Temperature Control Device Workshop

January 22-24, 2001
Saguaro Lake Ranch
Mesa, Arizona

Summary of Results

Organizations Represented

- GCMRC
- Fish and Wildlife Svc
- Bureau of Reclamation
- EPA
- National Park Service
- USGS
- AGFD
- Utah DNR
- Arizona State Univ.
- Utah State Univ.
- Colorado State Univ.
- Northern Arizona Univ.
- Argonne National Lab.
- SWCA
- Ecometrics
- Reservoir Environ. Mgmt.
- Stevens Consulting

REQUESTED INFORMATION

- Summary of variables being measured,
- Frequency and intensity of measurements,
- Methods of analysis,
- Ability to detect change in those variables,
- Recommendations for additions or changes to assess effects of a TCD.

Presentations

- GCDAMP Background: Dennis Kubly and Barry Gold (AMP and TCD), Barb Ralston (AMP Science Program)
- Modeling: Josh Korman (Conceptual Model), Amy Cutler (CEQUAL-W2), Dave Harpman (Flow Routing)
- Empirical: Susan Hueftle (Lake Powell-Colorado River Water Quality), Joe Shannon (Algae-Invertebrates), Wayne Gustaveson (Lake Powell Fisheries), Bill Persons (Lees Ferry Trout), Rich Valdez (Mainstream Native-Nonnative Fish), Lew Coggins (Little Colorado River Native-Nonnative Fish), Larry Stevens (Riparian)

Types of Monitoring

- Core monitoring to measure status and trends of high priority resources; highly standardized, few changes once established
- Effects monitoring to measure conditions before and after management actions are taken; more flexible, event driven, set up to accommodate particular actions

Monitoring & Management Actions

- Water temperature is modified as a consequence of modifying hydrology: consider them together in planning
- Researchers need more lead time for design and implementation; water managers need to work more closely with researchers

Riparian Monitoring

- Water Quality & Hydrogeology—Flows, GIS network, local velocities, system-wide air temp and relative humidity (10 Tw sites)
- Establish meterological instrument stations to measure and model nearshore climate
- After third year of TCD measure dendrochronology of *Tamarix* and *Salix exigua*
- Secondary productivity of important insects
- Diet analysis of herps as surrogate for riparian birds

Recreation Monitoring

- Questionnaire to river runners 2 yrs before TCD and during operation re: occurrence of bacterial infections, sickness, injuries during swimming
- Involve Center for Disease Control in monitoring for *Shigella* and other pathogens?

Core Monitoring Physicochemical

	Uplink Continuous	Continuous	Monthly
Forebay	Water Temperature	Conductivity, DO, pH, chlorophyll	Nutrients (P, N, TOC), hydroacoustic survey
Dam	Water Temperature, Discharge	Conductivity, DO, pH, chlorophyll	Nutrients (P, N, TOC), plankton, eggs
Downstream (3 stations)	Water Temperature, Flow	Conductivity, DO, pH, chlorophyll	Nutrients (P, N, TOC)

Core Monitoring
Algae & Invertebrates

- Present sampling design is biased
- Change to randomized approach and clearly define the sampling universe; EPA ORD-EMAP approach, GIS-based
- Two index periods—spring and fall
- Three major habitats—cobble bars, backwaters, and tributaries
- 30-50 samples in each stratum
- Integrate physical habitat, water quality, lower trophic, and fish sampling

Core Reservoir Fish Monitoring

- Shad population measurement indicative of all elements of Lake Powell fishery
- Sample with midwater trawls and tow nets
- Some hydroacoustic work done; may be useful tool in forebay for measuring potential for entrainment with TCD

Core Fish Monitoring - LCR

Trips	Purpose
May (1-2 weeks)	Suite of demographic parameters • > 100 mm TL pit tag • intensive mark-recapture • hoop net, trammel catch rates • stock synthesis models • native fish emphasis
June (2-3 weeks)	
Oct (1-2 weeks)	
Nov (2-3 weeks)	

Core Fish Monitoring - Mainstem

Trips	Purpose
March-April	Mark-recapture HBC, FM, BH aggregations in tributaries Spike flow camps Kanab, Havasu
Early April	Systemwide survey LF-DC
May	Systemwide survey LF-DC
Mid-May	Lees Ferry, native fish on spawning bars, trammel nets
June-July	Mark-recapture LCR area (HBC, FM, BH),
Sep	Nonnative electrofishing, predator collections

Lee's Ferry Trout Fishery Frequency of Sampling

- Electroshocking:
  - 1984-1990 Inconsistent
  - 1991-1996 15 sites 3x / year 2000 sec/site
  - 1997-2000 9 sites 3x / year 2000 sec/site
  - 2001 - ? 9 + 27 sites 4x / year 500 sec/site
- Creel:
  - 1965-1970 Inconsistent
  - 1977-2000 Monthly estimates (12d/month)
  - 2001 - ?
- Snorkel:
  - 1998-2000 Exploratory
  - 2001 - ? 36 sites 4x / year to evaluate, calibrate

Status and Trend Variables Lee's Ferry Fishery

- Electrofishing:
  - Date, time, RM station, effort (seconds)
  - Species, length, weight, PIT tag info (growth, movement), sex, maturity
  - Wild/hatchery origin (coded wire tags)
- Creel:
  - Angler catch/hour
  - Angler use (angler hours/month)
  - Satisfaction
- Snorkel Surveys:
  - Fish density/calibration efforts

Lee's Ferry Trout Methods of Analysis

- Descriptive statistics for status and trends--Catch per unit effort (CPUE), Kn (relative condition), proportional stock density, length frequency distribution;
- Stock Synthesis Models--Age structured dynamic population model; calculate Walford/von Bertallanfy growth curves from mark/recapture.

Lee’s Ferry Trout Change Detection

- Power analysis and evaluation of electrofishing protocol--Preliminary results suggest that current protocol (1991-2000) was capable of detecting moderate variations in trout relative density and condition over both short (1-2 yr.) and long-term (5+ year) time scales;
- Results also indicate that detectable magnitudes of change vary considerably with fish size;
- Increases in number of sample sites and frequency of sampling should increase ability to detect short term change.

Temporal Indicators of Change

	Early (~Yr 1)	Mid (~Yr 2-5)	Late (~Yr 6-20)
Physico-chemical	Water temp System metabolism Allochthonous input (reservoir) C:N SI Ratios		
Lower Trophic	PB & MIB Biomass New colonists	PB Community Composition	MIB Community Composition
Fish	Catch rates, Range, Reprod success, Growth, SBE numbers, New colonists	Sustained range expansion, Growth, Disease/ parasites, Pop estimates	Recruitment, 2nd population, Down- and delisting of T&E

Requested Information

- Summary of variables being measured,
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- Recommendations for changes or additions to assess effects of a TCD.

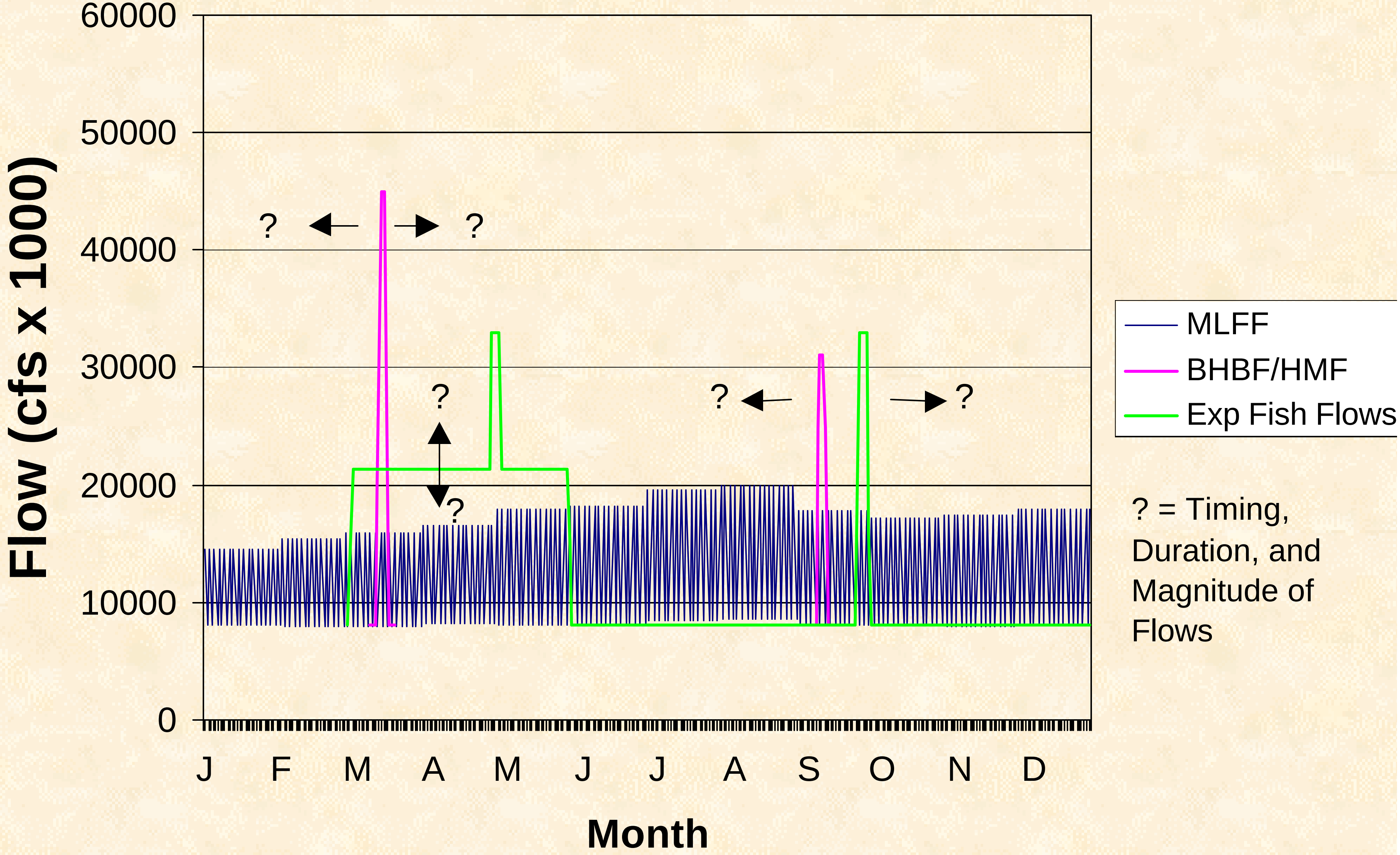
Change Detection

- Our ability to detect significant change depends on five interacting factors (Valdez):
- <Sample Size
- <Variability
- <Level of Significance
- <Power (probability of detecting a difference when one exists)
- <Minimum Detectable Effect

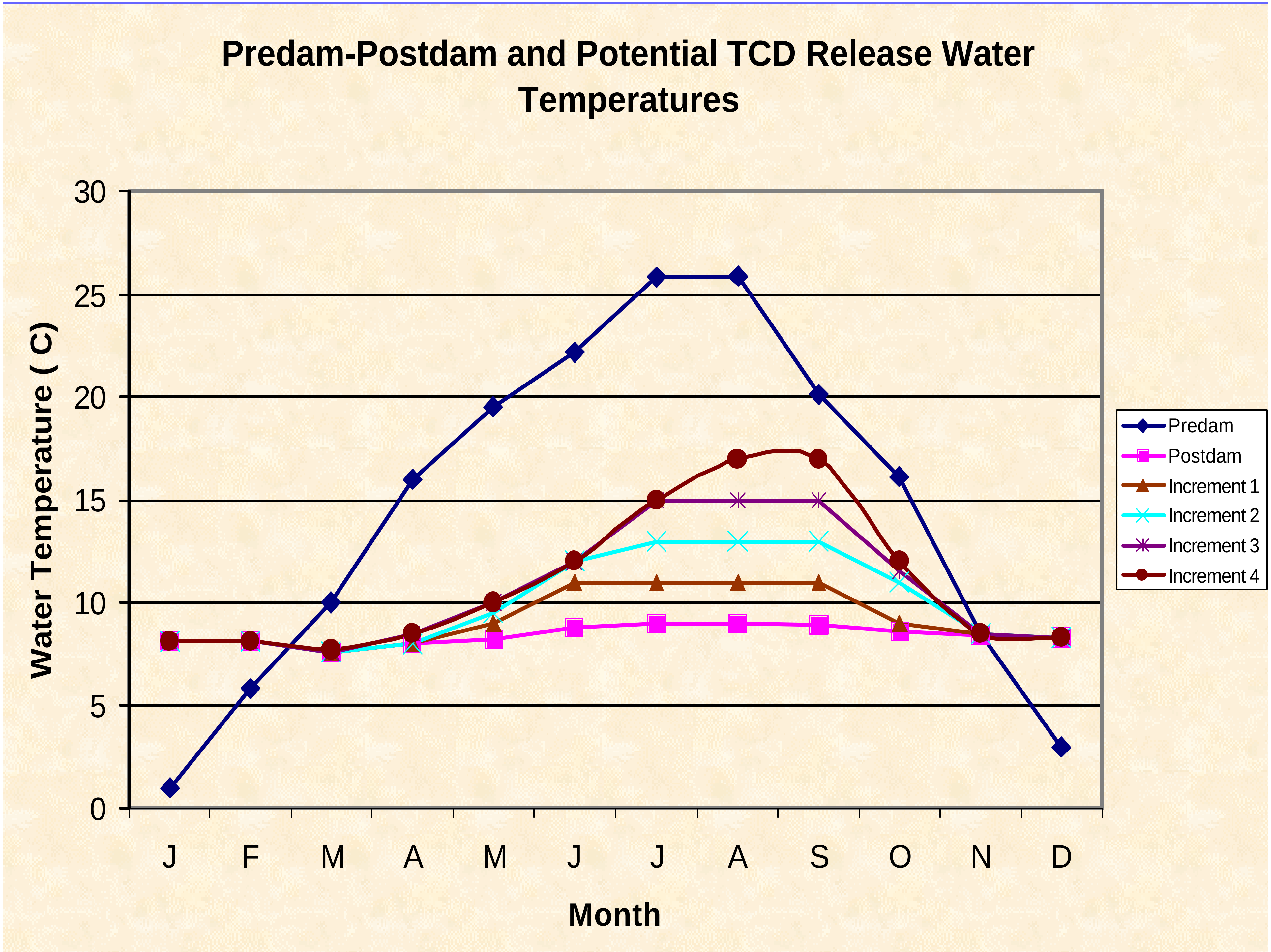
Types of Statistical Error

	Null Hypothesis True	Alternative Hypothesis True
Reject Null Hypothesis	Type I Error " Probability of Rejecting H_o when H_o is true	Correct Decision (1 - \$) Probability of Rejecting H_o when H_a is True
Fail to Reject Null Hypothesis	Correct Decision (1- ") Probability of Not Rejecting H_o when H_o is True	Type II Error \$ Probability of Failing to Reject H_o when H_a is True

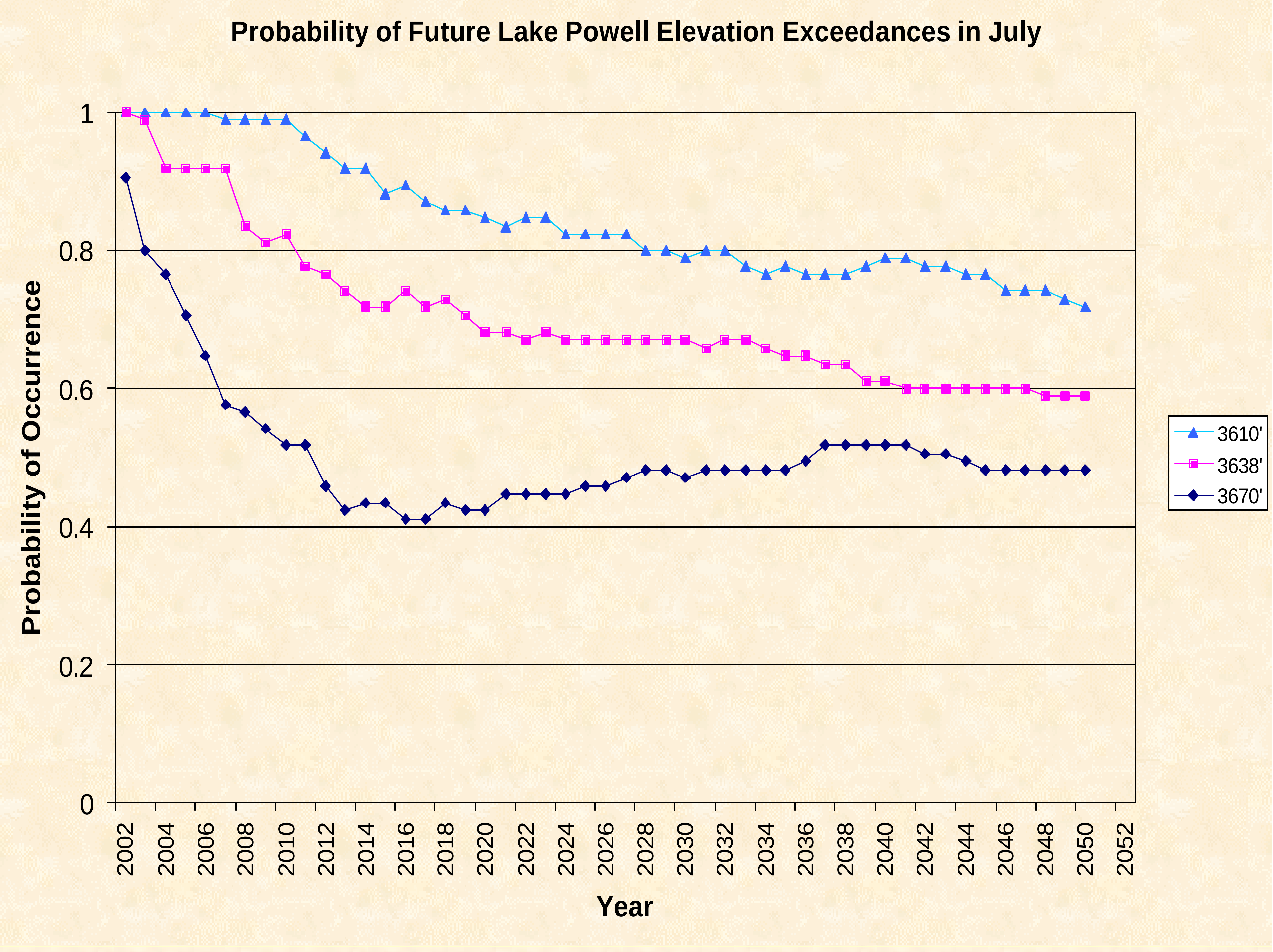
Potential Glen Canyon Dam Releases



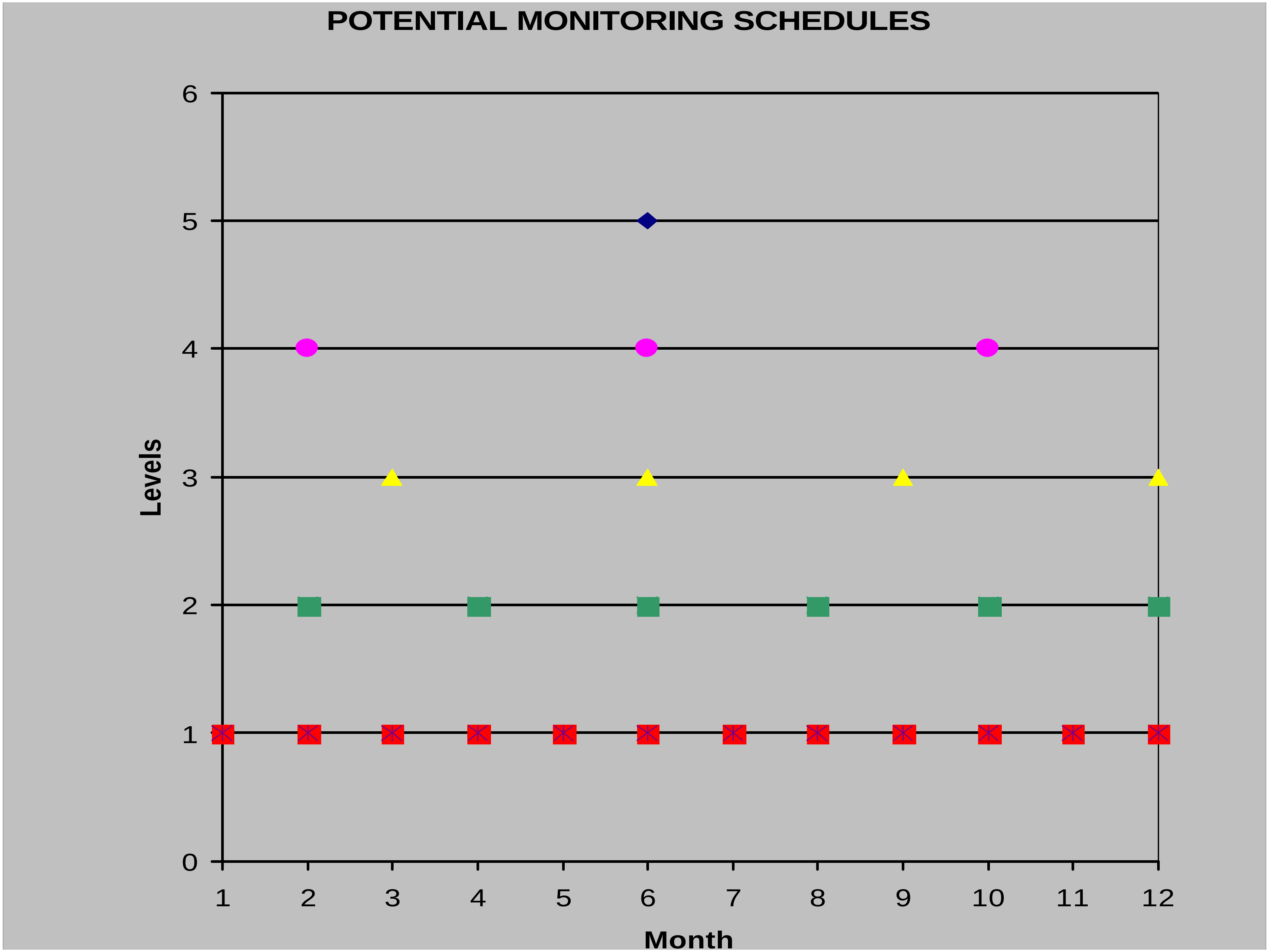
? = Timing, Duration, and Magnitude of Flows



Predam-Postdam and Potential TCD Release Water Temperatures
Water Temperature (C)
30
25
20
15
10
5
0
J
F
M
A
M
J
J
A
S
O
N
D
Month
Predam
Postdam
Increment 1
Increment 2
Increment 3
Increment 4



Probability of Future Lake Powell Elevation Exceedances in July
Probability of Occurrence
1
0.8
0.6
0.4
0.2
0
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050
2052
Year
3610'
3638'
3670'


POTENTIAL MONITORING SCHEDULES
Levels
0
1
2
3
4
5
6
Month
1
2
3
4
5
6
7
8
9
10
11
12