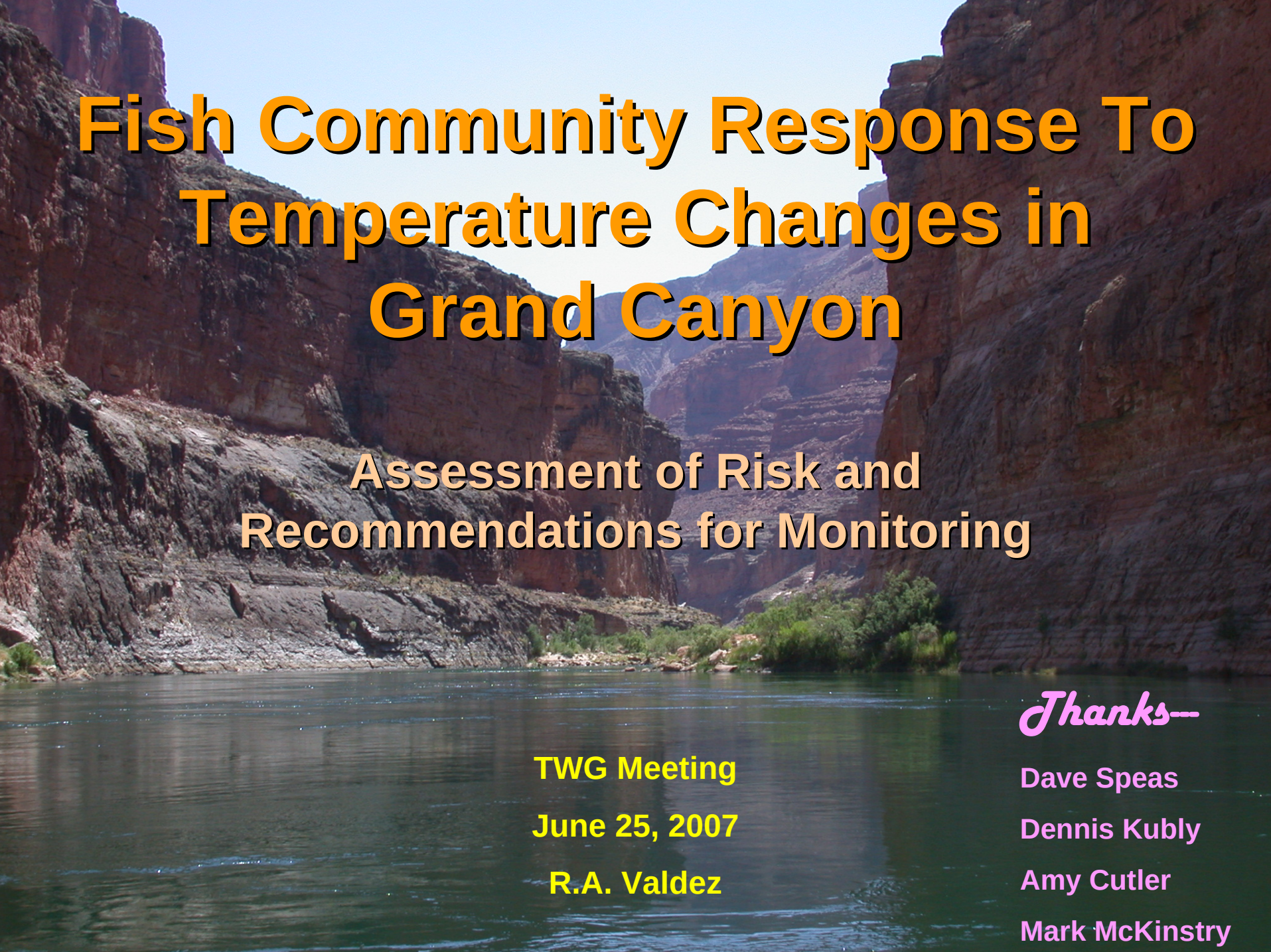


Fish Community Response To Temperature Changes in Grand Canyon

Assessment of Risk and Recommendations for Monitoring

TWG Meeting

June 25, 2007

R.A. Valdez

Thanks---

Dave Speas

Dennis Kubly

Amy Cutler

Mark McKinstry

APPROACH TO NONNATIVES IN GRAND CANYON

1. Identify native and nonnative species in or near Grand Canyon.

2. Evaluate benefit/risk to each species from temperature change.

3. Identify most effective monitoring strategy to detect response.

4. Develop and implement effective removal strategy, as necessary.

1. NATIVE FISH SPECIES (10)

Current Residents

1. humpback chub
2. flannelmouth sucker
3. bluehead sucker
4. speckled dace

Extirpated or Questionable

5. razorback sucker
6. roundtail chub
7. bonytail
8. Colorado pikeminnow

Tributary Species

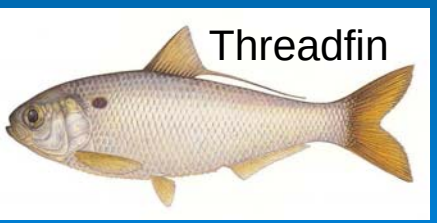
9. Little Colorado spinedace
10. Zuni bluehead sucker

NONNATIVE FISH SPECIES PRESENT (19)

1. black bullhead
2. channel catfish
3. yellow bullhead
4. brown trout
5. rainbow trout
6. threadfin shad
7. common carp
8. fathead minnow
9. golden shiner
10. red shiner
11. mosquitofish
12. plains killifish
13. walleye
14. striped bass
15. black crappie
16. bluegill
17. green sunfish
18. largemouth bass
19. smallmouth bass

NONNATIVE FISH SPECIES ABSENT (7)
(with possible access)

1. flathead catfish
2. gizzard shad
3. grass carp
4. redside shiner
5. sand shiner
6. Utah chub
7. blue tilapia



2. EVALUATE BENEFIT/RISK (Risk Assessment Model)

A. Evaluate benefits of temperature change to humpback chub and other native fish species.

B. Quantify risks associated with response of nonnative fish to changed water temperatures.

Risk Assessment Model

11 Model Parameters

Base Parameters

1. Presence/absence by region
2. Maximum adult size
3. Food habits
4. Known competitor/predator
5. Preferred temperature range
6. Reproductive potential
7. Multiple (fractional) spawners
8. Riverine species
9. Adapted to fast river
10. Diurnal/noctural feeder
11. Temperature Degree Days

TAXA IN RISK MODEL

- 36 Fish Species
- 4 Fish Parasites (AT, LC, TN, WD)
- 9 Zooplanktors
- 12 Primary producers
- 19 Macroinvertebrates

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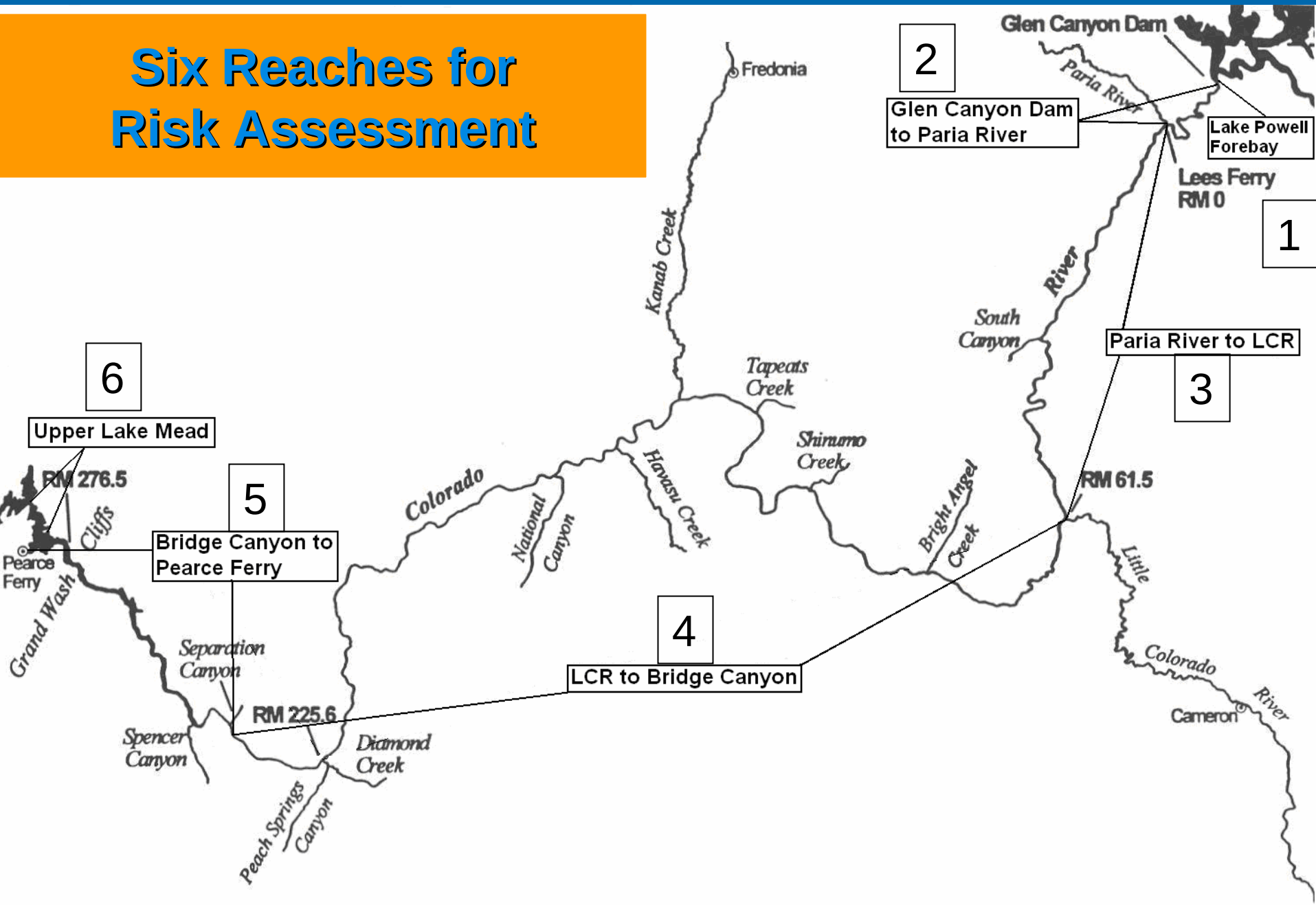
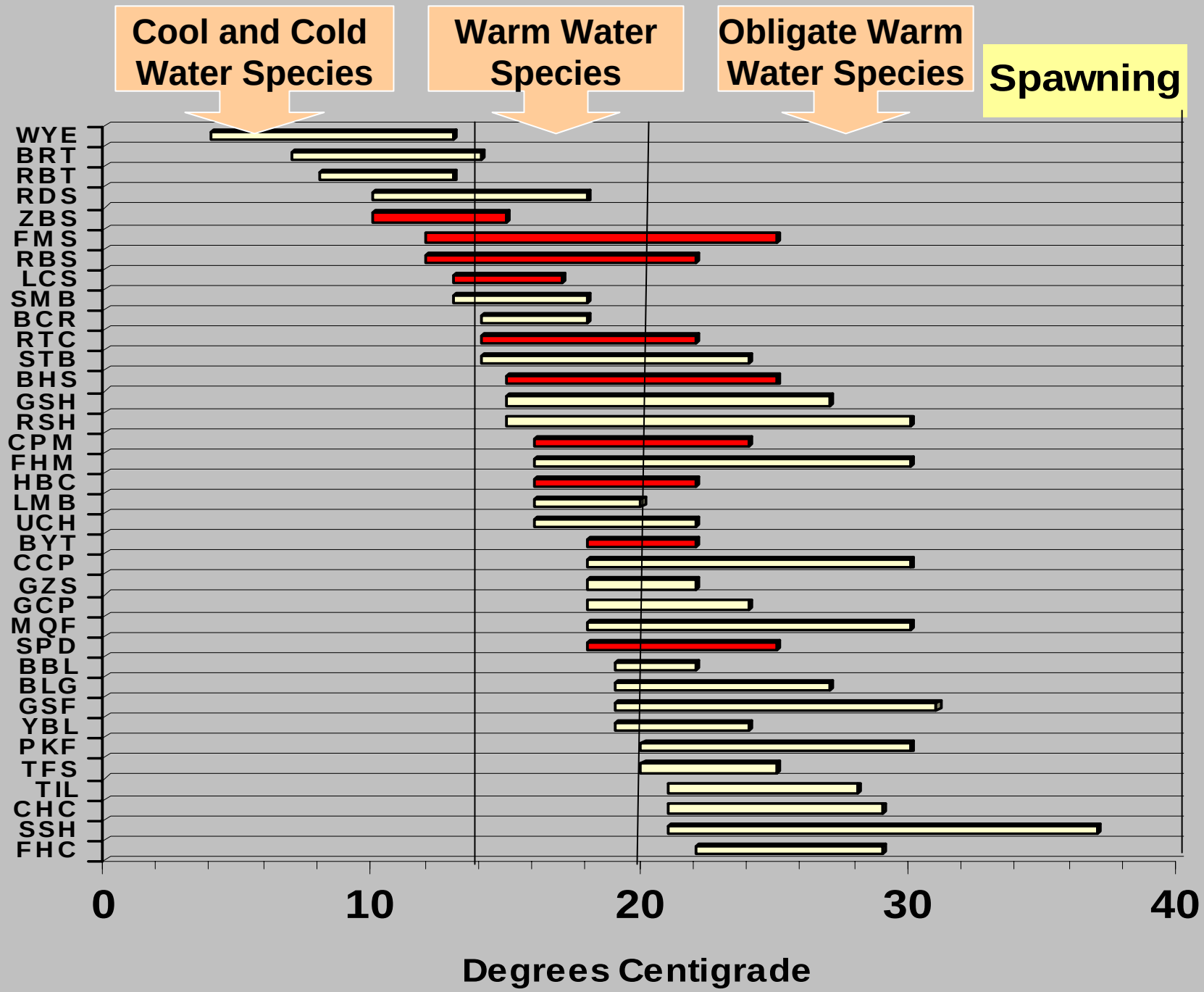
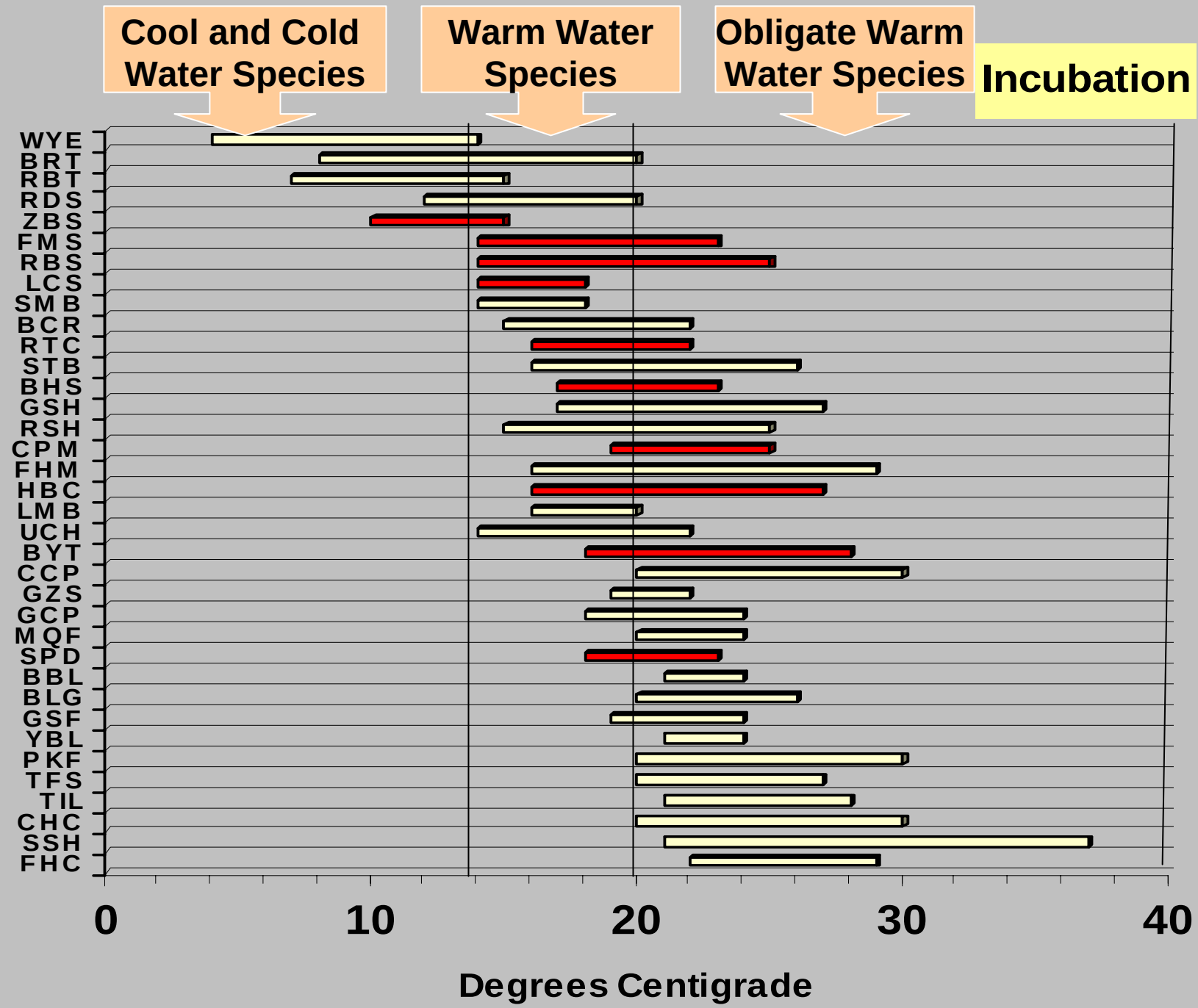
80 Taxa Total

Six Reaches for Risk Assessment




Cool and Cold Water Species
Warm Water Species
Obligate Warm Water Species
Spawning
WYE
BRT
RBT
RDS
ZBS
FMS
RBS
LCS
SMB
BCR
RTC
STB
BHS
GSH
RSH
CPM
FHM
HBC
LMB
UCH
BYT
CCP
GZS
GCP
MQF
SPD
BBL
BLG
GSF
YBL
PKF
TFS
TIL
CHC
SSH
FHC
0
10
20
30
40
Degrees Centigrade


Cool and Cold Water Species
Warm Water Species
Obligate Warm Water Species
Incubation
WYE
BRT
RBT
RDS
ZBS
FMS
RBS
LCS
SMB
BCR
RTC
STB
BHS
GSH
RSH
CPM
FHM
HBC
LMB
UCH
BYT
CCP
GZS
GCP
MQF
SPD
BBL
BLG
GSF
YBL
PKF
TFS
TIL
CHC
SSH
FHC
0
10
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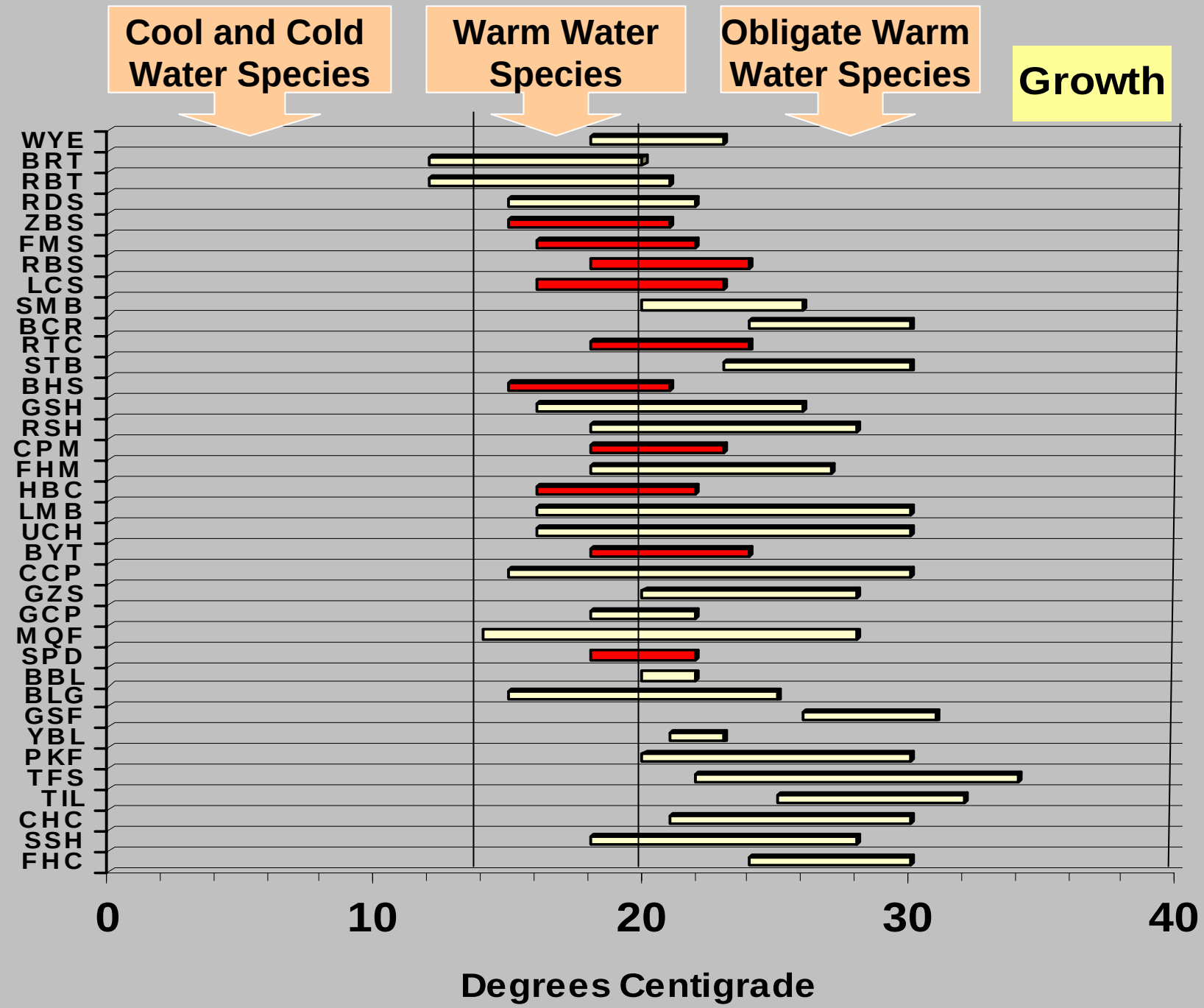
30
40
Degrees Centigrade


Cool and Cold Water Species
Warm Water Species
Obligate Warm Water Species
Growth
WYE
BRT
RBT
RDS
ZBS
FMS
RBS
LCS
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RTC
STB
BHS
GSH
RSH
CPM
FHM
HBC
LMB
UCH
BYT
CCP
GZS
GCP
MQF
SPD
BBL
BLG
GSF
YBL
PKF
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TIL
CHC
SSH
FHC
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10
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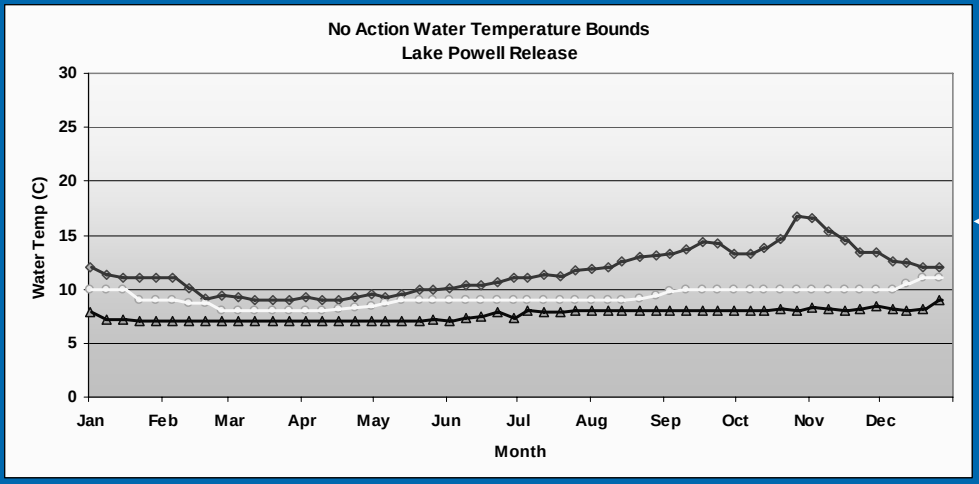
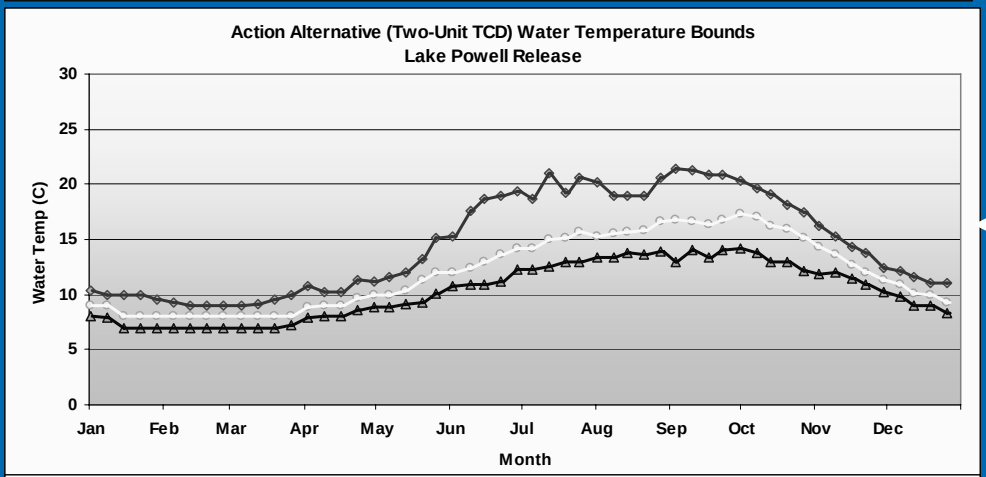
30
40
Degrees Centigrade

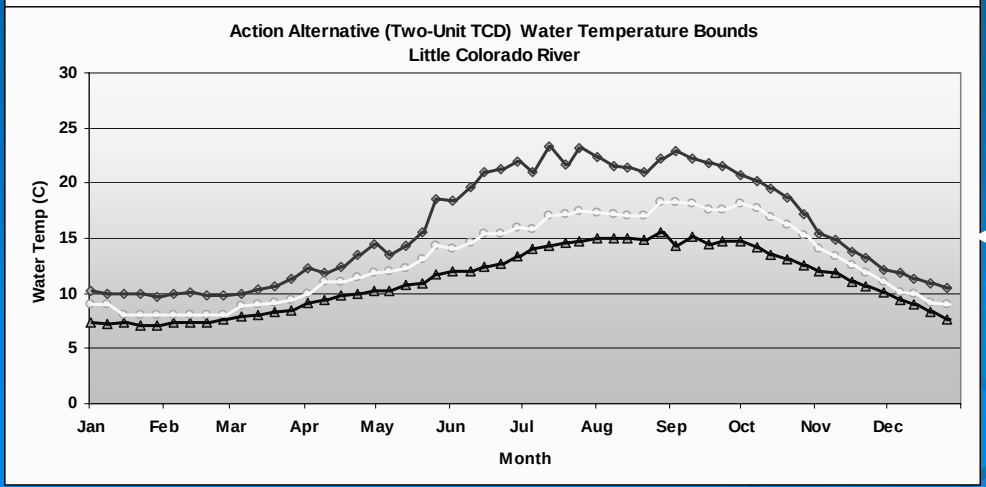
Model uses average daily temps



Minimum, median, maximum temperatures at GCD, 1990-2005

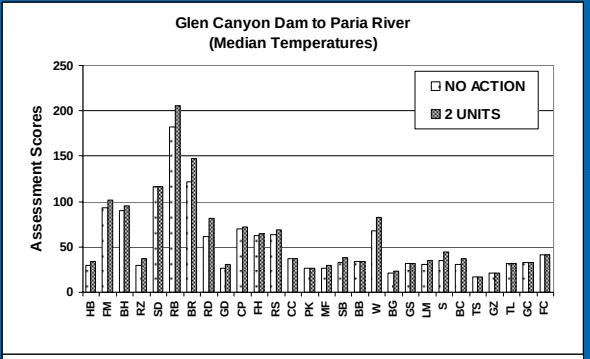


Predicted temperatures for GCD releases with a 2-unit SWS

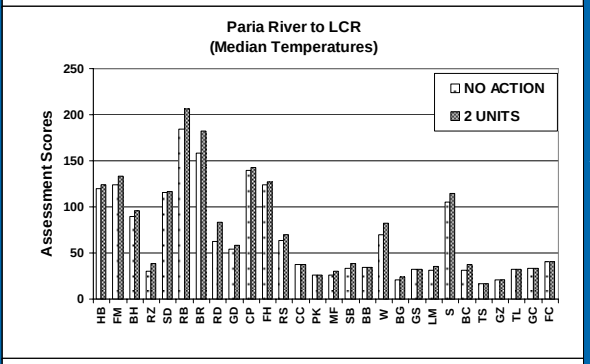


Predicted temperatures of the Colorado River at the LCR with a 2-unit SWS

SAMPLE OUTPUT

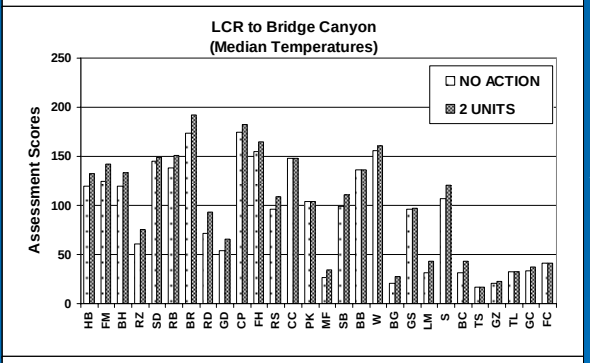


Glen Canyon Dam to Paria River

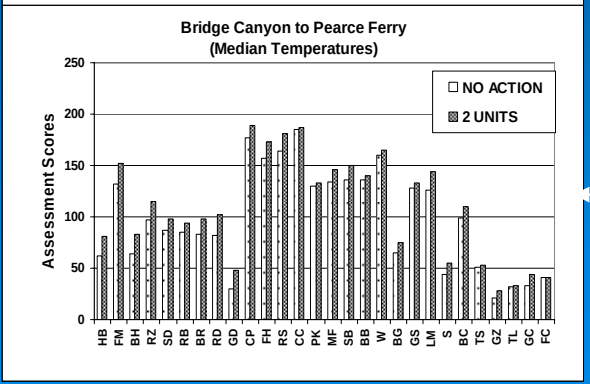


Paria River to LCR

Response by fish to 2-unit SWS

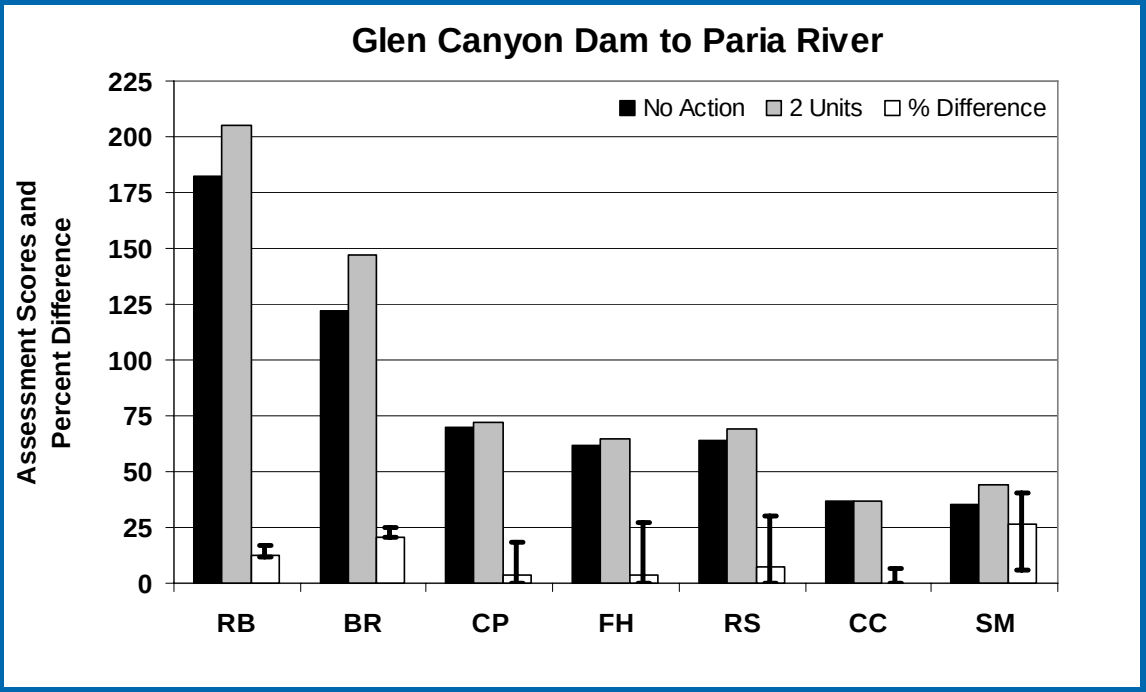


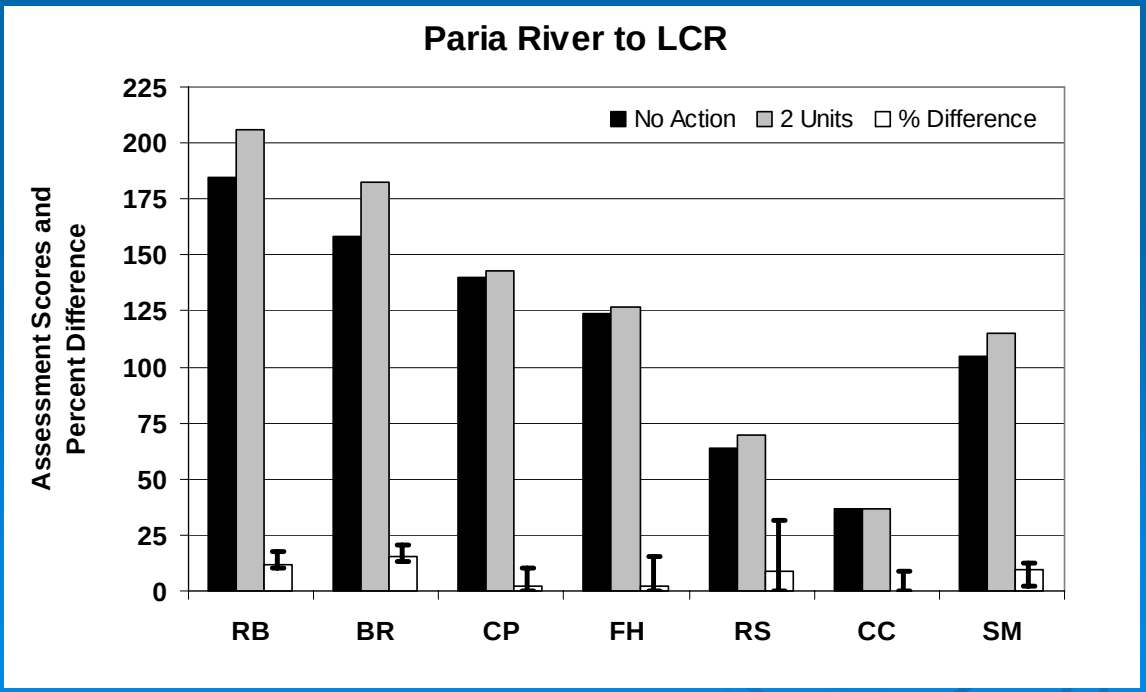
LCR to Bridge Canyon

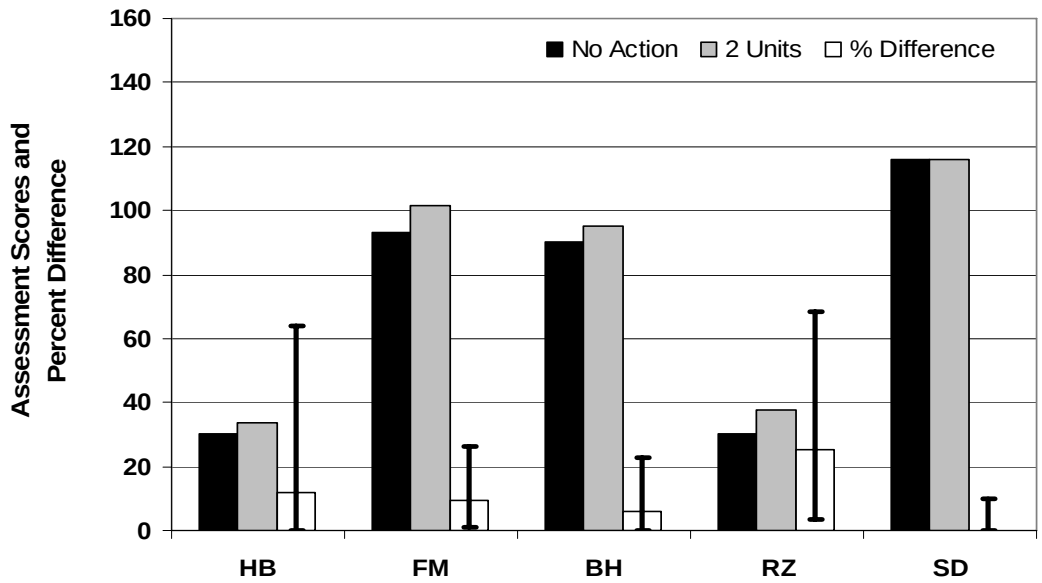


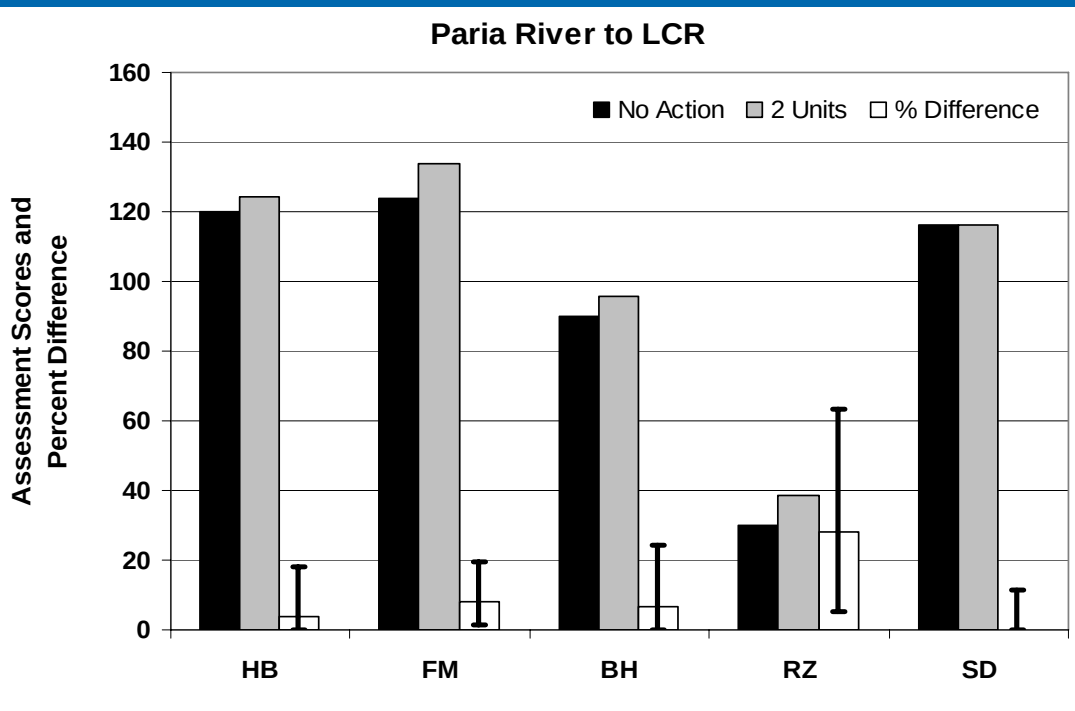
Bridge Canyon to Pearce Ferry

Nonnative Fish






Glen Canyon Dam to Paria River
Assessment Scores and Percent Difference
160
140
120
100
80
60
40
20
0
No Action
2 Units
% Difference
HB
FM
BH
RZ
SD


Paria River to LCR
Assessment Scores and Percent Difference
160
140
120
100
80
60
40
20
0
No Action
2 Units
% Difference
HB
FM
BH
RZ
SD

Native Fish

Fish Species of Greatest Risk
(aka: The Dirty Dozen)

1. Smallmouth bass—predaceous, prolific
2. Brown trout—predaceous
3. Rainbow trout—competitor, predator
4. Red shiner—prolific, predaceous, competitor
5. Common carp—omnivorous, prolific, versatile
6. Channel catfish—nocturnal predator, populous
7. Fathead minnow—tolerant, competitive
8. Green sunfish—prolific, predaceous
9. Black bullhead—nocturnal omnivore
10. Walleye—predaceous!
11. Flathead catfish—predaceous, prolific
12. Grass carp—vegetarian, fluvial

3. MONITORING STRATEGY

1. Recognize Sources
2. Identify Habitat Guilds—BW, SH, TR, MS
3. Target Life Stage—season, locale, habitat
4. Synoptic Sampling Initially
5. Use Appropriate Gear Array

5 Sources of Access

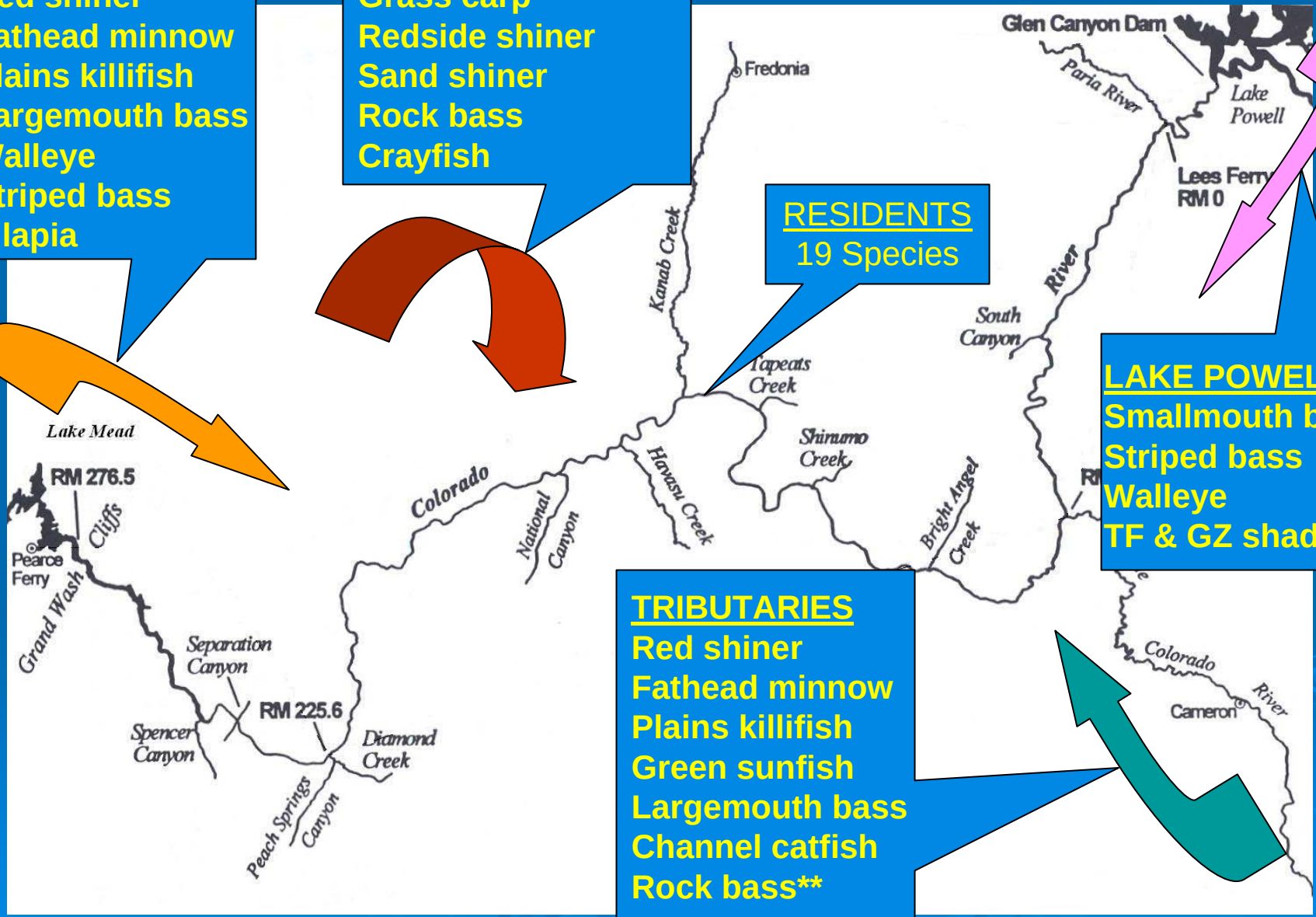
LAKE MEAD
Channel catfish
Red shiner
Fathead minnow
Plains killifish
Largemouth bass
Walleye
Striped bass
Tilapia

OUTSIDE SOURCES
Flathead catfish
Grass carp
Redside shiner
Sand shiner
Rock bass
Crayfish

RESIDENTS
19 Species

LAKE POWELL
Smallmouth bass
Striped bass
Walleye
TF & GZ shad

TRIBUTARIES
Red shiner
Fathead minnow
Plains killifish
Green sunfish
Largemouth bass
Channel catfish
Rock bass**



FISH OF GREATEST RISK (Reproductive Habitat Guilds)

Species	Spawning/Nursery	Juveniles	Adults
smallmouth bass, green sunfish	Guarded nests in 1-3 ft on GR, CO	Shallow shores in structure	Steep drop offs near structure
brown trout, rainbow trout	Shallow GR, CO bars	Shorelines	Mid-channel
red shiner, fathead minnow, redside shiner, common carp	Shallow warm quiet backwaters, shorelines	Warm backwaters, shorelines	Warm backwaters, shorelines
channel catfish, black bullhead, flathead catfish	Crevices, structure	Shallow, near structure	Various
walleye	Broadcast over riffles	Shallow shores in structure	Deep cool areas
grass carp	Pelagic spawners in flowing water	Shallows with vegetation	Prefer vegetation

4. CONTROL/REMOVAL

1. Identify sensitive life stage(s)—"Achilles Heel"
2. Exercise flow options, when possible
3. Implement mechanical control, as necessary
4. Establish success criteria (Ricker, Beverton-Holt, Shaefer)
5. Develop/implement institutional controls (nonnative fish stocking policy)

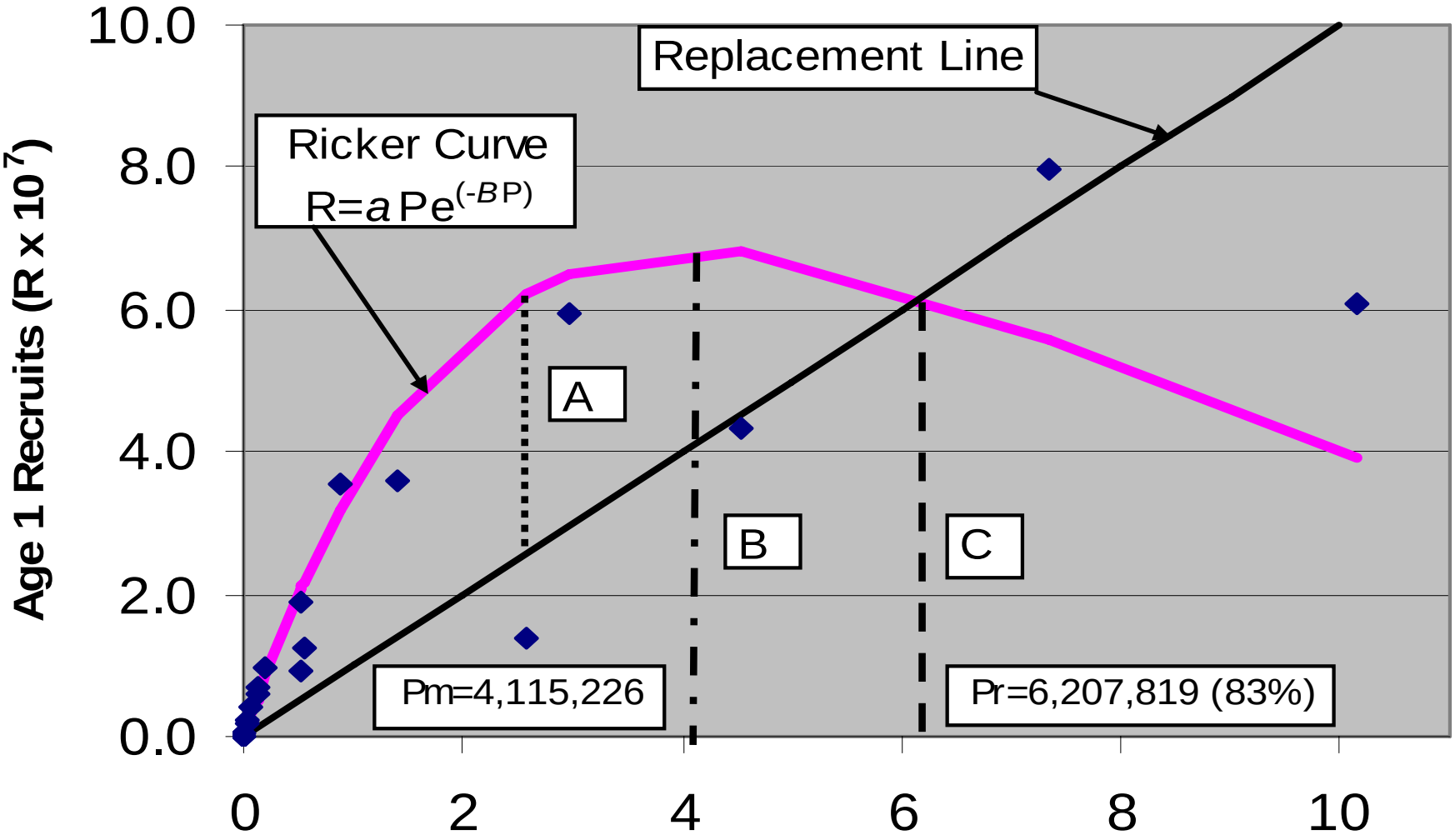
NOTE: Once certain species have become established, they cannot be eradicated!

HOW MANY FISH MUST BE REMOVED TO AFFECT REPRODUCTIVE/RECRUITMENT POTENTIAL?

“Break The Back of The Population”

Ricker Stock Recruitment Curve

Utah Lake Carp



A = MSY; B = Max recruitment; C = Replacement level

Schaefer Yield Curve -- Utah Lake Carp

Unrestricted Harvest

"Tragedy of the Commons"