

Gaming to Study Flexing The X2 Standard

SWRCB Workshop on Flexing
August 31, 2005

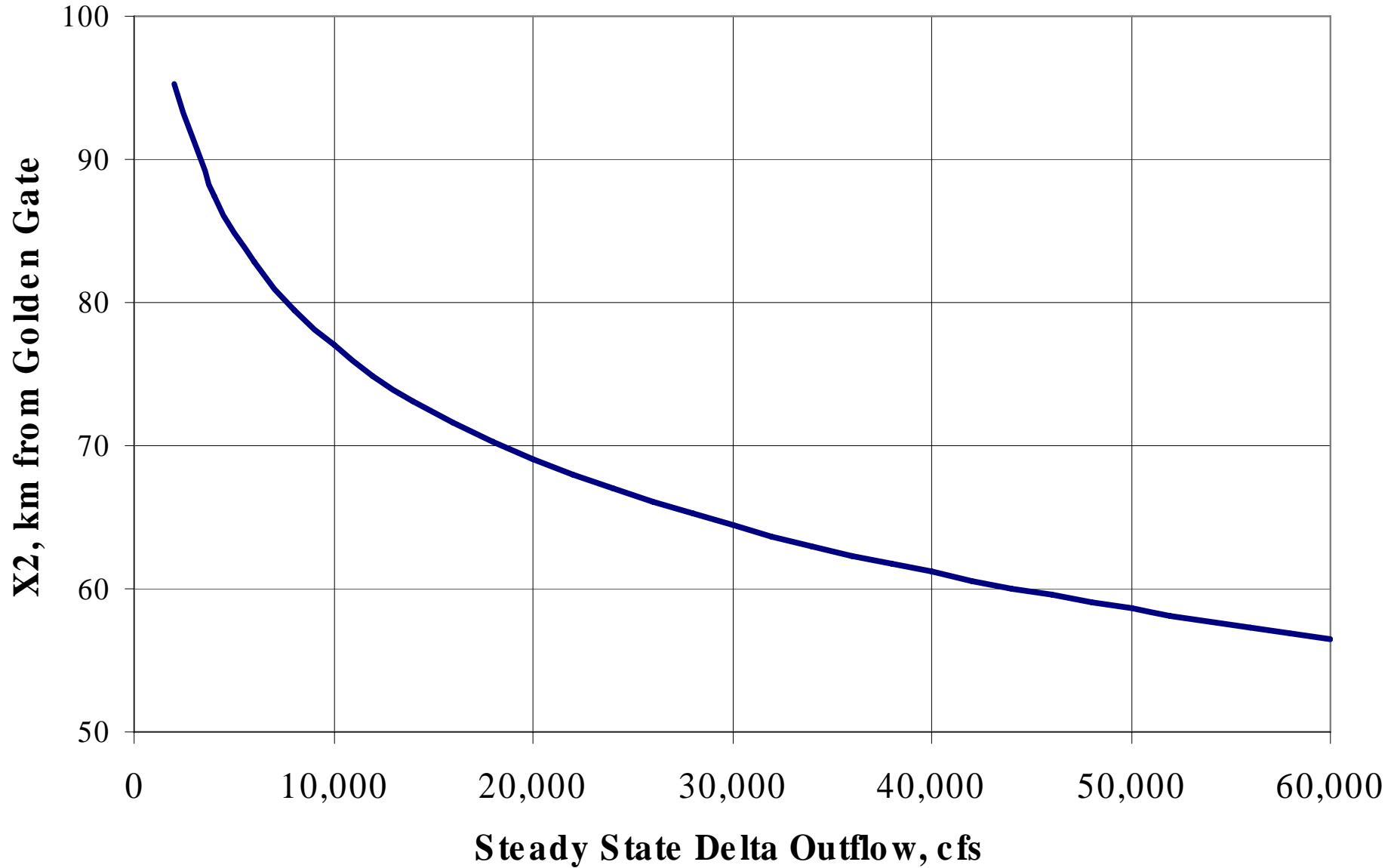
Outline of Presentation

- Why game?
- Who participated in various games?
- What was gamed?
- How was gaming conducted?
- Goals
- Results

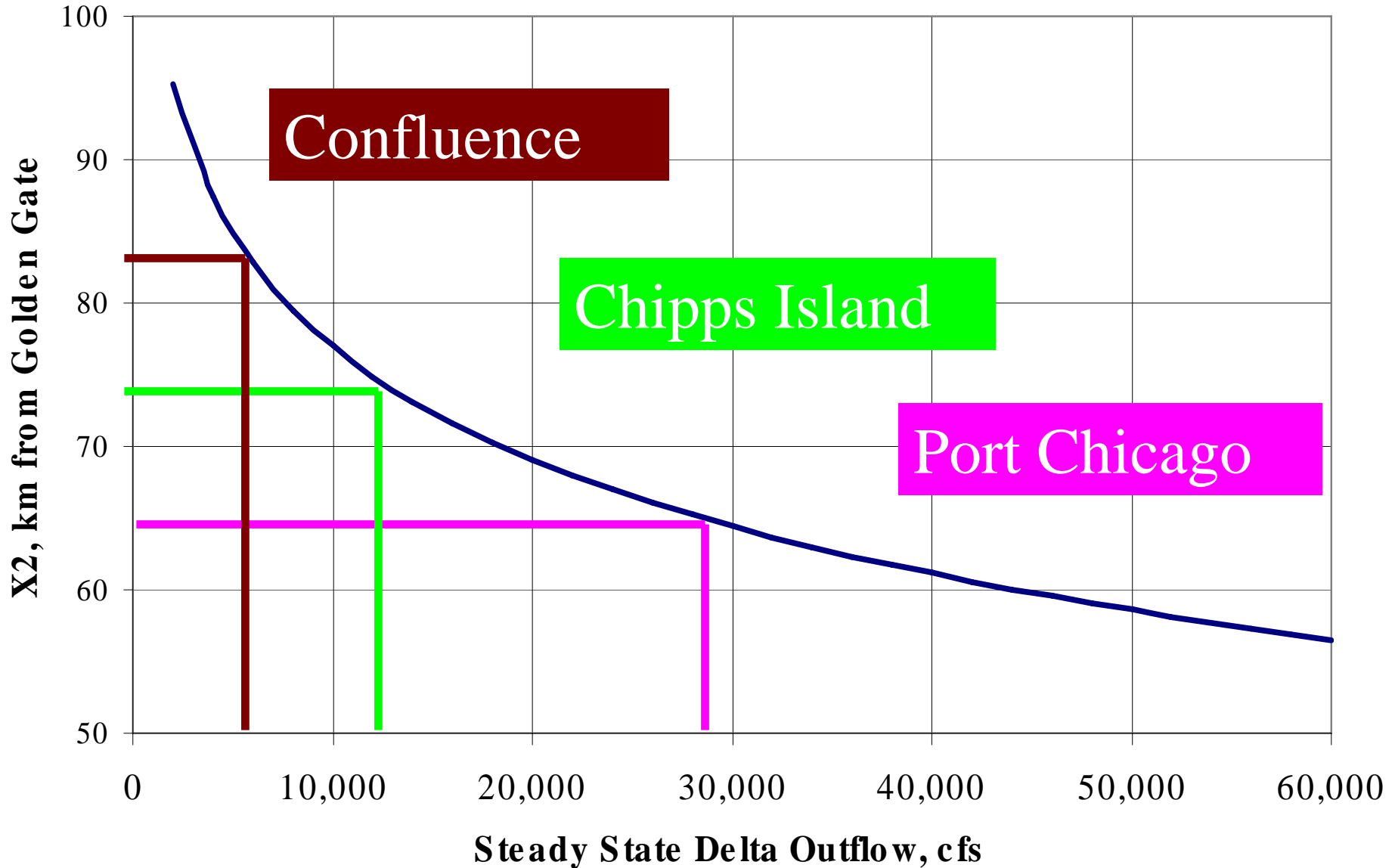
Why Game?

- Responds to SWRCB request.
- Test hypothesis that outflow flexibility can allow for improved overall operational patterns, considering costs and benefits:
 - Species linked to average X2 position
 - Upstream flow fluctuations
 - Upstream carryover storage
 - Supplies for Projects and environment
- Gain insight into possible sideboards.

X2 vs. Steady State Delta Outflow



X2 vs. Steady State Delta Outflow



Participation

Stakeholder (Game 1)

- NOAA Fisheries
- USFWS
- DFG
- DWR
- USBR
- EPA
- SWC
- MWD

- WWD
- SLDMWA
- Bay Institute
- American River Water Forum
- SWRCB Rep

Export Contractor (Games 2 & 3)

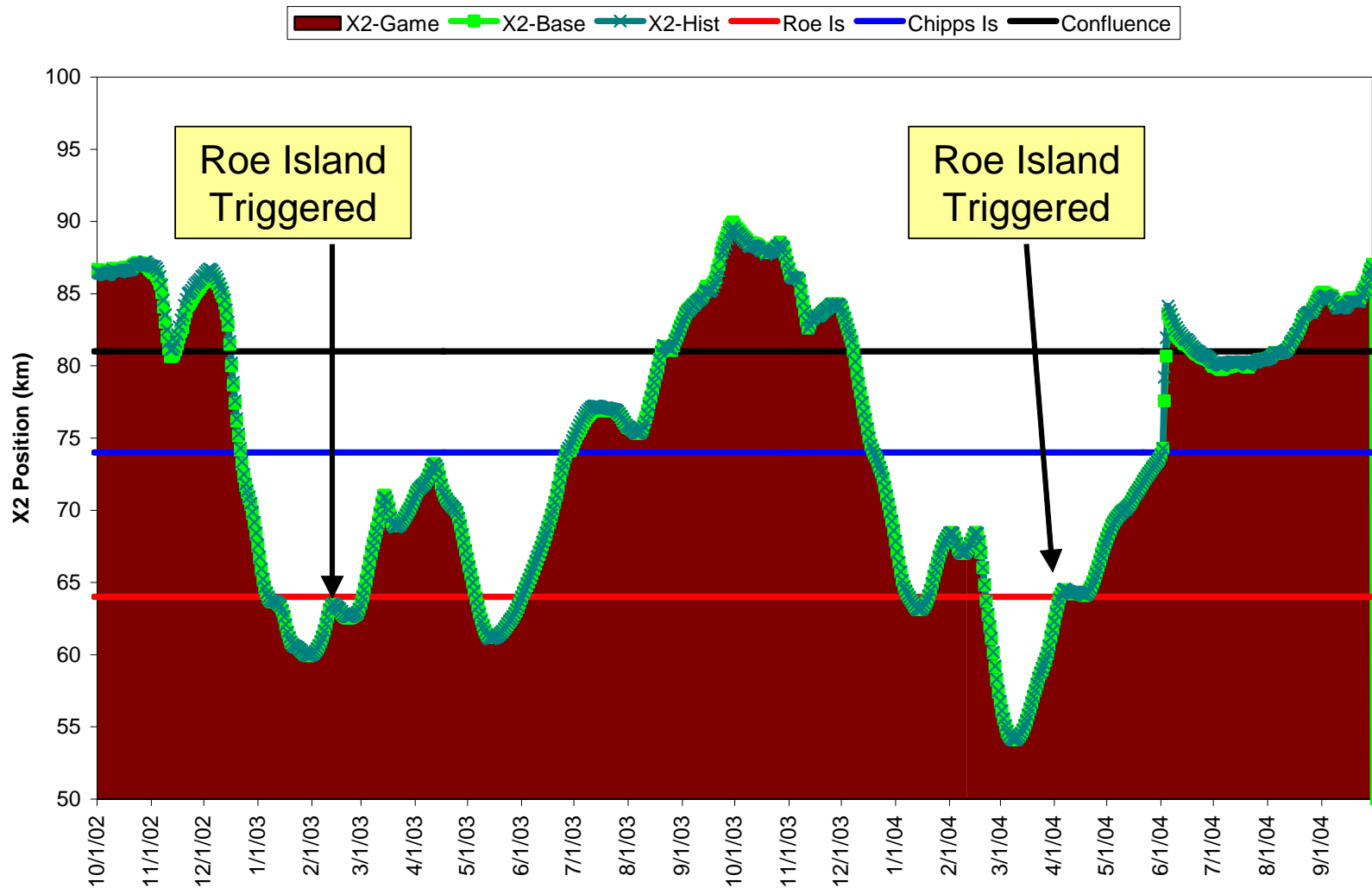
- SWP Export Contractors
- CVP Export Contractors

What was Gamed?

- Game 1 (April 28, 2005).
- Game 2 & 3 (April 29, 2005)
- Episodes when compliance with X2 caused large upstream releases from storage:
 - February 2003
 - April 2004

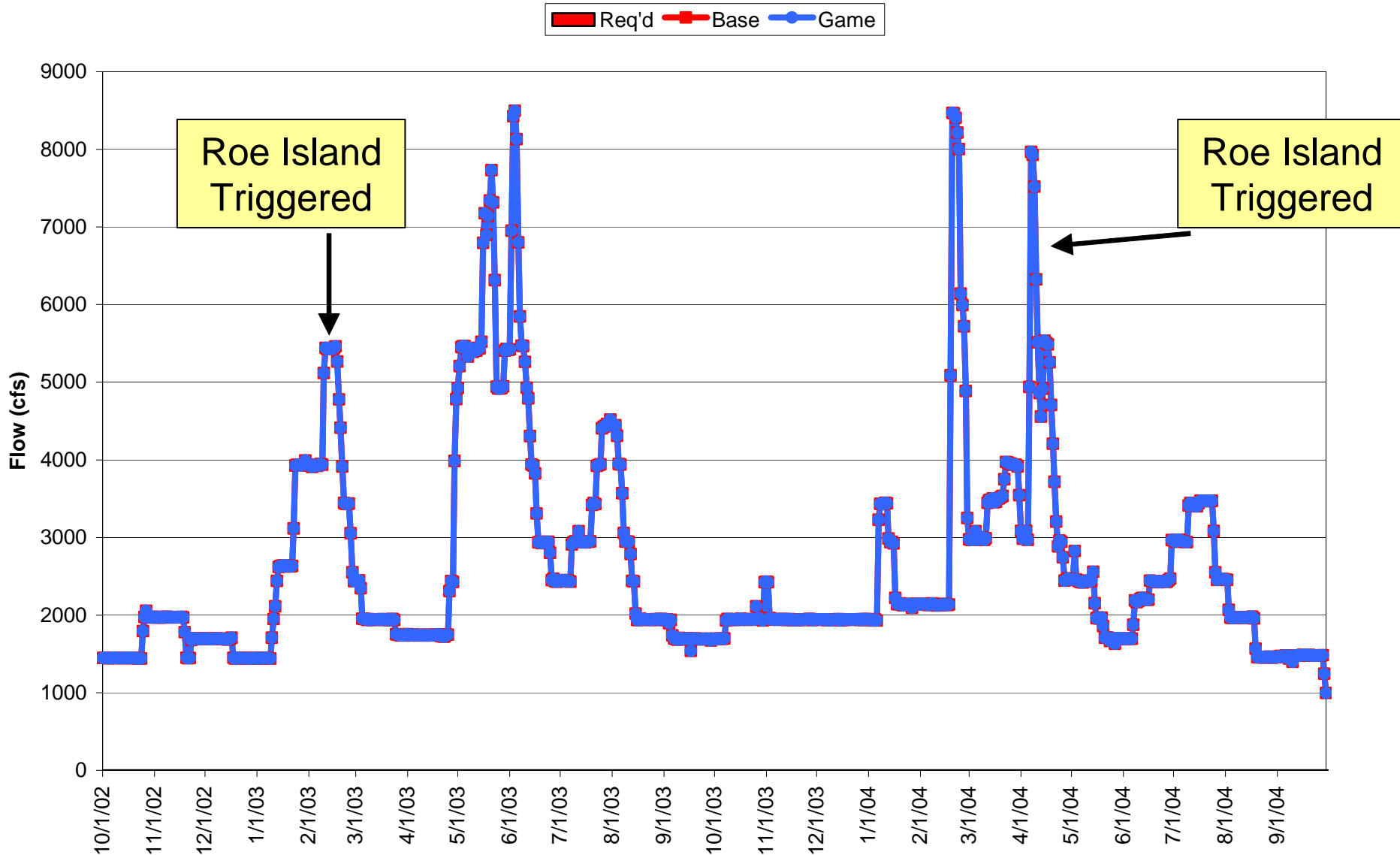
X2 Patterns: 2003 and 2004

Delta X2 Position



American R. Patterns 2003 & 2004

American River Flow below Nimbus



Process of Gaming

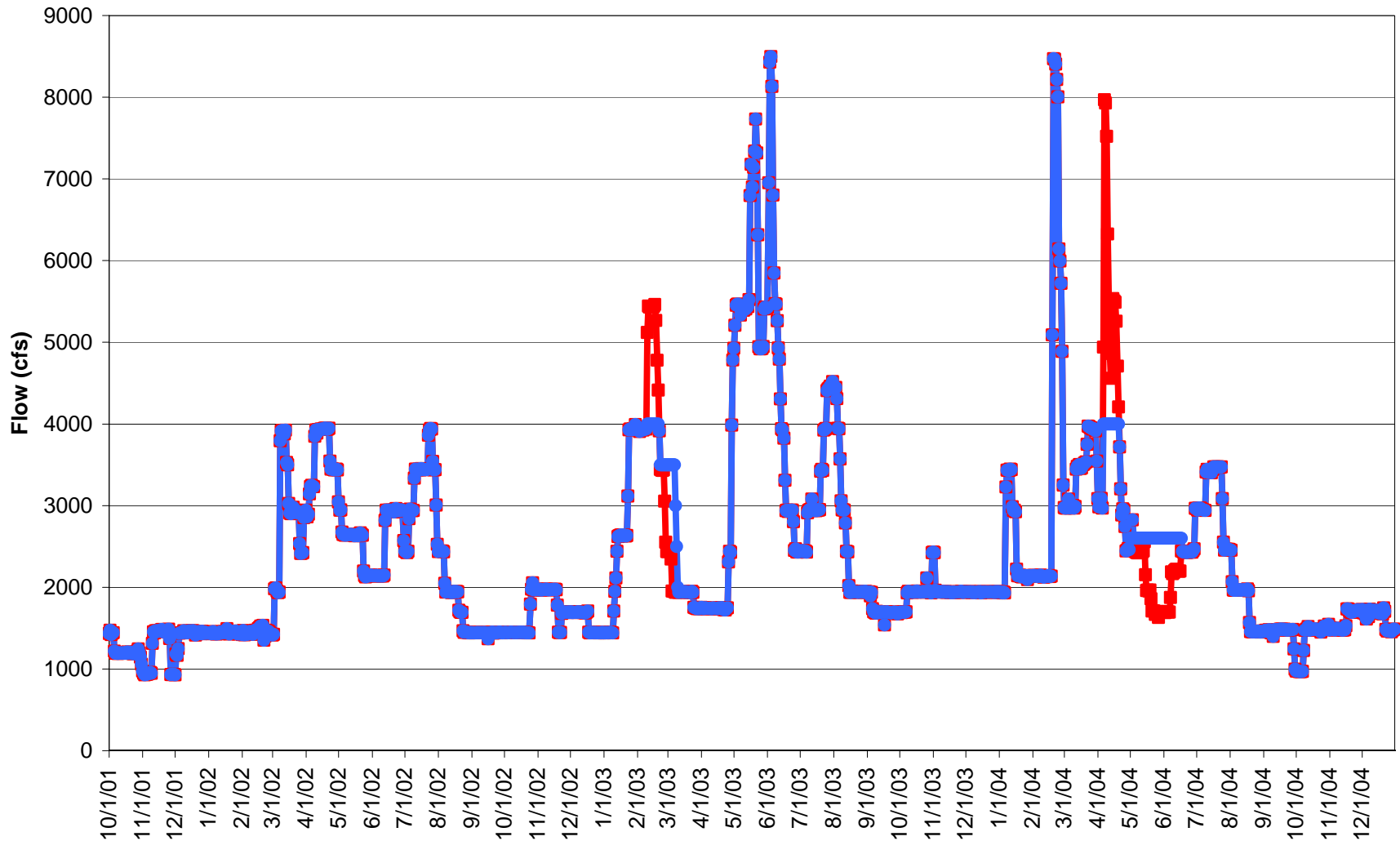
- Spreadsheet model
- Start from historic operations
- Try a different operation
- Track changes in flow and parameters related to flow
 - X2
 - Species correlated to X2
 - Storage
 - Upstream flow patterns
 - Exports

Game 1 Description

- February 2003 and April 2004
- Primary goal: eliminate upward spike in American River flows
- Secondary goals:
 - Game 1.1 Protect/enhance average X2 -- Rerelease water for outflow ASAP
 - Game 1.2 Enhance Folsom storage. Generate flow/export benefits in summer and fall.

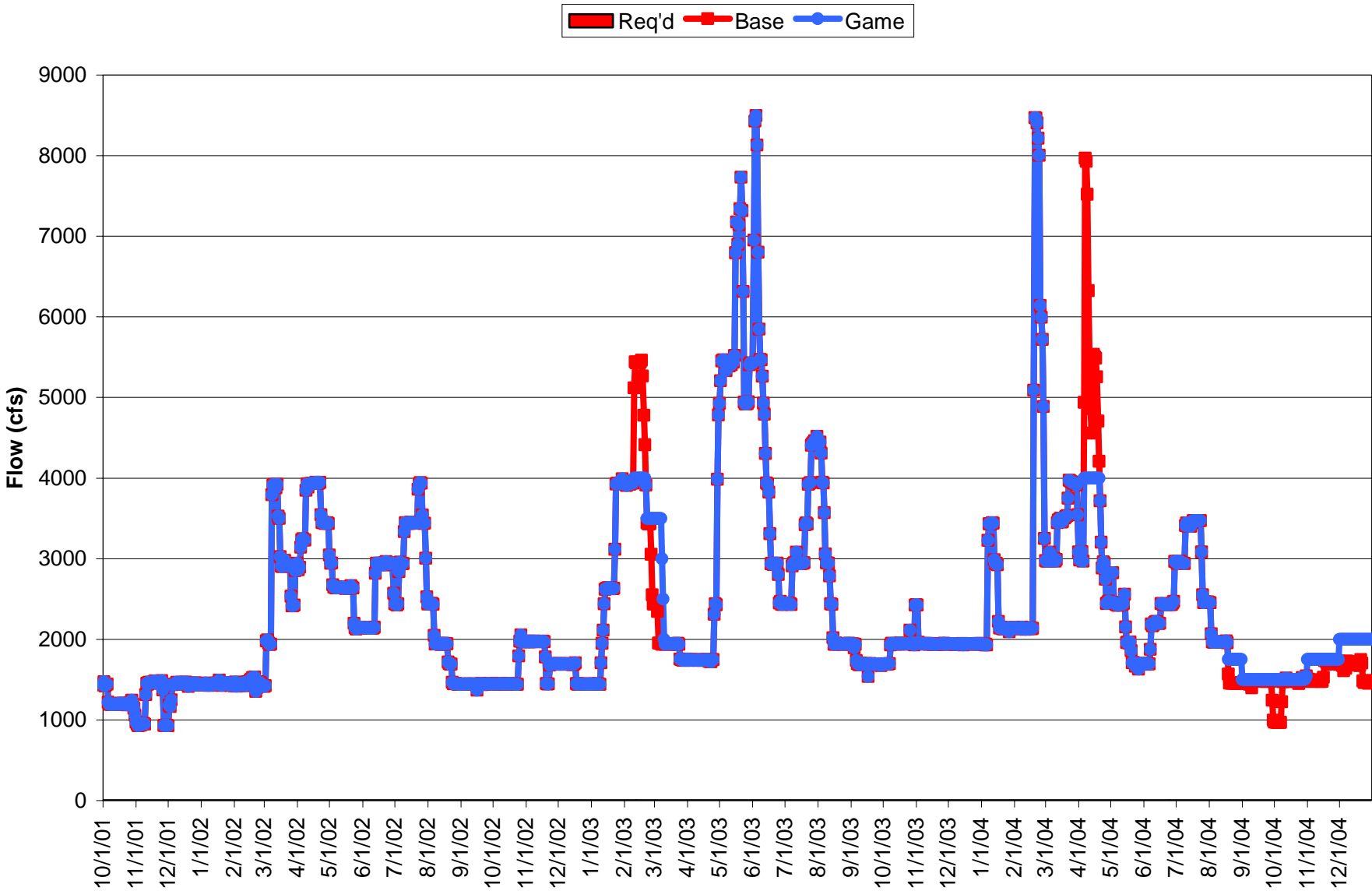
Game 1.1 American R Flows

American River Flow below Nimbus



Game 1.2 American R. Flows

American River Flow below Nimbus

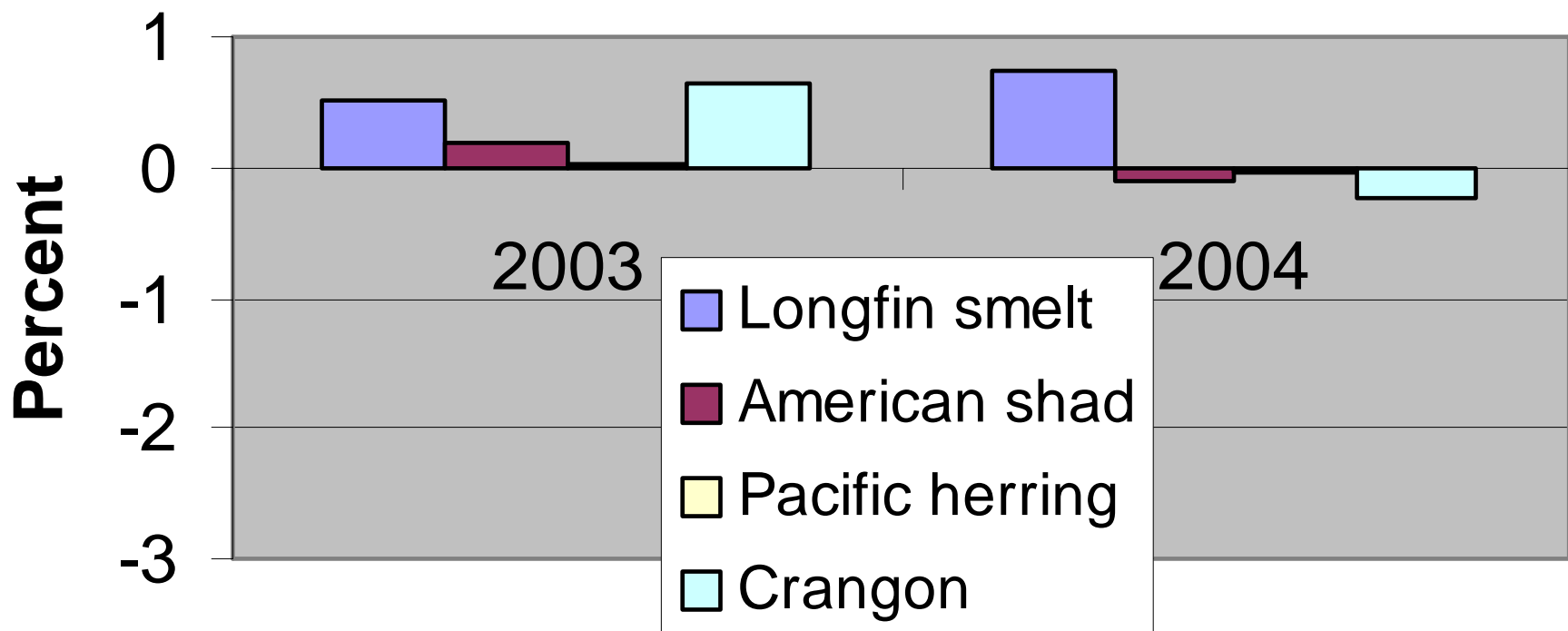


Game 1.1 Results

	Feb 2003	Apr 2004
Change in Folsom storage (TAF)	+27 Feb. -27 Feb–Mar	+51 Apr -51 May – Jun
Upstream benefits	No flow spike	No flow spike
Change in Feb – Jun X2	-0.07 km (downstream)	-0.08 km (downstream)
Req'd/Historical/ Final X2 Days	25/26/26	18/23/21
Potential Exports (TAF)	0	0

Game 1.1

Changes in Indices linked to X2

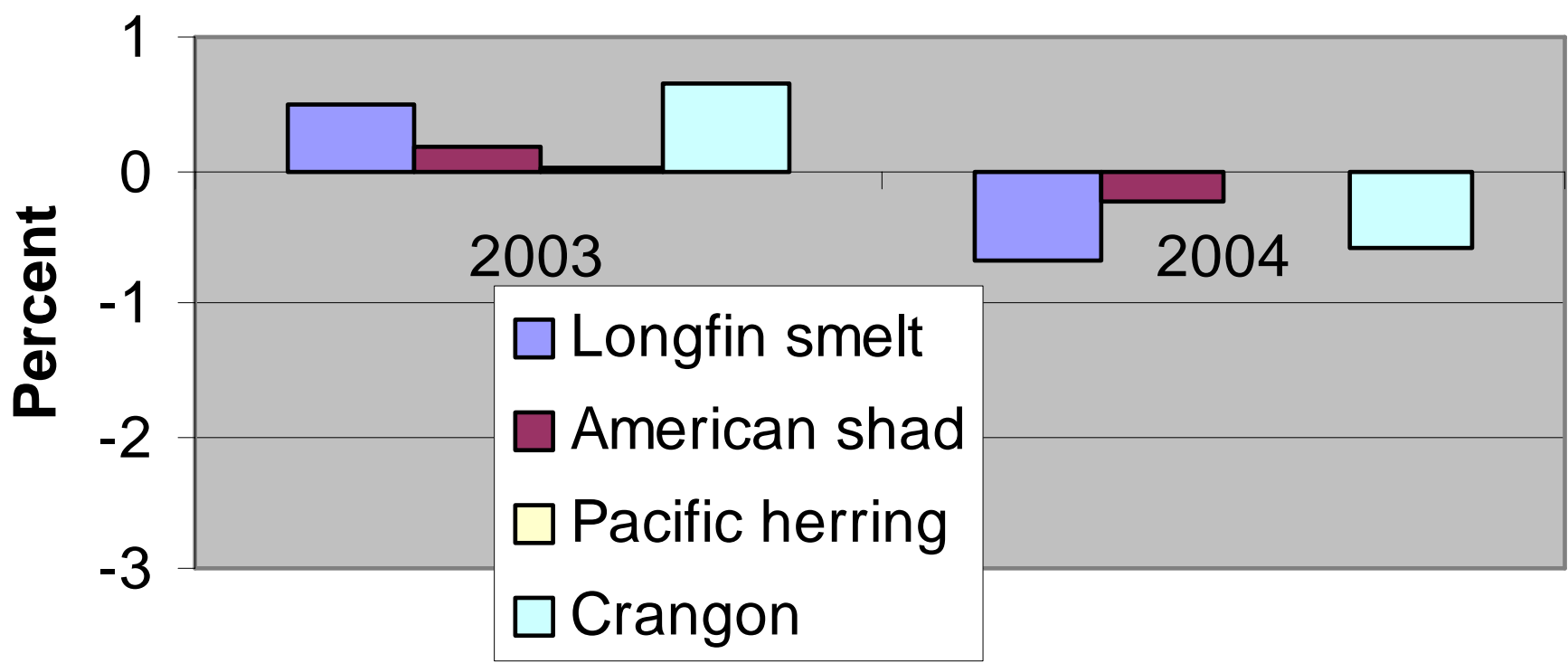


Game 1.2 Results

	Feb 2003	Apr 2004
Change in Folsom storage (TAF)	+27 Feb. -27 Feb–Mar	+51 Apr -29 Aug – Nov -22 Post Nov
Upstream benefits	No flow spike	No flow spike. Boost fall releases
Change in Feb – Jun X2	-0.07 km (downstream)	+.06 km (upstream)
Req'd/Historical/ Final X2 Days	25/26/26	18/23/21
Potential Exports (TAF)	0	22

Game 1.2

Changes in Indices linked to X2

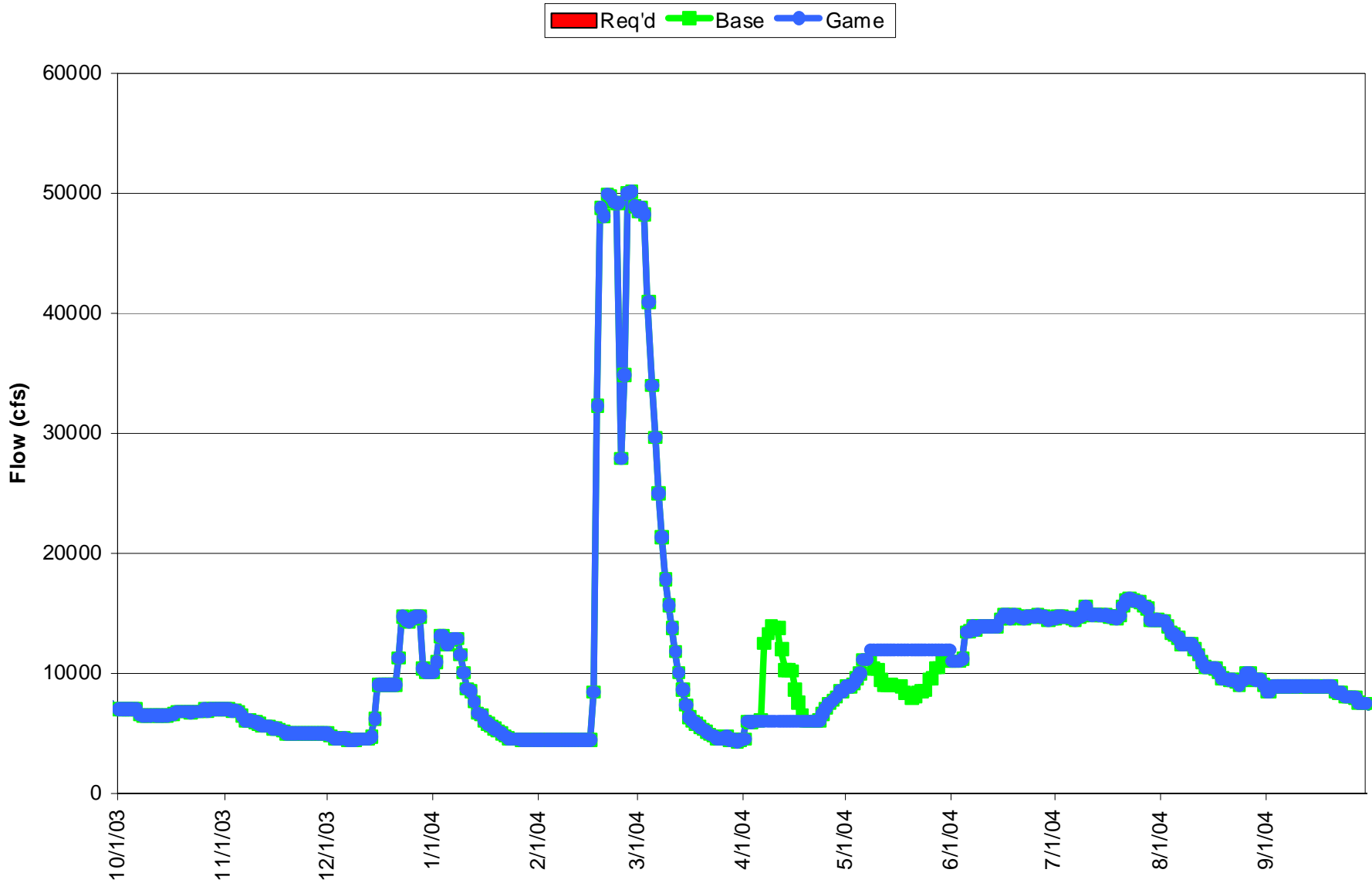


Game 2 Description

- April 2004 only
- Goals
 - Eliminate upward spike in American Sacramento Rivers.
 - Game 2.1 Protect/enhance average X2 -- Rerelease water for outflow ASAP
 - Game 2.2 Enhance upstream storage. Generate flow/export benefits in summer and fall.

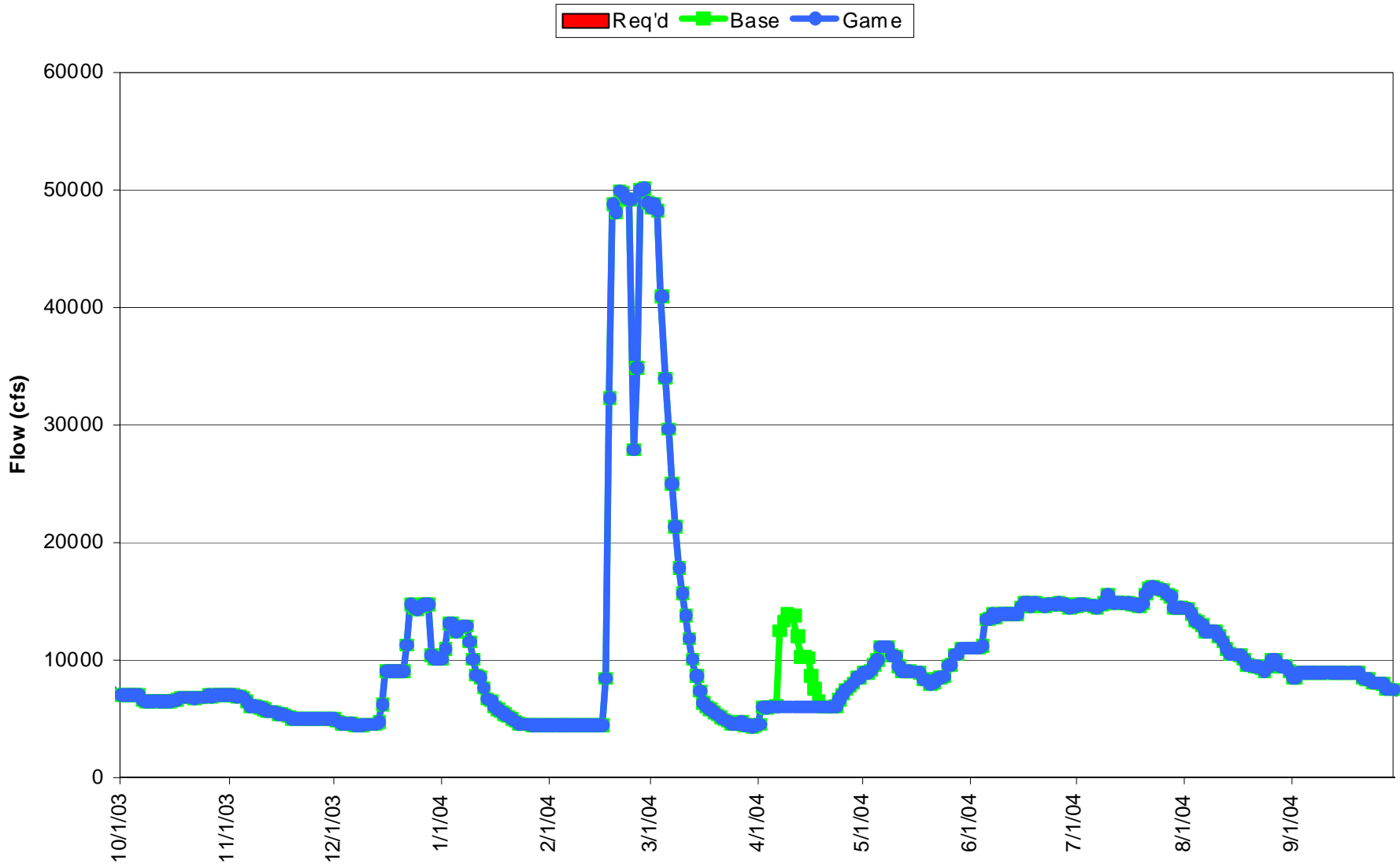
Game 2.1 Keswick Releases

Sacramento River Flow below Keswick



Game 2.2 Keswick Releases

Sacramento River Flow below Keswick

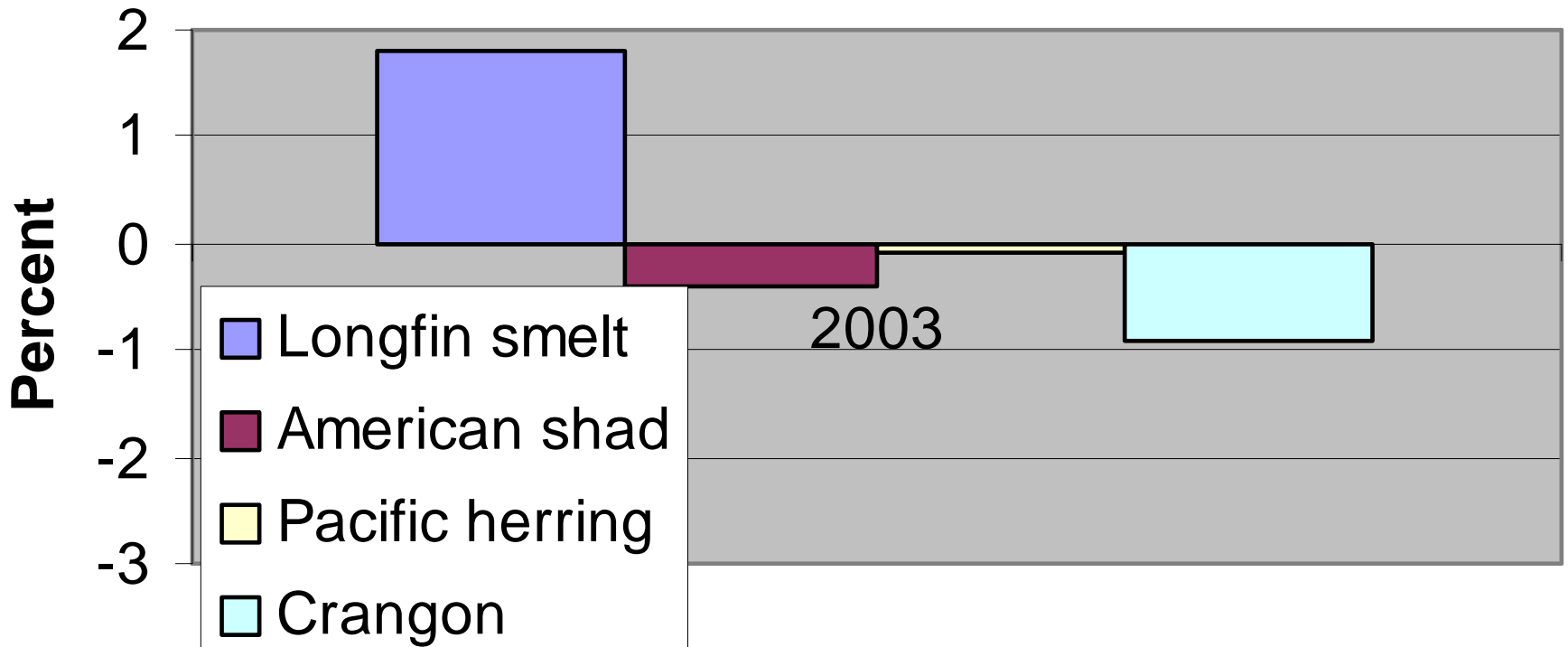


Game 2.1 Results

	Apr 2004
Change in upstream storage (TAF)	+172 April -172 May – June
Upstream benefits	No flow spikes
Change in Feb – Jun X2	-0.18 km (downstream)
Req'd/Historical/ Final X2 Days	18/23/17
Potential Exports (TAF)	0

Game 2.1

Changes in Indices linked to X2

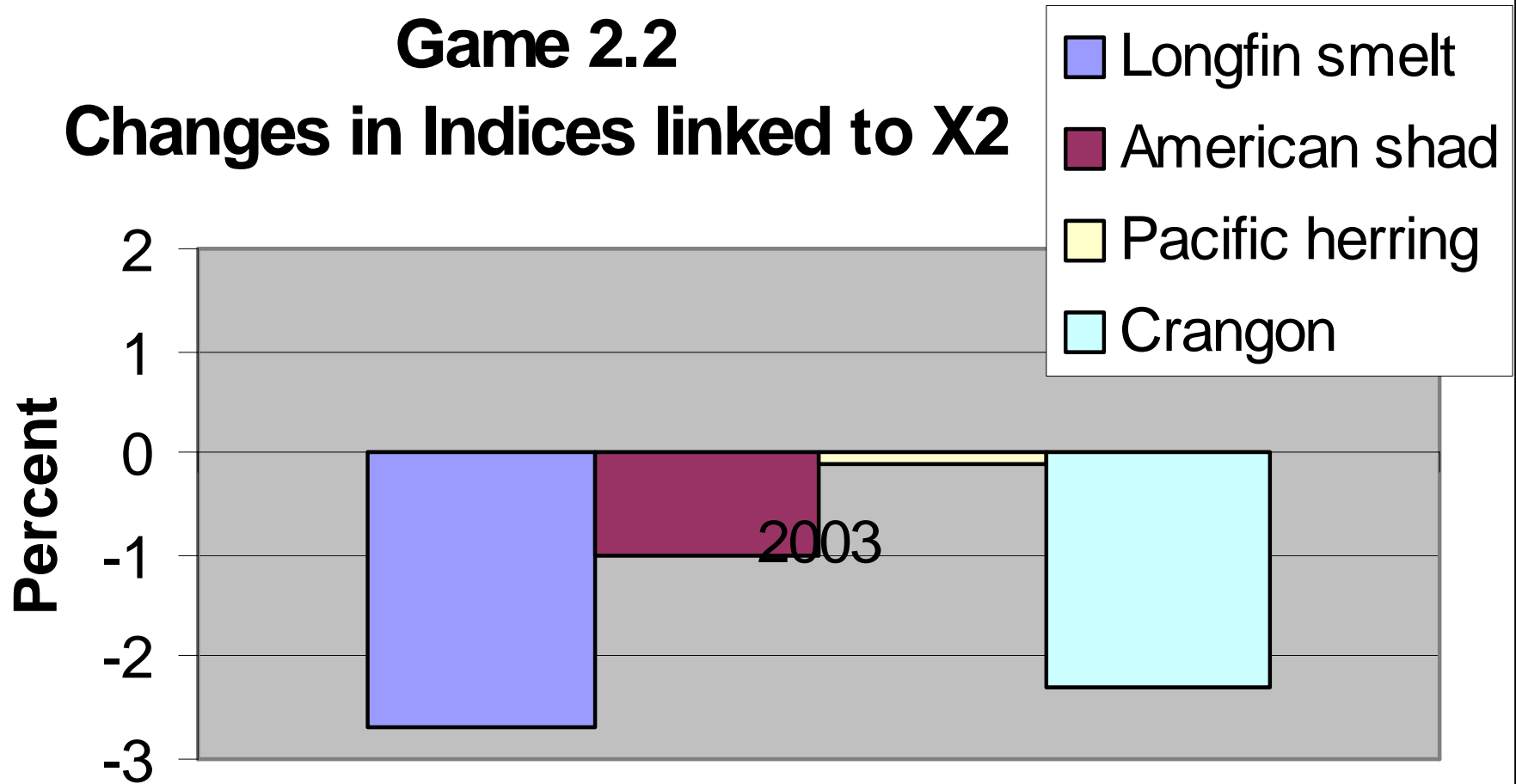


Game 2.2 Results

	Apr 2004
Change in upstream storage (TAF)	+172 April -172 Aug – Dec
Upstream benefits	No flow spikes. Boost Fall flows upstream
Change in Feb– Jun X2	0.28 km (upstream)
Req'd/Historical/ Final X2 Days	18/23/17
Potential Exports (TAF)	166

Game 2.2

Changes in Indices linked to X2

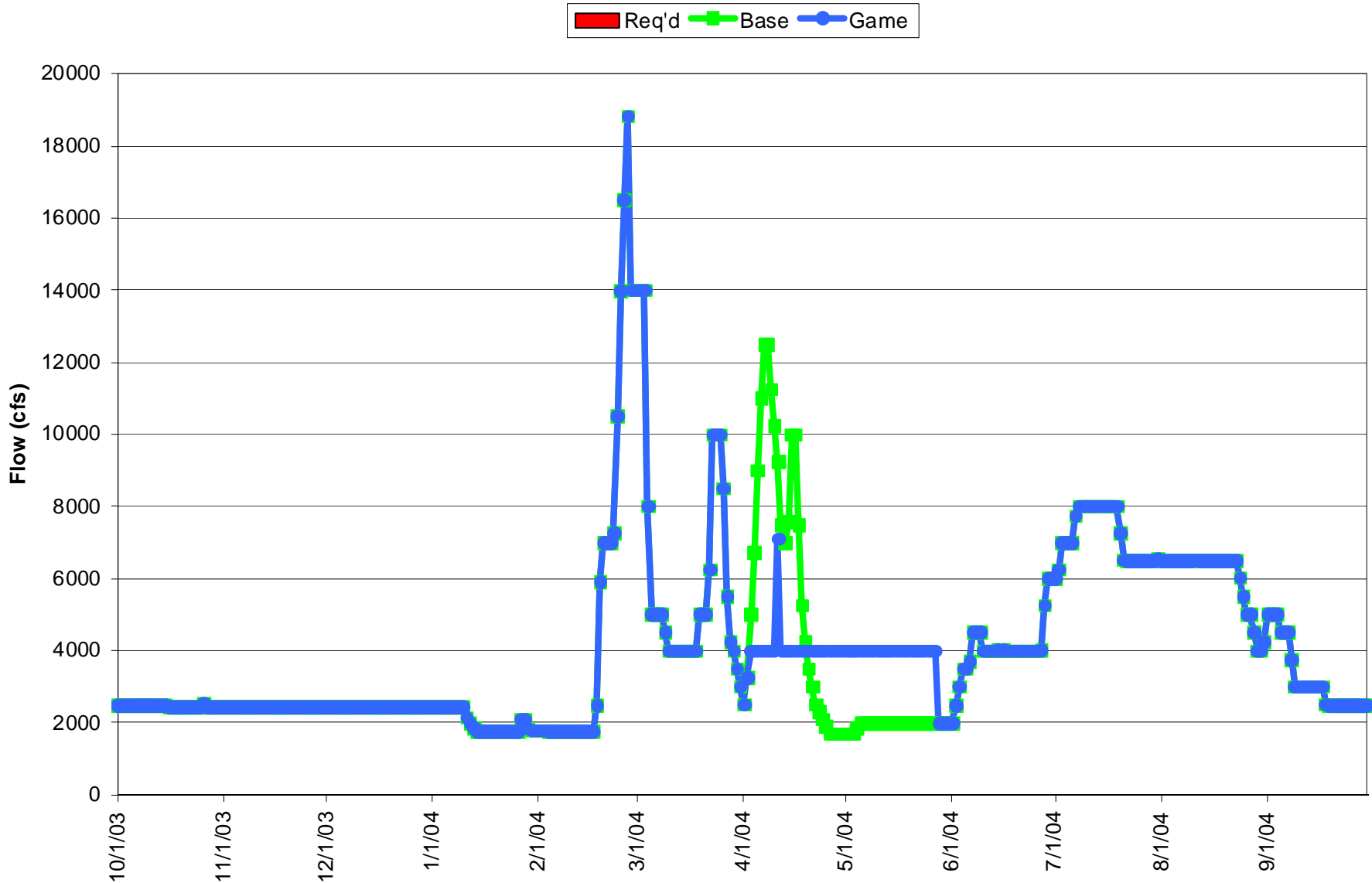


Game 3 Description

- April 2004 only
- Goals
 - Eliminate upward spike in American, Sacramento and Feather Rivers.
 - Game 3.1 Protect/enhance average X2 -- Rerelease water for outflow ASAP.
 - Game 3.3 Keep average X2 constant. Enhance upstream storage. Generate flow/export benefits in summer and fall.

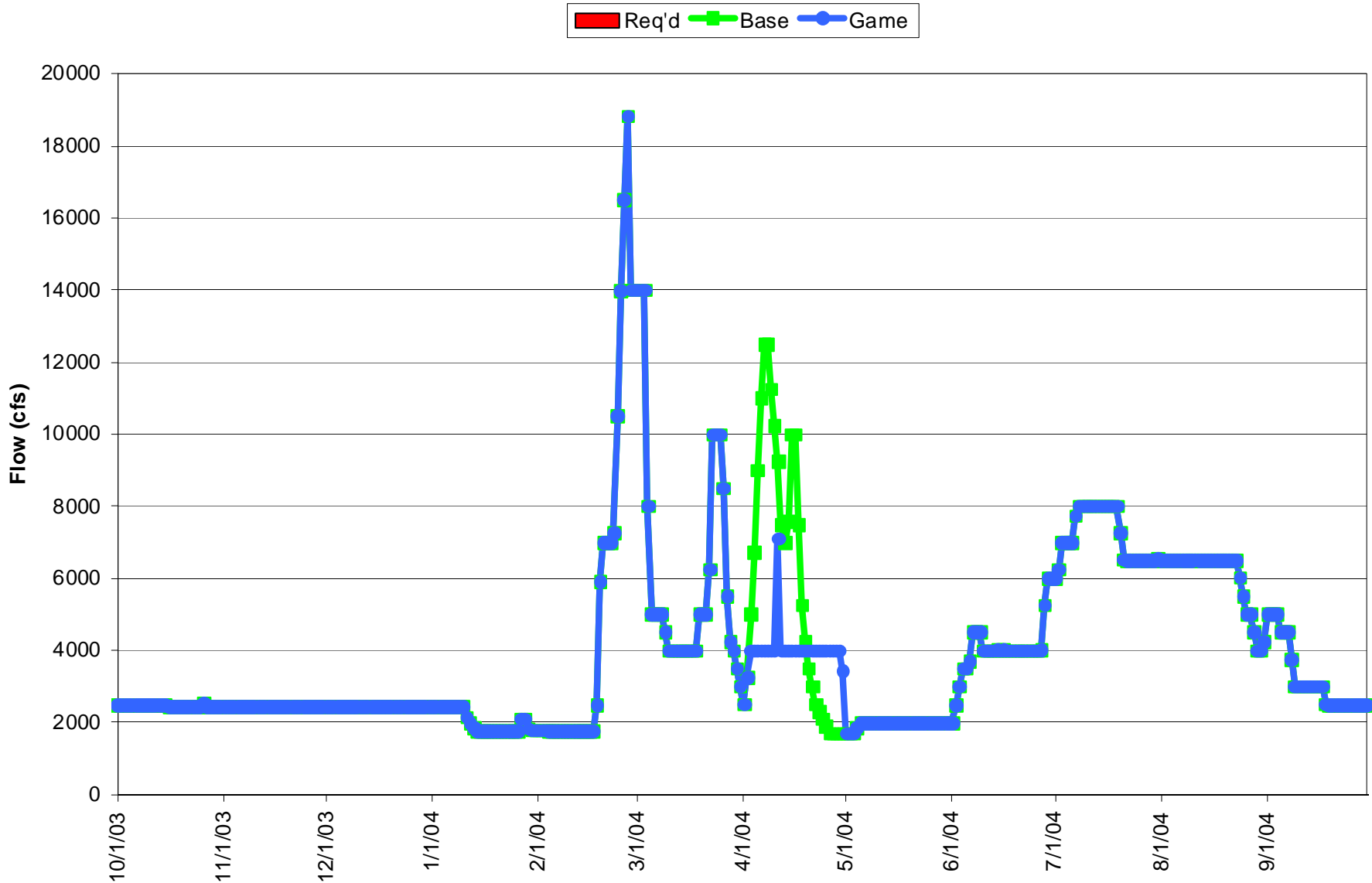
Game 3.1 Feather Flows

Feather River Flow below Thermalito



Game 3.3 Feather Flows

Feather River Flow below Thermalito

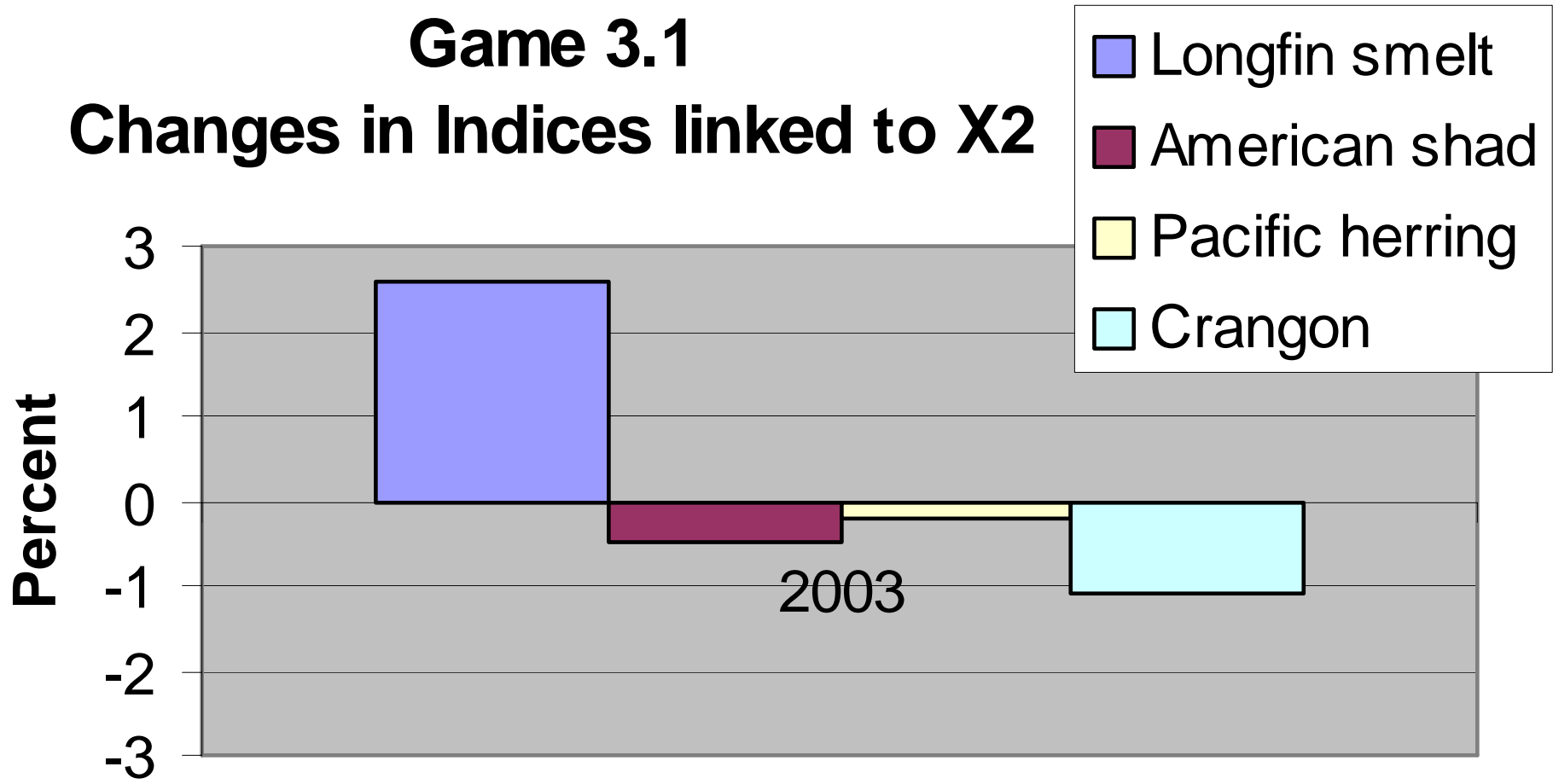


Game 3.1 Results

	Apr 2004
Change in upstream storage (TAF)	+322 April -172 April – June
Upstream benefits	No flow spikes
Change in Feb – Jun X2	-0.25 km (downstream)
Req'd/Historical/ Final X2 Days	18/23/4
Potential Exports (TAF)	0

Game 3.1

Changes in Indices linked to X2

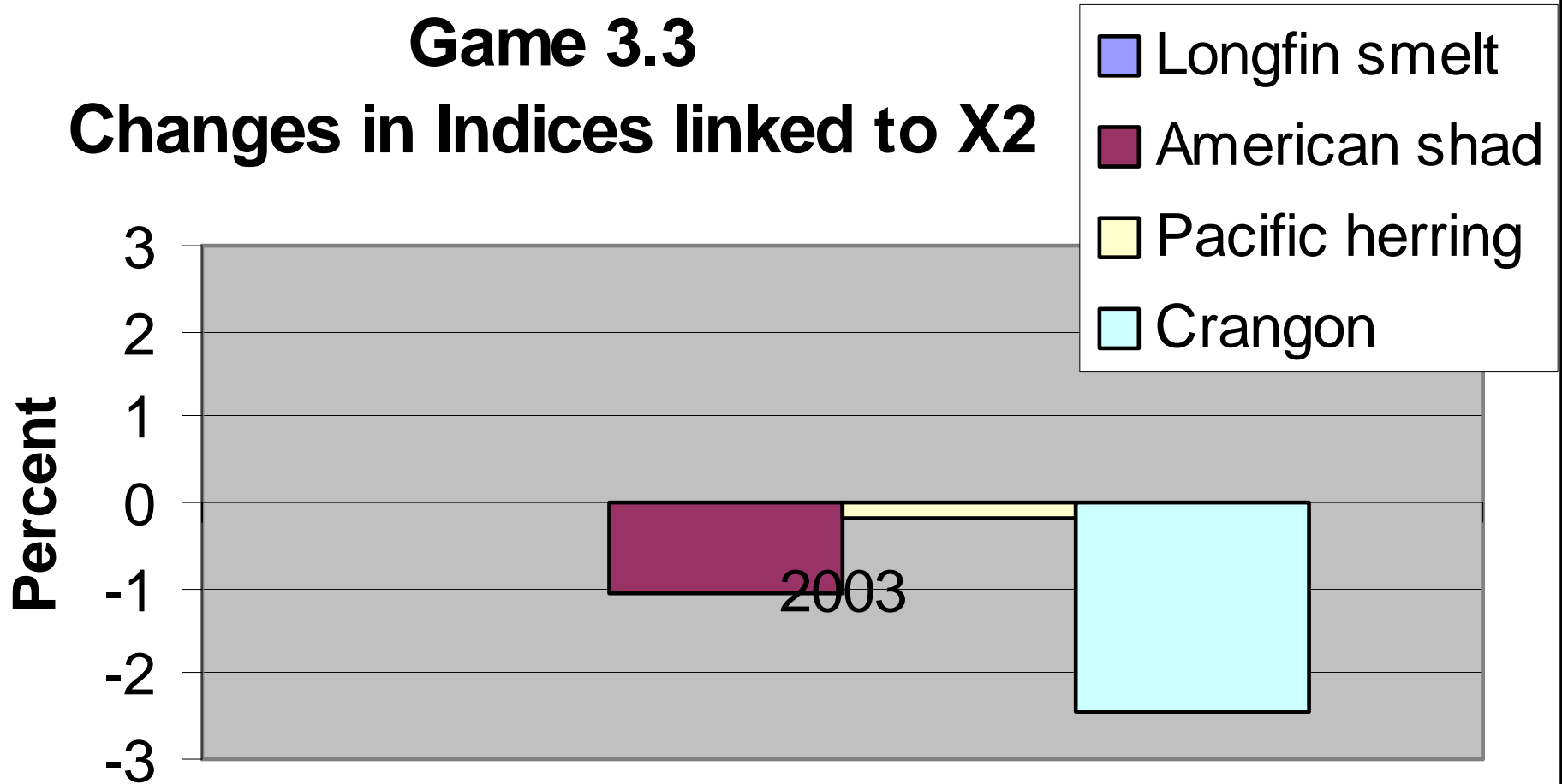


Game 3.3 Results

	Apr 2004
Change in upstream storage (TAF)	+322 April -211 May – June 111 July - Dec
Upstream benefits	No flow spikes. Boost fall releases upstream
Change in Feb – Jun X2	-0.0 km
Req'd/Historical/ Final X2 Days	18/23/4
Potential Exports (TAF)	Approximately 90

Game 3.3

Changes in Indices linked to X2



Overcompliance

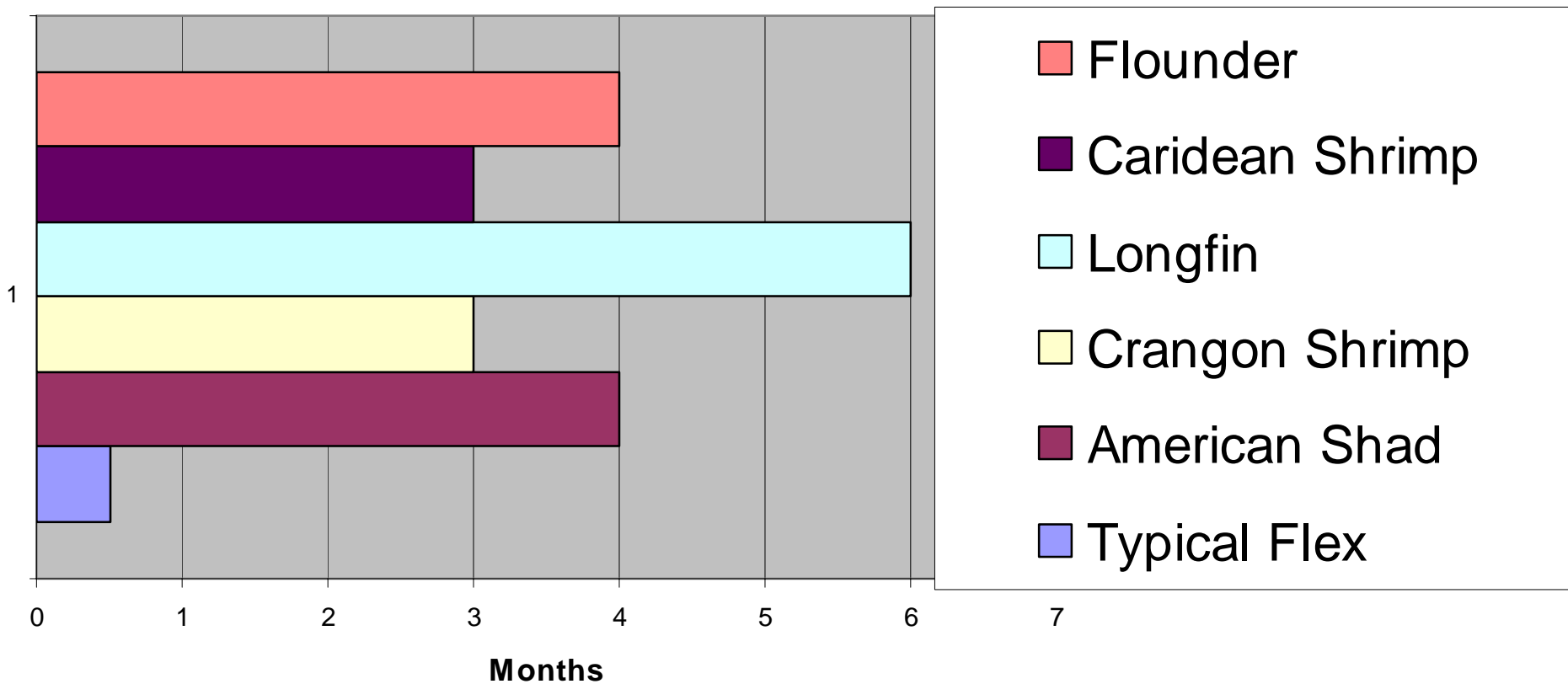
- Game 1 X2 std met despite “flex”
- Game 2 X2 std nearly met despite 172 TAF reduction in releases.
- Conclusion. Lots of excess releases to comply with X2.
- Compared to simple compliance, impacts to X2 indices are exaggerated.

Discussion

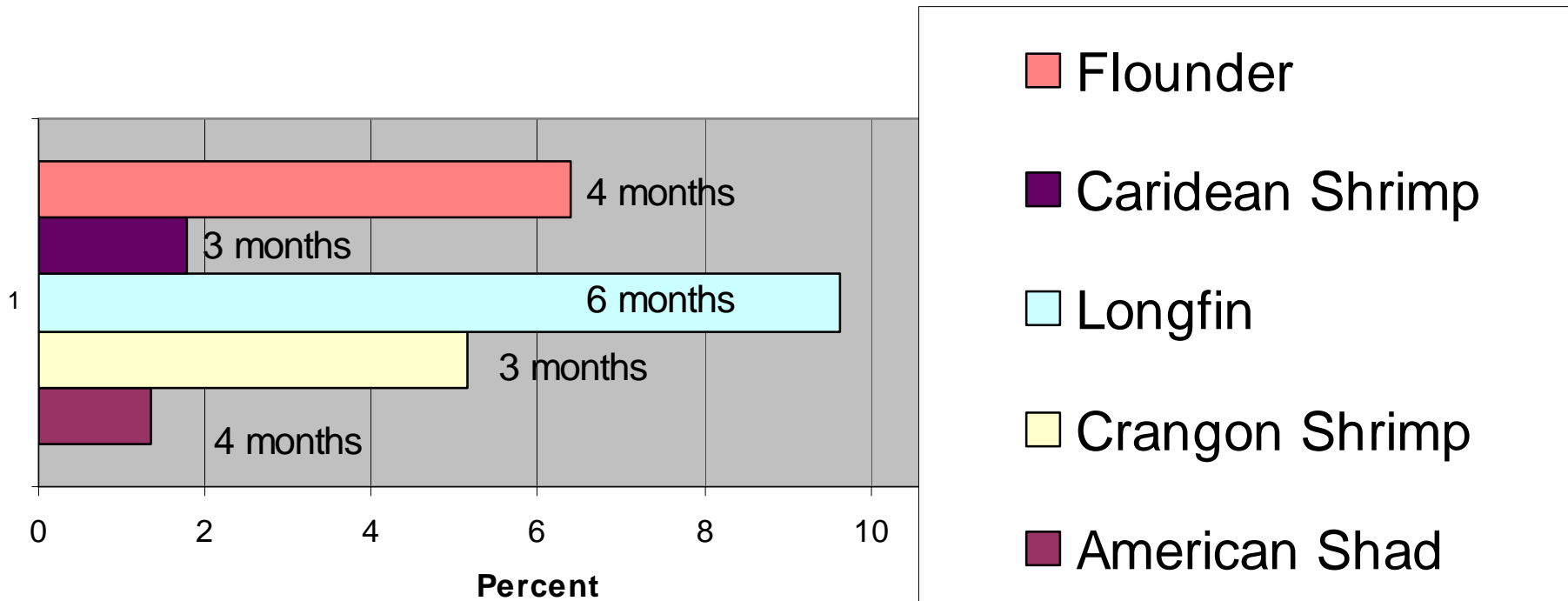
- A variety of flexes possible with various effects.
 - Reduce harmful upstream fluctuations
 - Move average X2 slightly upstream or downstream.
 - Generate upstream storage for flow enhancement, Project supply, EWA supply, etc.

End of Presentation

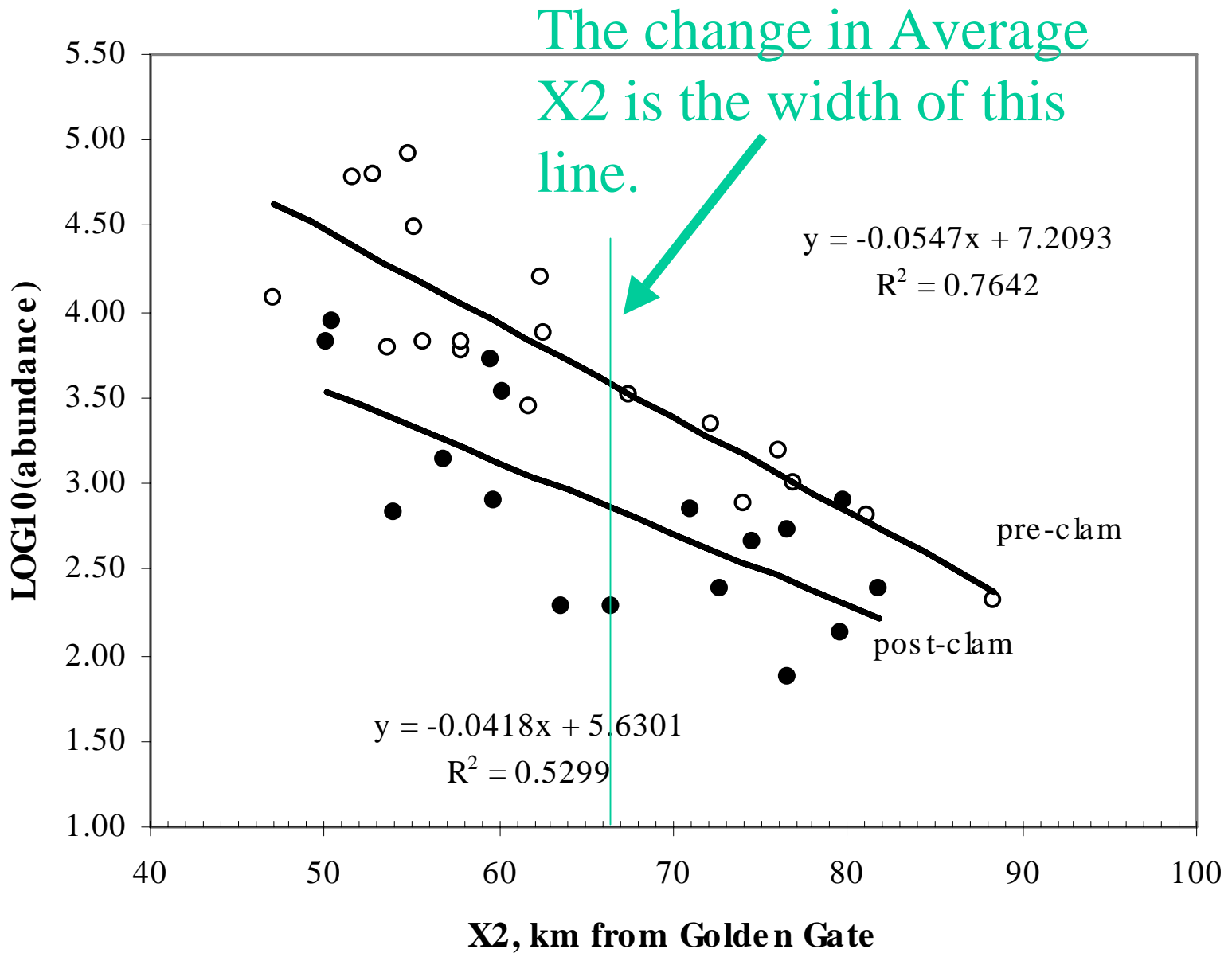
X2 Correlation Periods vs Typical Flex Period



Change in Population Index per km change in Average X2 over the Entire Period



long fin smelt



american shad

The change in Average
X2 is the width of this
line.

