What do fish communities tell us about the biotic condition of streams in western Placer County?

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Statement of Problem

With paradigm shift toward community and system-based management, can DFG's stream survey protocol be updated with inclusion of an index of biotic integrity (*IBI*) to inventory and assess California's stream fish resources and the systems that support them?

<u>What's an IBI?</u>
The IBI assigns scores to pre-determined fish community characteristics that are summed and normalized to provide an index of the gross ecological health of the stream.

Ideally, this IBI-based stream survey protocol would:

- build upon DFG's current stream survey protocol(s);
- be relatively simple to apply;
- allow for landscape-level assessment of fish communities both within and across stream systems on a regional basis; and
- allow for objective assessment over time.

Putah Creek IBI

Moyle, P. B., and M. P. Marchetti. 1999. Pages 367-380 in T. P. Simon, ed. Assessing the sustainability and biological integrity of water resources using fish communities.

Eight metrics that assess:

- Composition: e.g., *native or introduced*
- Structure: *age classes and trophic status*
- Relative abundance

of fishes captured in section-specific samples.

Minimum Data Requirements

- Species composition: each species sampled must be identified to the species level
- Number of individuals of each species
- Length data for at least a random sub-sample of each species → needed to assess age structure

Putah Creek IBI Metrics

Metric		Points		
		1	3	5
I	Percentage native fish species	<20%	20–80%	>80%
II	Number of native species present	0–1	2–4	>4
III	Number of age classes of native cyprinids, suckers, and trout	0–1	2	3+
IV	Total number of fish species present	<5	5–7	>7
V	Total fish abundance	Low numbers present	Common in small #s	Abundant in large #s
VI	Percentage top carnivore species	<1%	1–5%	>5%
VII	Percent tolerant species	>20%	5–20%	<5%
VIII	Percent introduced “pond” species	>40%	10–40%	<10%

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With scores assigned, the numerical index is then determined by:

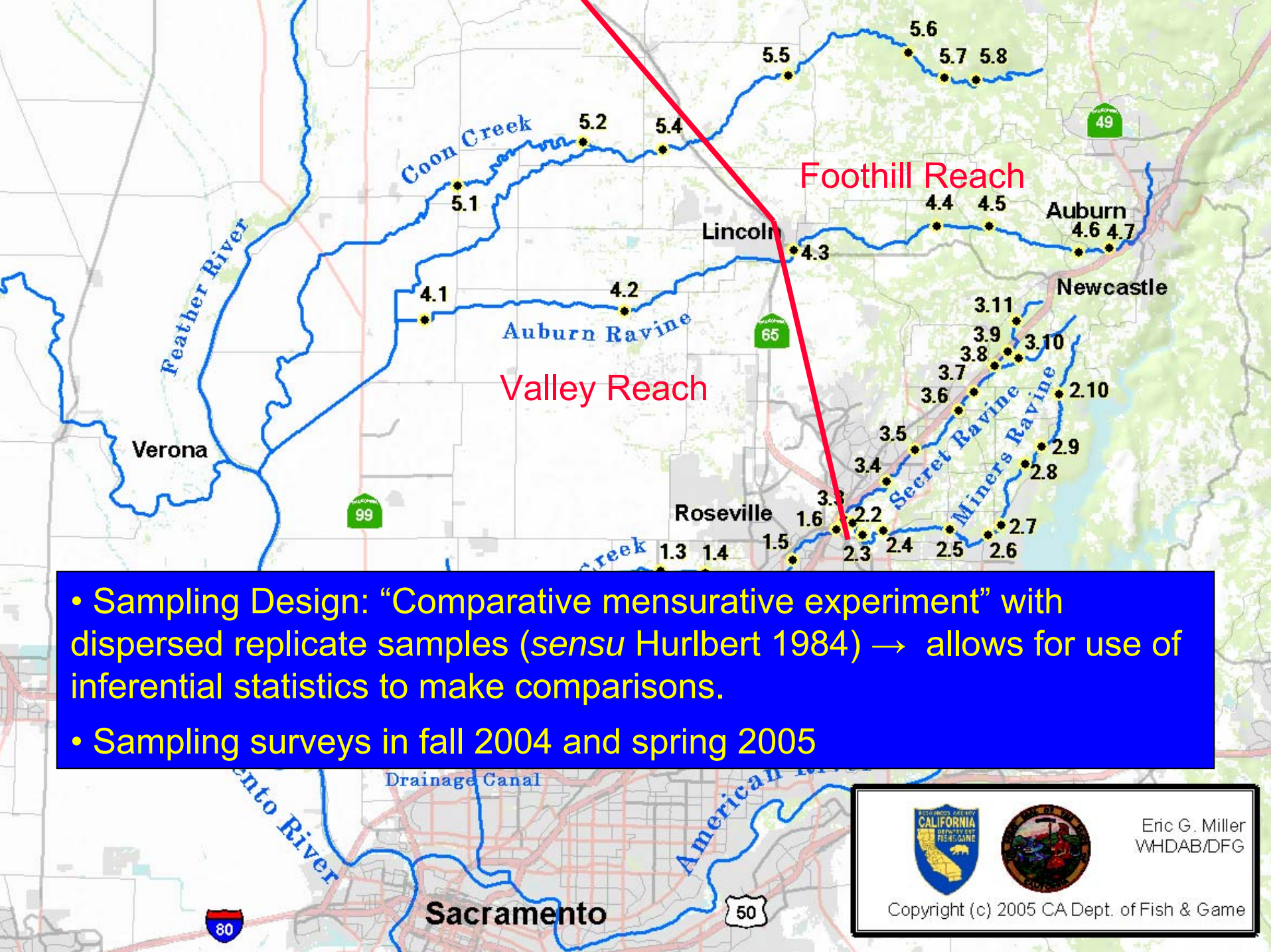
- IBI score = (Total points/number of metrics) × 20
- Provides relative measure of fish community and stream condition where:

  80–100 = very good to excellent

  60–79 = good

  40–59 = fair

  <40 = poor



- Sampling Design: "Comparative mensurative experiment" with dispersed replicate samples (*sensu* Hurlbert 1984) → allows for use of inferential statistics to make comparisons.
- Sampling surveys in fall 2004 and spring 2005

Eric G. Miller
WHDAB/DFG

Dry Creek System
incl. Miners & Secret ravines

Auburn Ravine

Coon Creek

Foothill sample sections

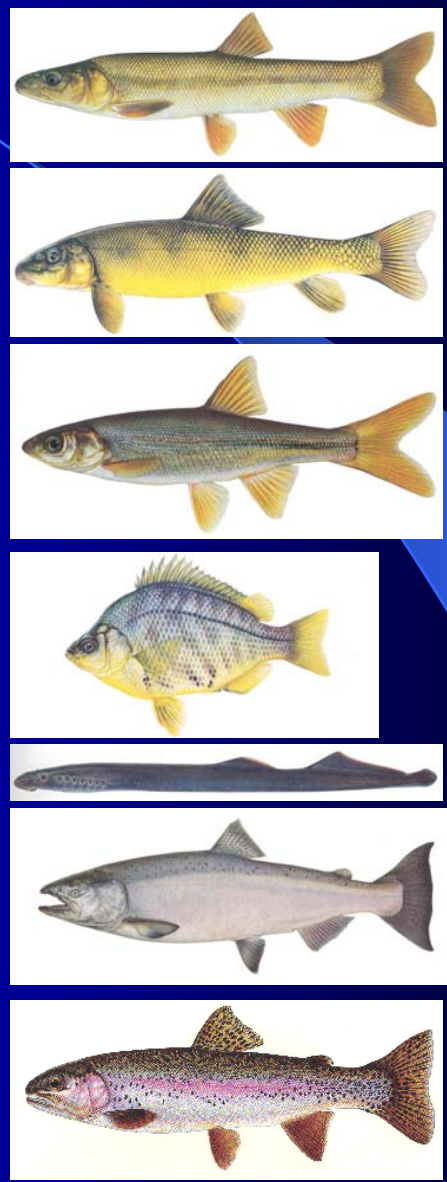
Valley sample sections

Reference fish assemblage: *Central Valley pikeminnow-hardhead-sucker and deep-bodied fish assemblages* (Moyle 2002)

- Sacramento pikeminnow
- Sacramento sucker
- Hardhead
- California roach
- Speckled dace
- Rainbow trout
- Riffle sculpin
- Tule perch

+ anadromous species

- Pacific lamprey
- Chinook salmon
- Steelhead



Illustrations from Moyle (2002) & Behnke (1992)


Electrofishing Miners Ravine

A variety of native and introduced fish species was observed

- Pacific lamprey
- Sac pikeminnow
- Hitch
- Sac sucker
- Steelhead/rainbow trout
- Prickly sculpin

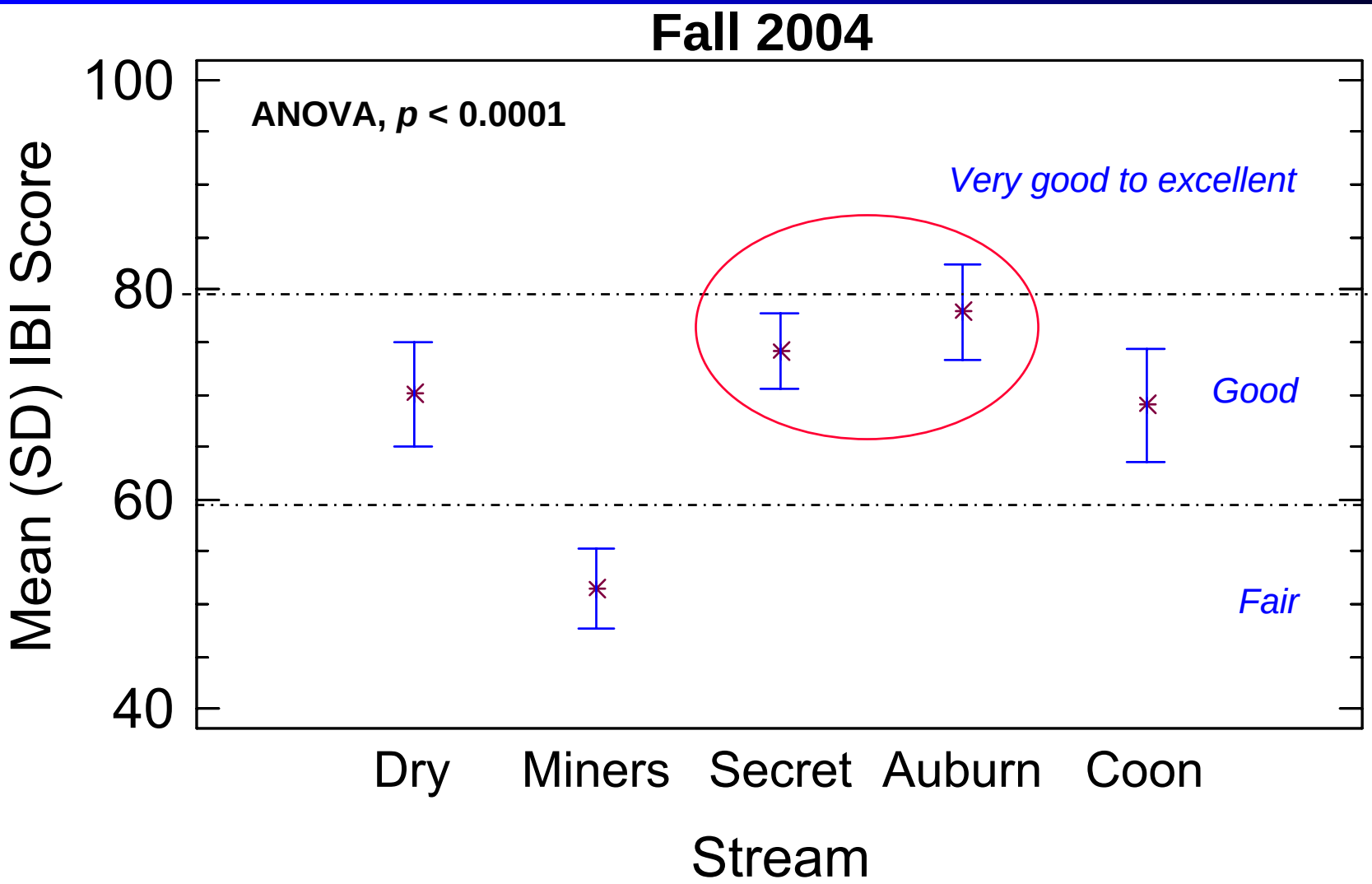
NOTE: Most native species were expected members of the pikeminnow-hardhead-sucker assemblage

- Golden shiner
- Brown bullhead
- Bluegill
- Pumpkinseed
- Green sunfish
- Warmouth
- Crappie
- Largemouth bass
- Spotted bass

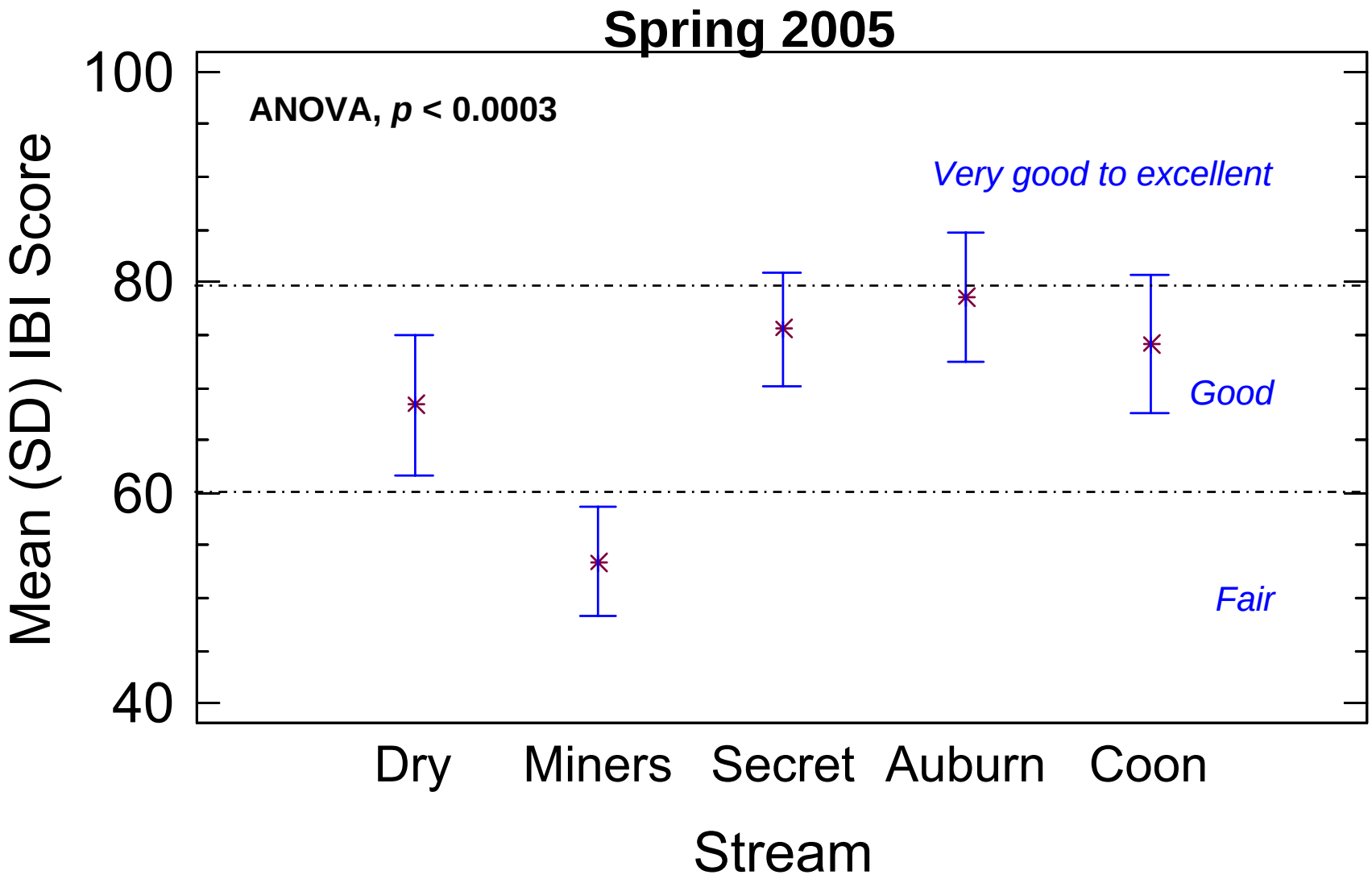
IBI scores varied significantly among creeks

Secret and Auburn ravines received high scores

Miners Ravine had relatively low scores



IBI scores among creeks in spring 2005 were almost identical to fall 2004 scores



These observations were supported by the results of a two-factor analysis of variance

Source	**Sum of Squares**	**DF**	**F-Ratio**	***p***
Creeks	7338	4	11.5	<0.0001
Fall vs. spring	42	1	0.4	0.51
Interaction term	70	4	0.2	0.95

IBI scores were similar between valley and foothill reaches

Valley

- Mean IBI = 73 in fall, 74 in spring
- Range: 50–85 in fall, 65–95 in spring
- Average sample section condition was high ‘good’

Foothill

- Mean IBI = 66 in fall, 67 in spring
- Range: 40–90 in fall, 35–95 in spring
- Average sample section condition was a low ‘good’

Lower Dry Creek

Upper Auburn Ravine

These observations were supported by the results of a three-factor analysis of variance

Source	**Sum of Squares**	**DF**	**F-Ratio**	***p***
Creeks	6700	4	18.0	<0.0001
Fall vs. spring	33	1	0.4	0.56
Valley vs. foothill	125	1	1.3	0.25

Low IBIs may point to problem areas in a stream

For example:

- Uppermost sample section of Miners Ravine: IBI = 35–40
- Catch dominated by golden shiner
- Golden shiner = environmentally tolerant species
- It can handle poor water quality to the exclusion of environmentally sensitive native species

Question: ***Is water quality a chronic stressor to fishes in Miners Ravine where IBI scores averaged 52 in fall 2004 and 54 in spring 2005?***

Some findings

- Modified Putah Creek IBI seems to be effective at quantifying apparent differences in fish community composition and structure between creeks
- Creeks with highest IBI's on average (Secret and Auburn ravines) are the primary steelhead production areas
  - Driven by summer flow and temperature conditions?
- Miners Ravine is dominated by spotted bass and other introduced fish species, including tolerant species like golden shiner
  - Water quality issues?

- Steelhead occur in very low abundance in Coon Creek in areas where expected (e.g. Spears Ranch)
  - Smallmouth bass a problem?

Utility of fish IBI in stream survey protocol?

- Data requirements are minimal
- IBI data can be additive in assessments of target species
- IBI structure is flexible
- IBI provides quantitative data that can be analyzed with standard statistical procedures to make assessments over space and time
  - ***Including to assess influence of adjacent land use***

Acknowledgements

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