

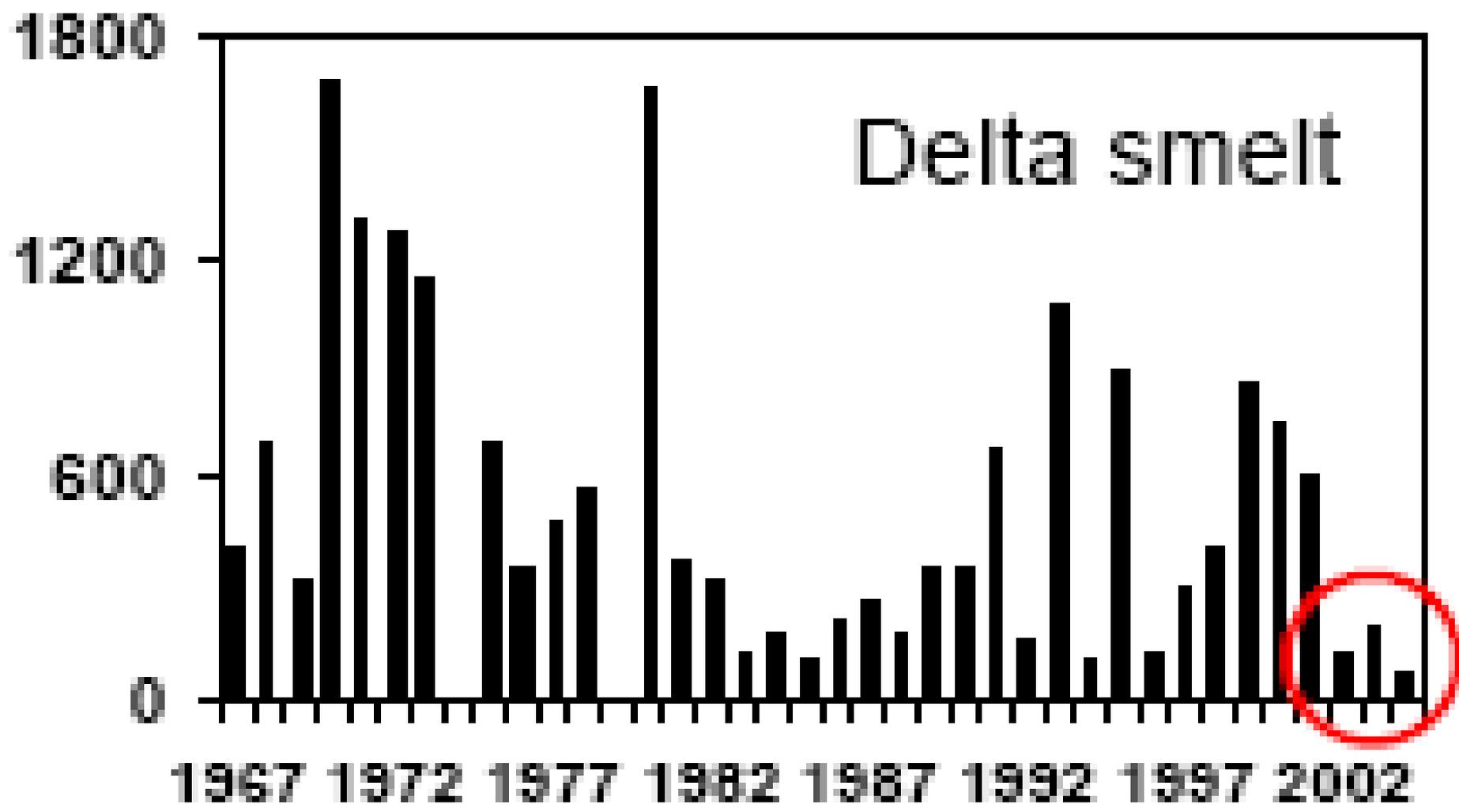
# Alternative Statistics for Time Series of Rare, Threatened, or Endangered Pelagic Species

A report on a cooperative study of the Delta Smelt Index Based on Fall Midwater Trawl Surveys

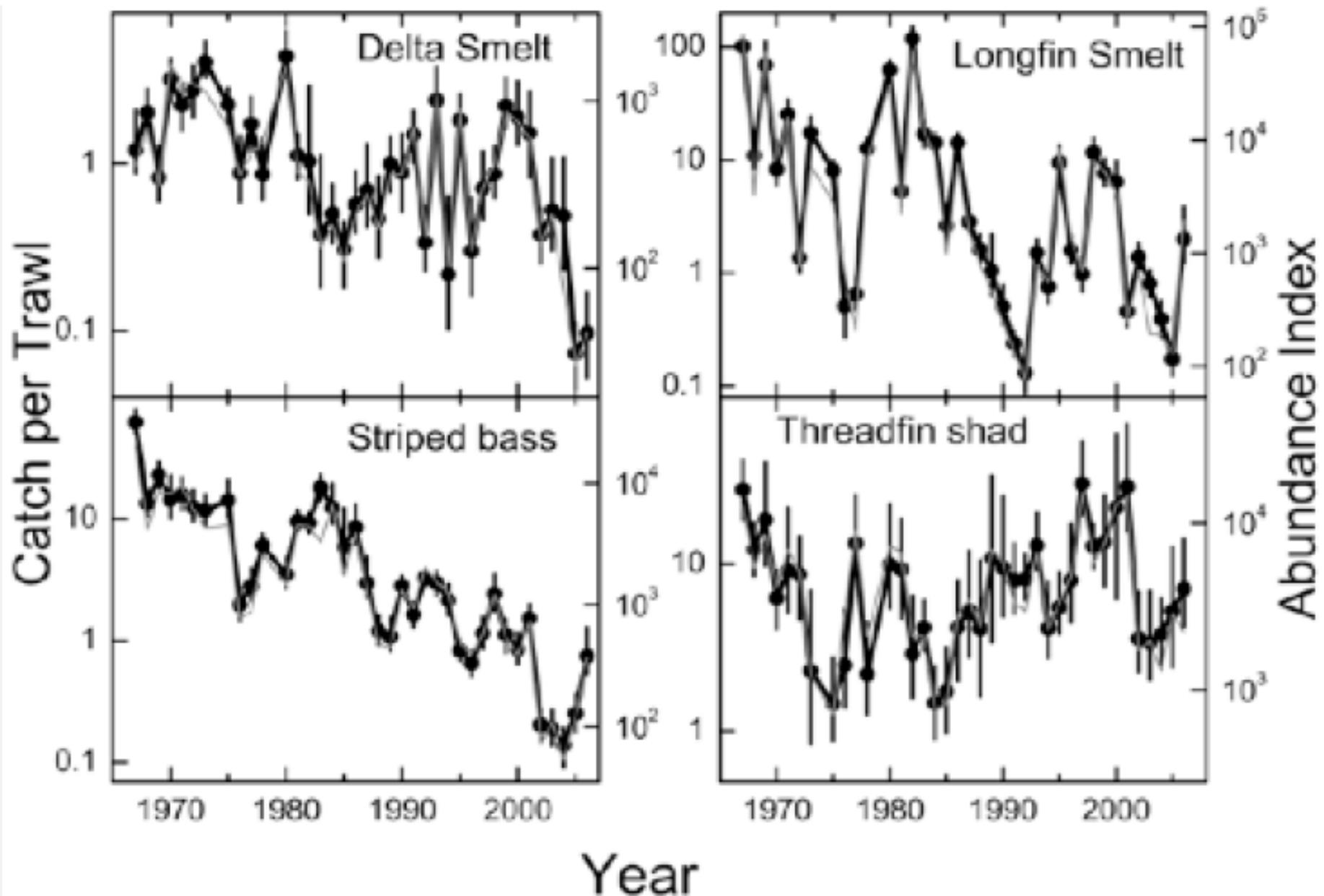
Paul Smith, ISB and Randall Baxter, CF&G

Independent Science Board  
Sacramento August 2007

# No Confidence Limits – Arithmetic Scale



# Bootstrapped Confidence Limits – Log Scale



## **Partial List of Findings**

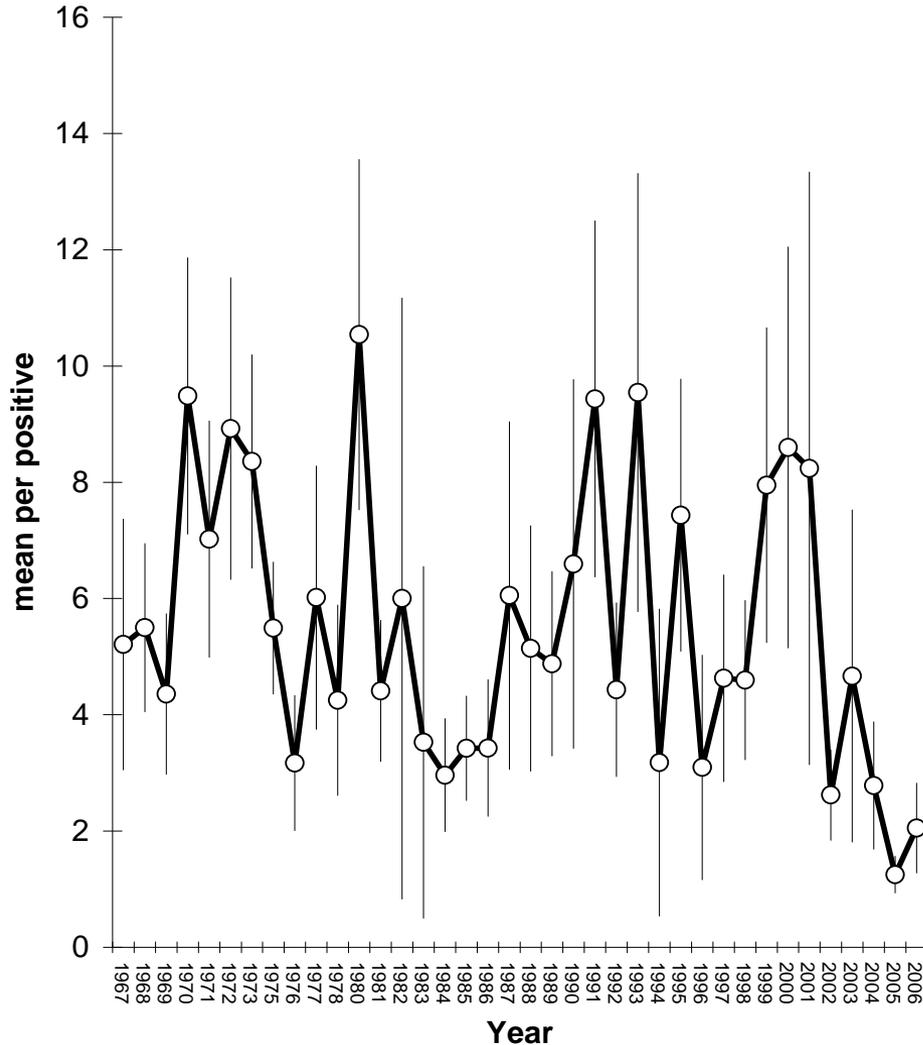
**Delta Smelt Index is the product of two quite different variables - Incidence and Density**

**Density is a contagious distribution probably caused by aggregation of fish**

**Confidence limits on Incidence can be estimated by assuming a binomial distribution – presence/absence**

**Confidence limits on density can only be established with a number of positive samples sufficient to ensure a 'representative' sample.**

## Delta Smelt

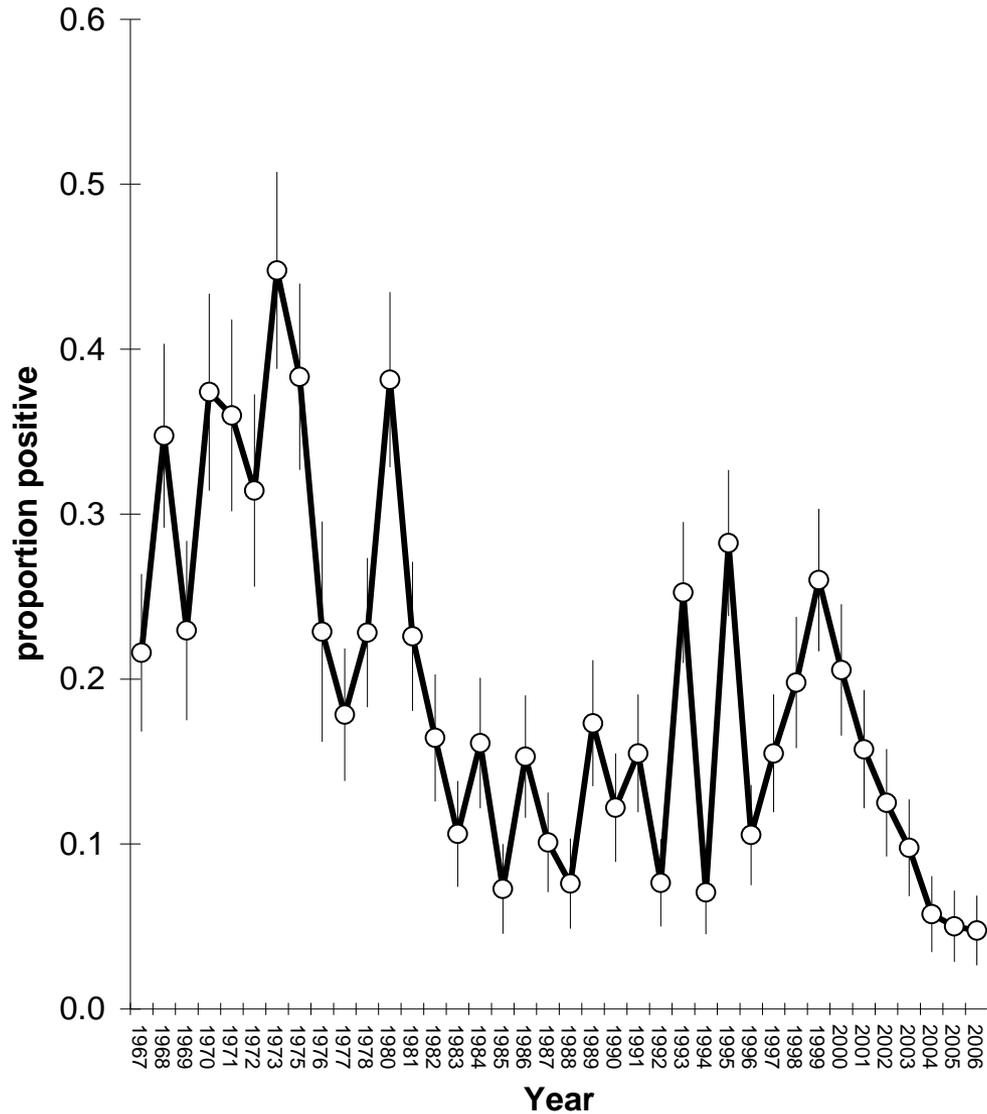


**Mean plus or minus  
2 std. errors for annual  
Index estimates.**

**Note two features:  
Limits strongly depend  
on means**

**Most annual error  
limits encompass  
the overall mean of  
six fish per trawl**

# Delta Smelt



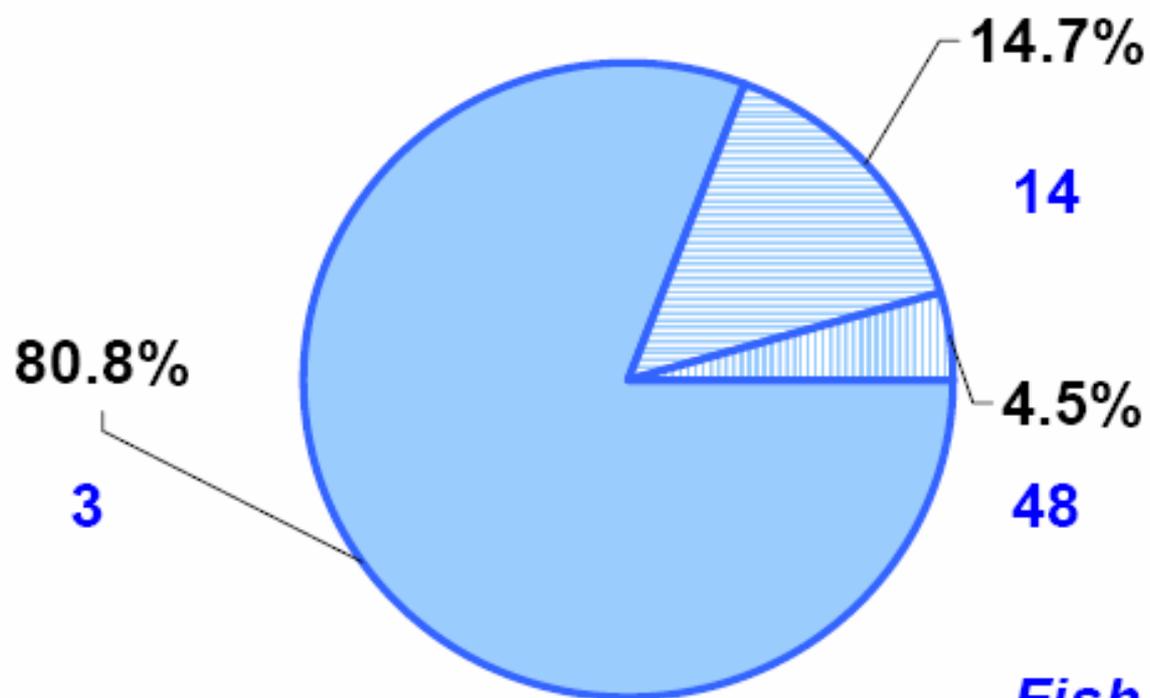
**Annual Mean proportion  
plus or minus 2 std.  
errors**

**Note sustained trends**

**Most recent 3 years are  
indistinguishable**

## Delta Smelt Pre-Recruits FMWT

**No Fish 80%**



*Fish per trawl*

# **Conclusions**

**Interannual Change Cannot Be Detected  
at the Current Level of Sampling Effort**

**Historic time series should be maintained  
but Additional Work can be designed to  
Augment i.e. Additional Stratified Trawls**

**Precision of Delta Smelt Index is  
controlled more by fish aggregation  
than by variable sampling procedures**