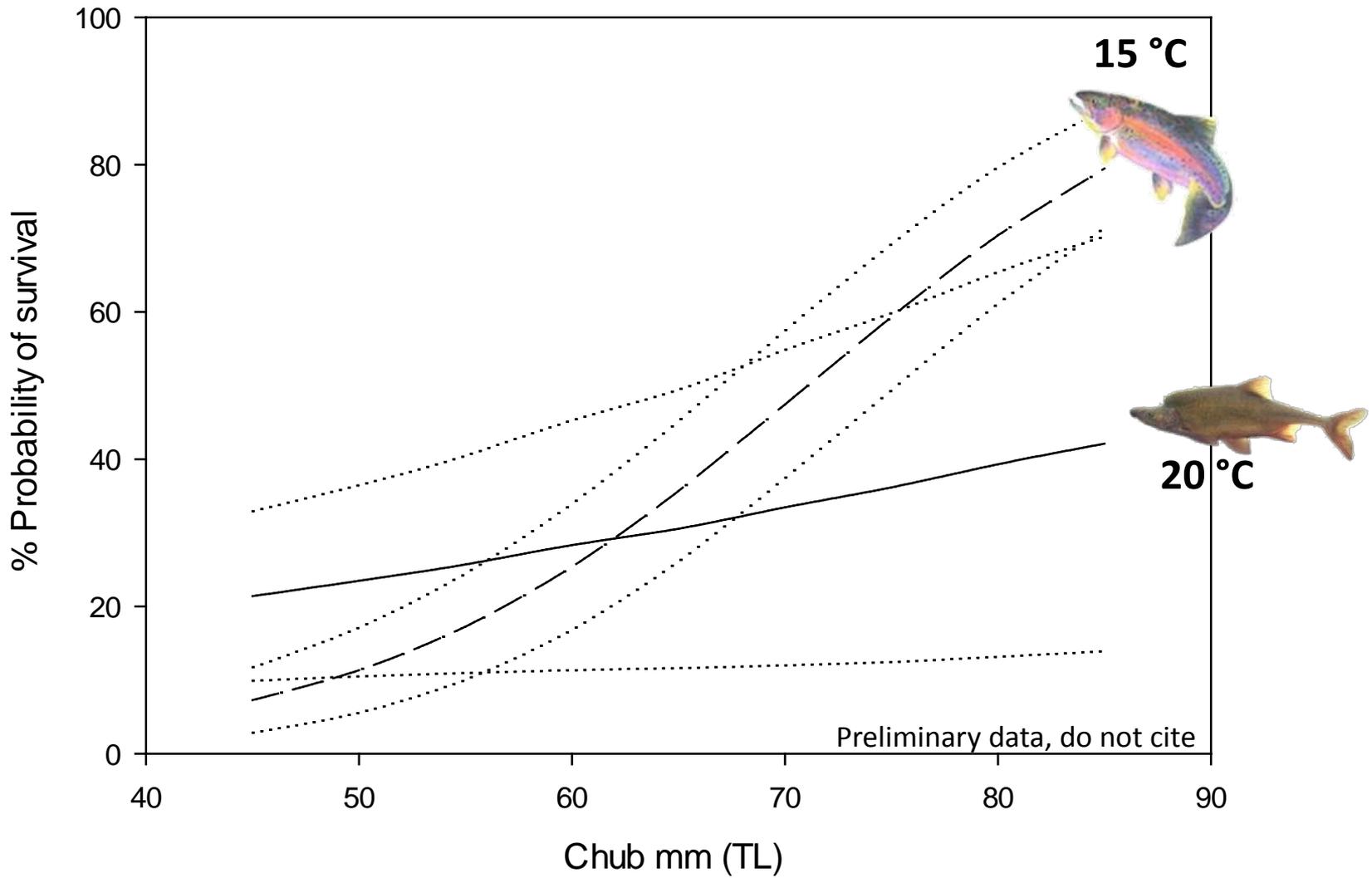


Percent probability of survival for juvenile humpback chub (60 mm TL) exposed to predation by brown trout (285 mm TL) as turbidity increases from 0 – 150 FNU at 15° C.

20 °C

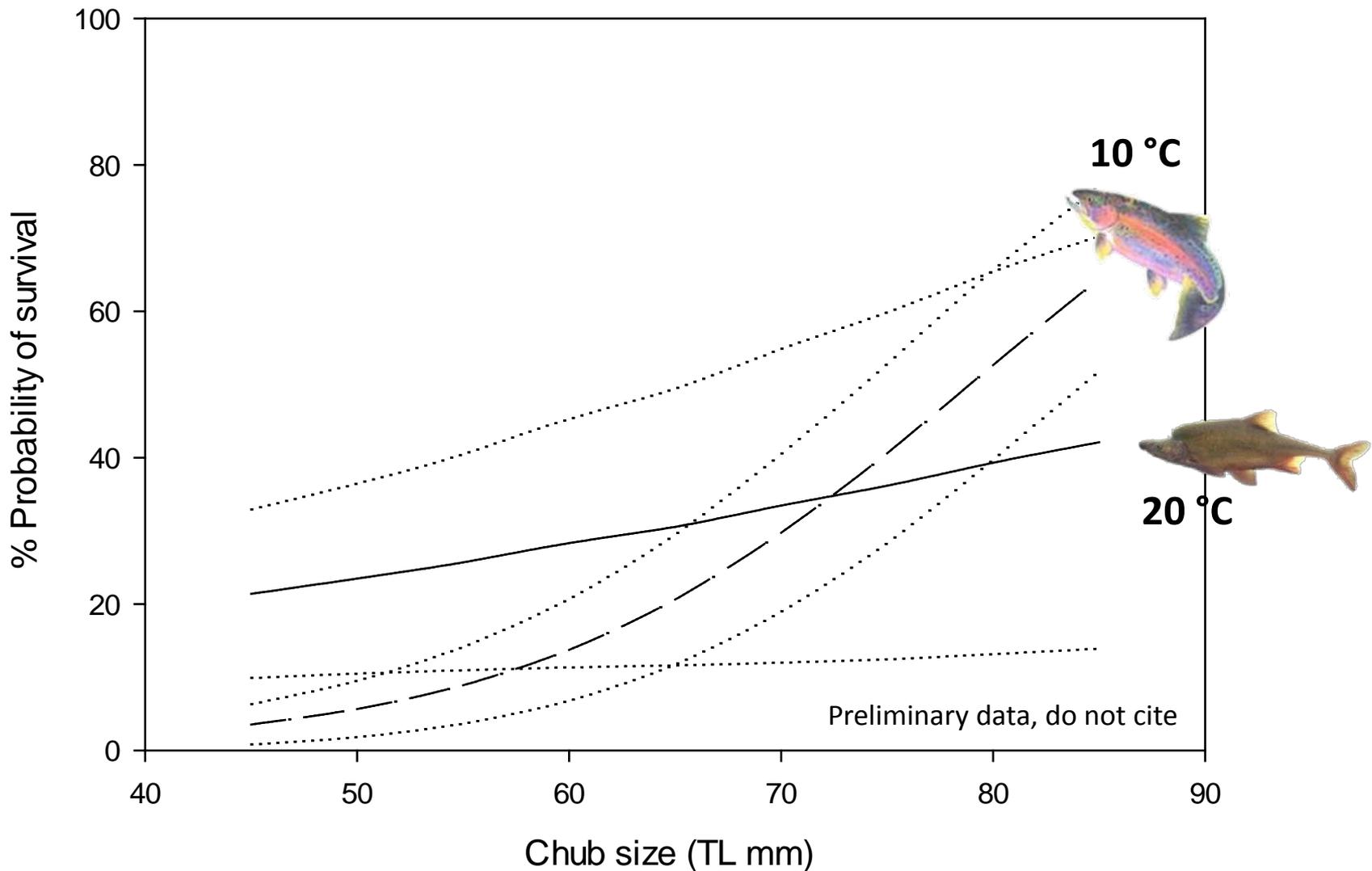


Percent probability of survival for juvenile chub exposed to predation by adult roundtail chub (260 mm TL) or rainbow trout (260 mm TL) at 20° C in overnight laboratory trials.



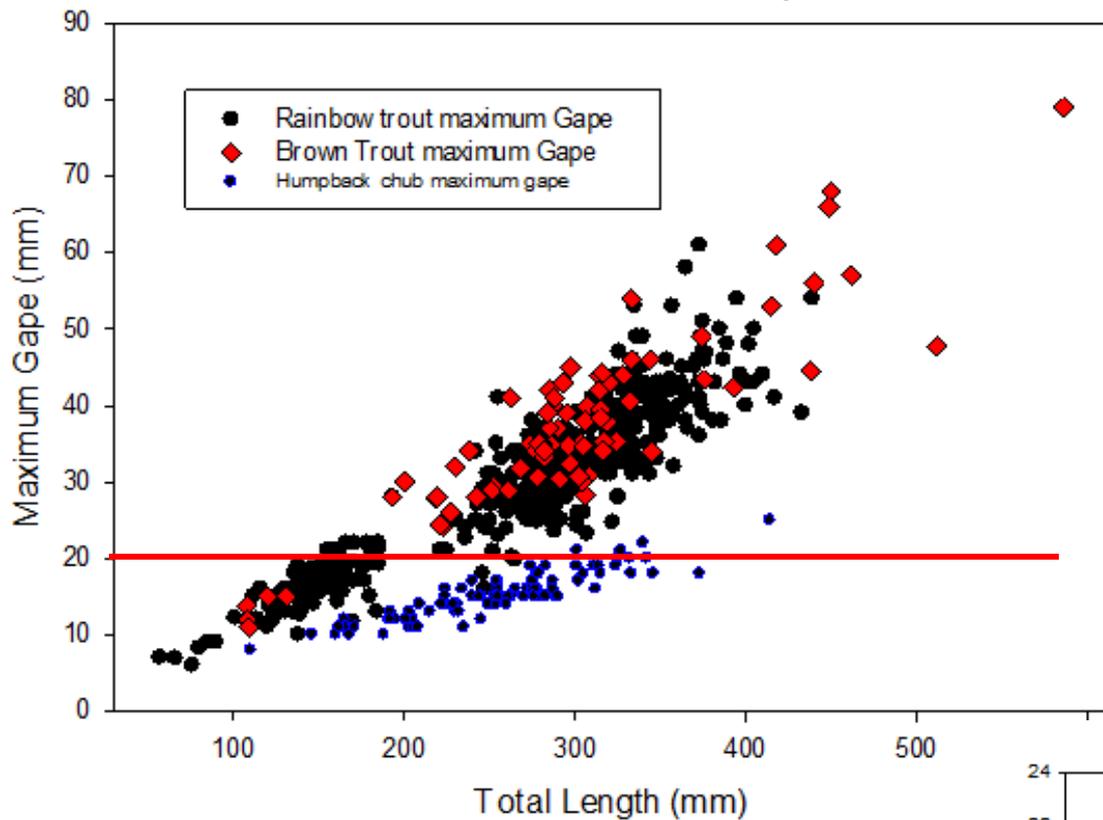
Preliminary data, do not cite

Percent probability of survival for juvenile chub exposed to predation by adult roundtail chub (260 mm TL) at 15° C or rainbow trout (260 mm TL) at 10° C in overnight laboratory trials.

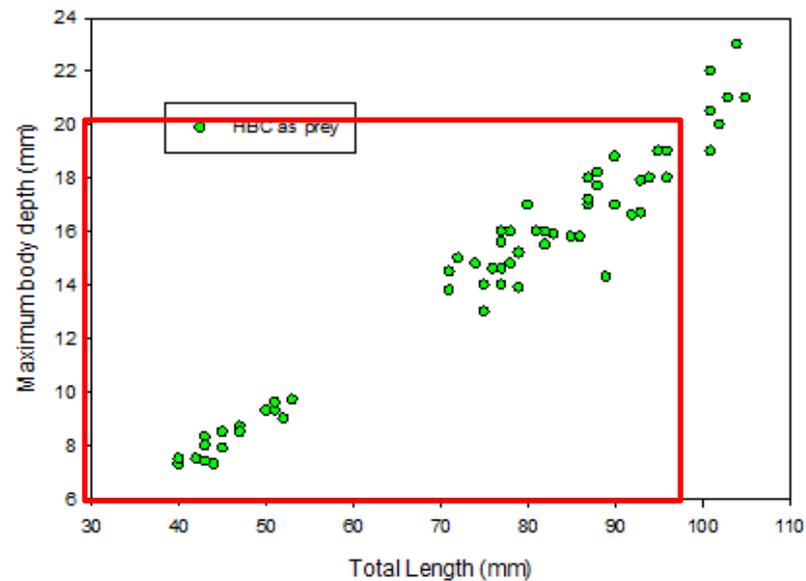


Percent probability of survival for juvenile chub exposed to predation by adult roundtail chub (260 mm TL) at 10° C or rainbow trout (260 mm TL) at 10° C in overnight laboratory trials.

Predator Maximum Gape



Humpback chub



Preliminary data, do not cite

Lets evaluate the lab data in terms of what we see in the field

1. Differences in water temperature
2. Changes in Prey Size
3. Changes in average trout size
4. Annual variability in turbidity

jmp

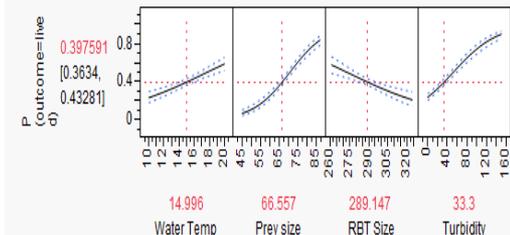
Statistical Discovery.™ From SAS.

DISCOVER JMP®

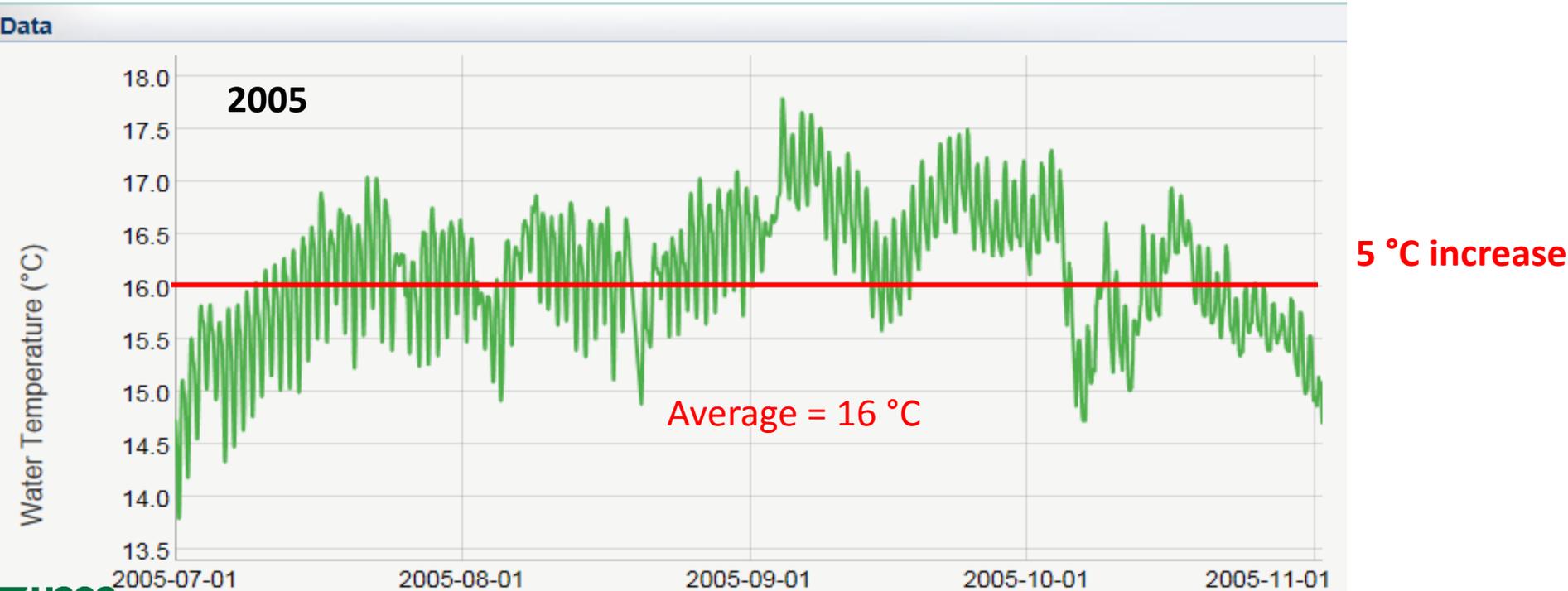
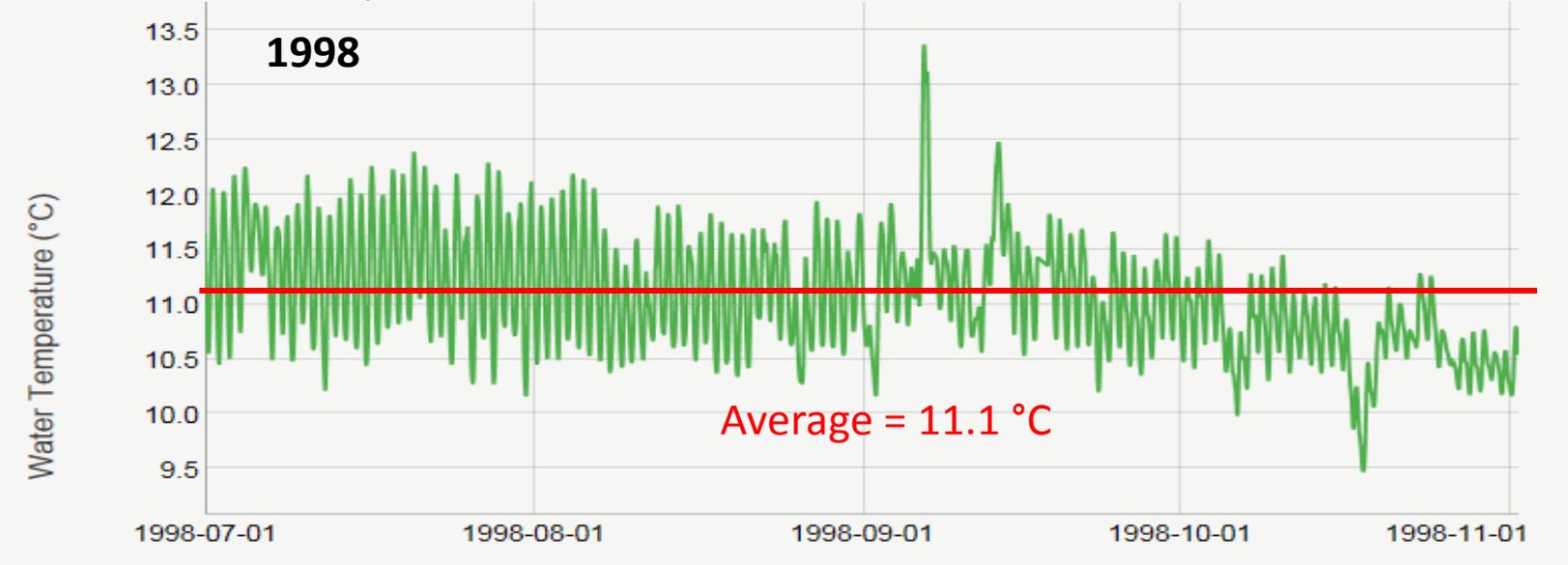
Download your free 30-day trial.



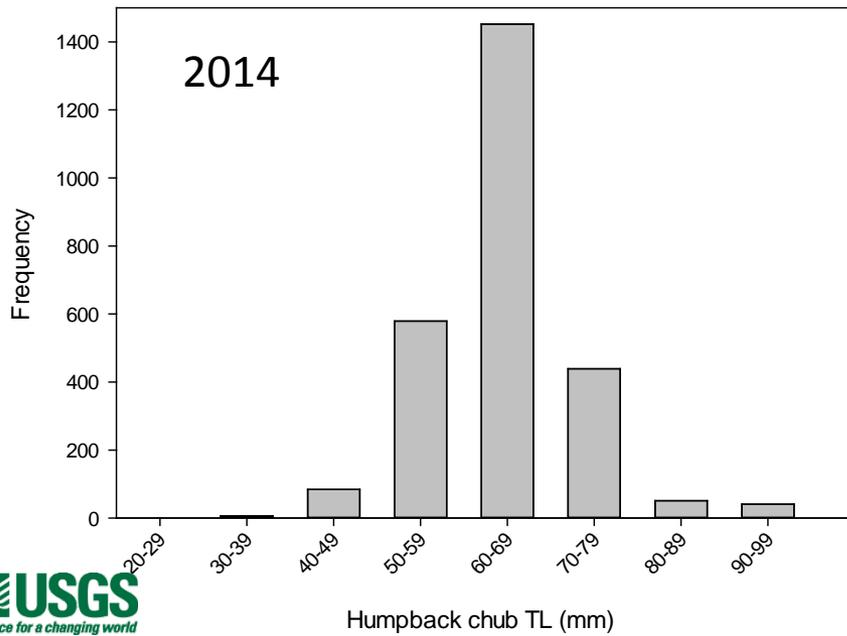
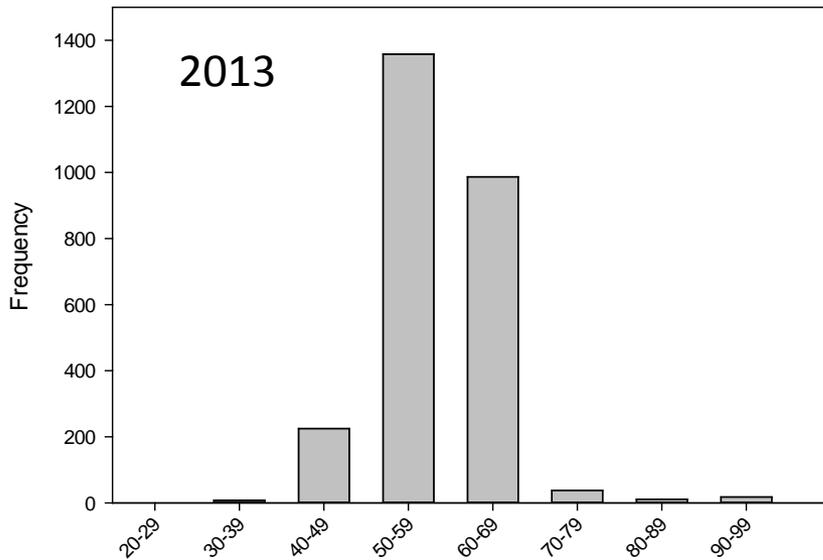
Prediction Profiler



Data Water Temperatures: Colorado River near Little Colorado River Confluence

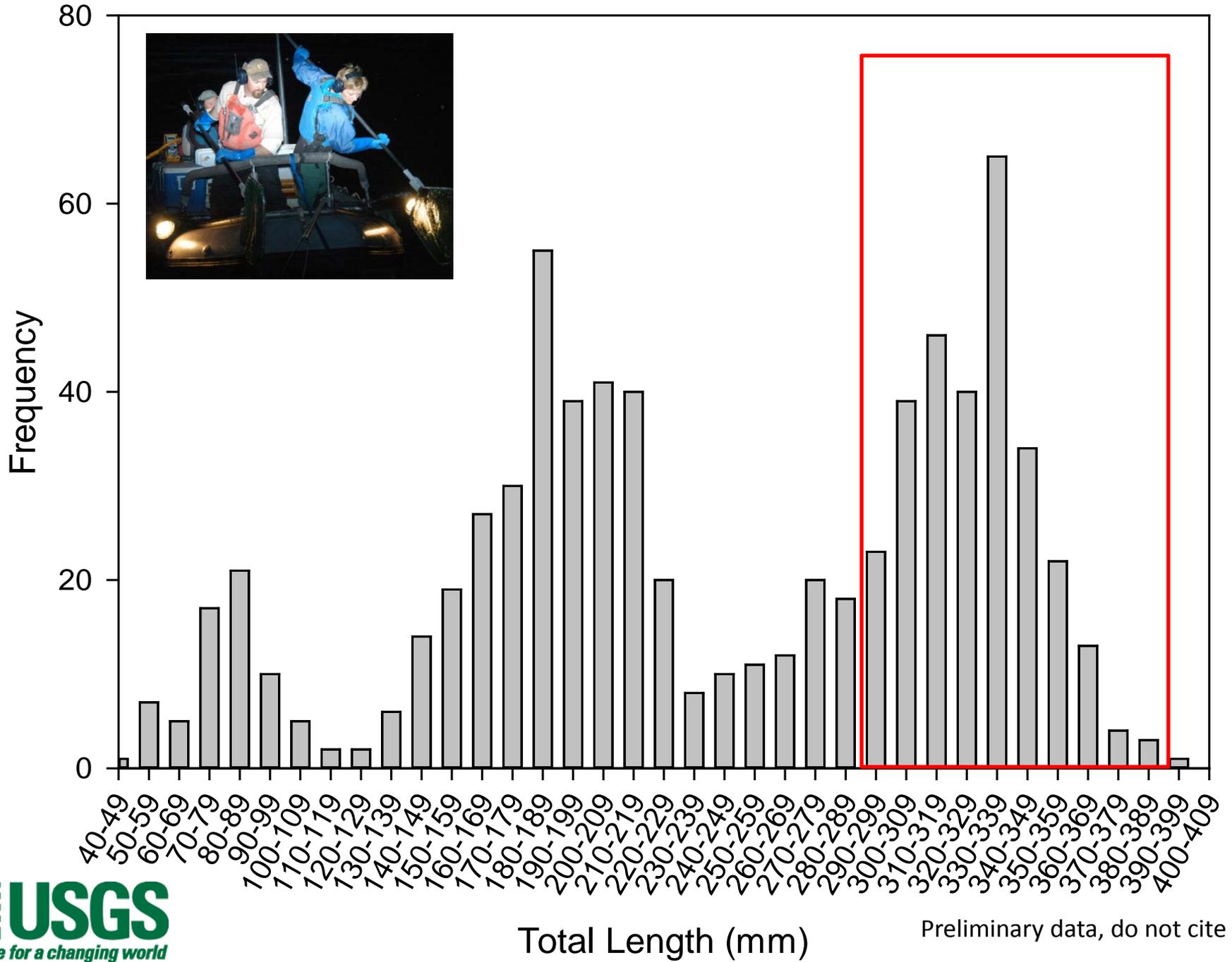


Length Frequency histograms for Age-0 humpback chub in July in the Little Colorado River



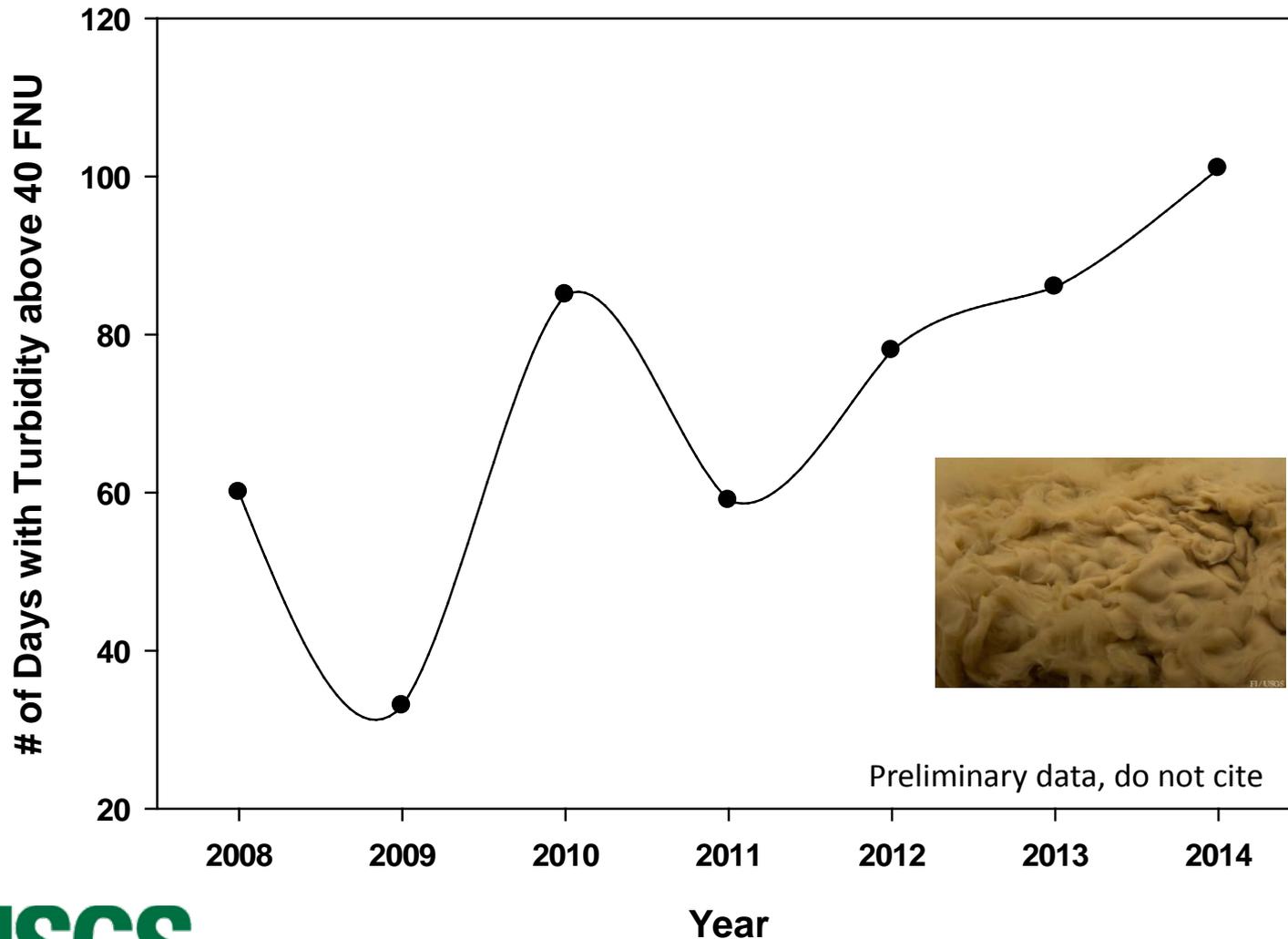
**10 mm increase
In YOY HBC this year**

RBT above and below the LCR 2014



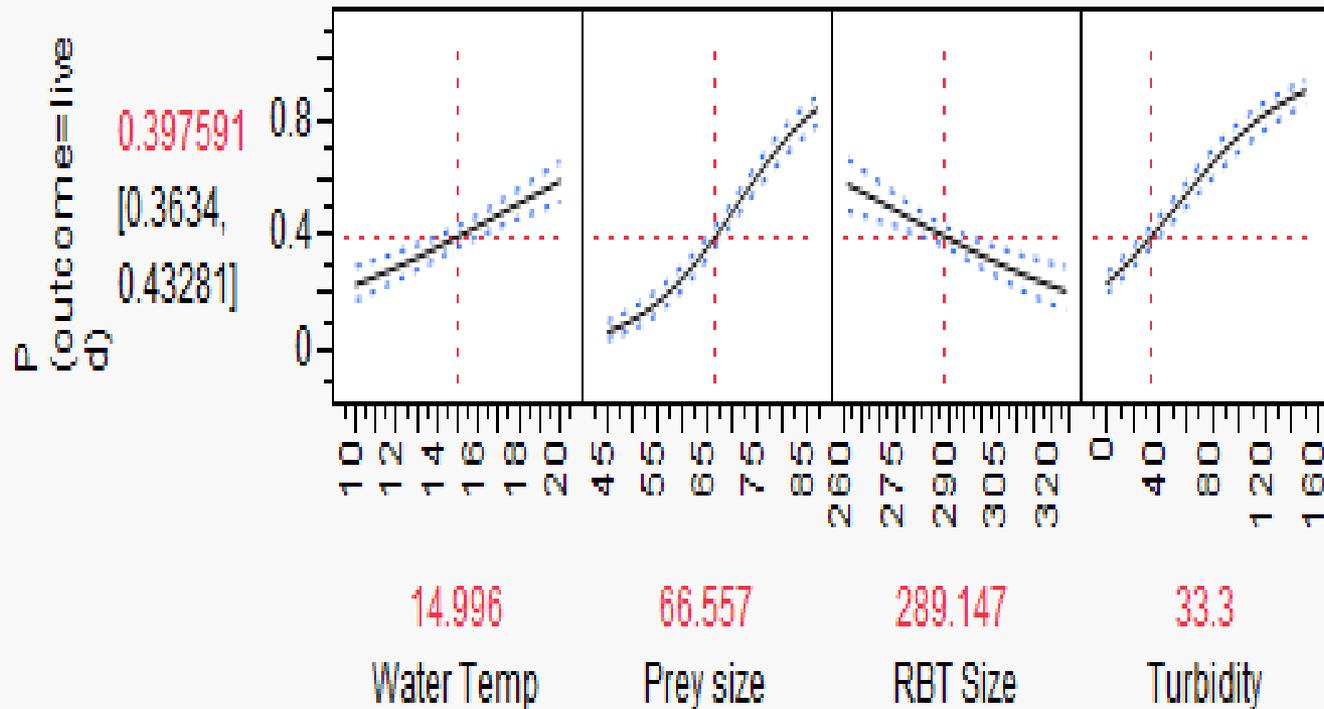
Annual variability in turbidity

Turbidity at Grand Canyon gauge July 1 to Nov 1



Evaluate Scenarios in JMP

Prediction Profiler



Conclusions

- Brown trout are bad news for native fish!
- A small chub is a vulnerable chub!
- Increases in chub size greatly reduce predation vulnerability!



Conclusions

- Relatively small changes in turbidity may be sufficient to alter predation dynamics of rainbow trout on humpback chub!

