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Presentation

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Establishing reference conditions for multimetric health indices: the benefits and challenges of historical data sets



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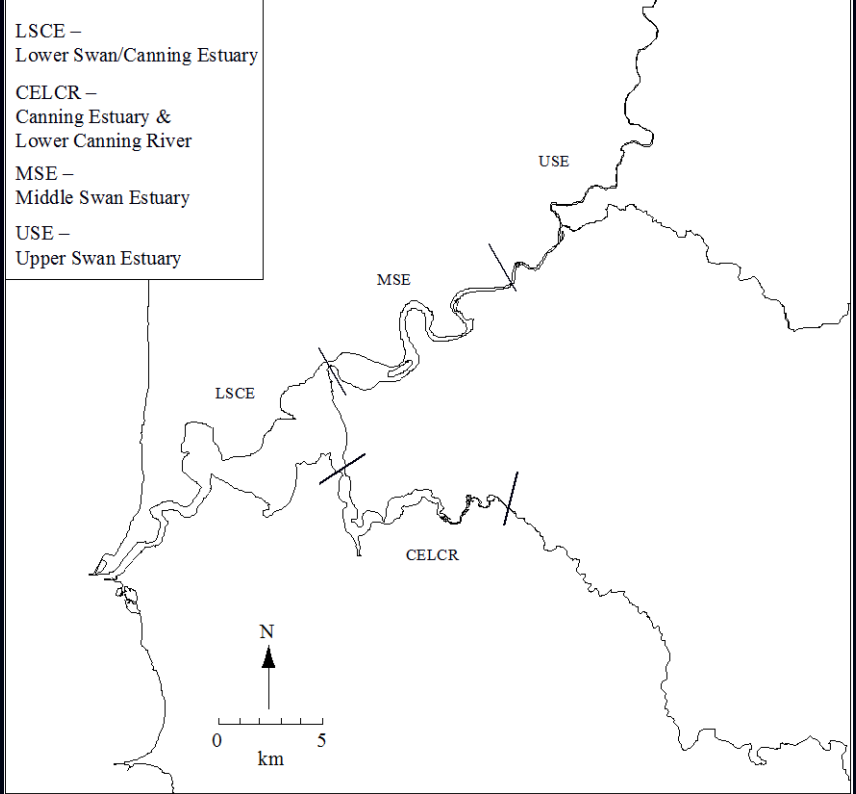
Centre for Fish and Fisheries Research, Murdoch University, WA



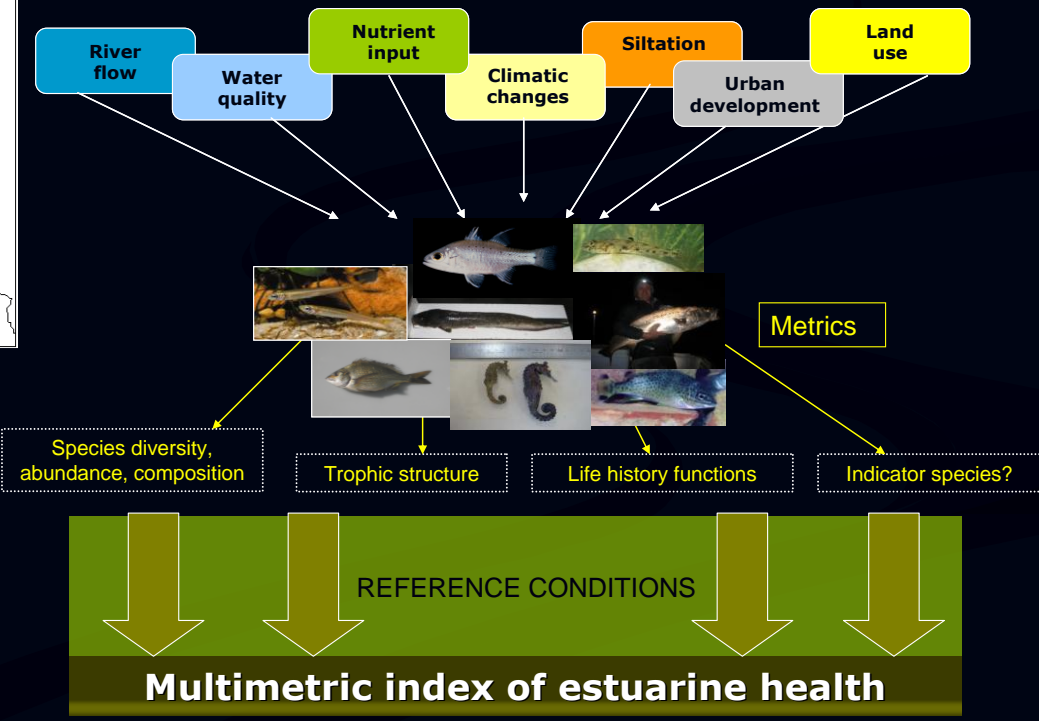
Fishbase



Outline

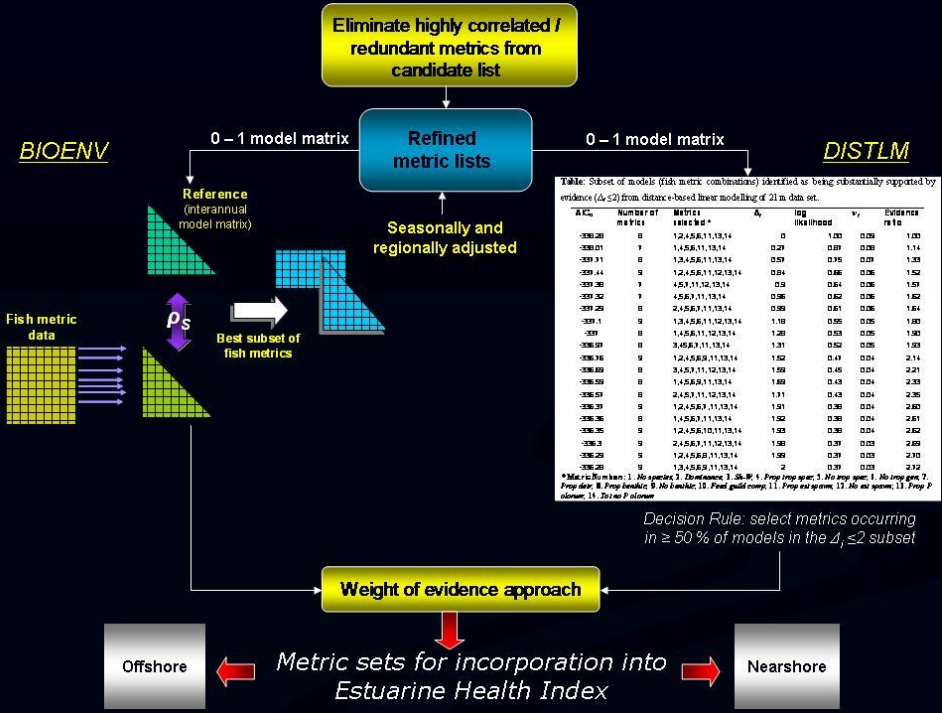


- Multimetric indices
- Metric selection
- Reference conditions – data standardisation
- Benefits and challenges



Metric selection

- Distance-based linear modelling (DISTLM)
- Non-linear multivariate techniques (BIOENV)
- Multiple data sets and analyses
- Weight of evidence approach
- Select suite of metrics which efficiently represents ecosystem health



Metric	Nearshore	Offshore
No species		
Dominance		
Sh-div		
Prop trop spec		
No trop spec		
No trop gen		
Prop detr		
Feed guild comp		
Prop benthic		
No benthic		
Prop est spawn		
No est spawn		
Prop P. olorum		
Tot no P. olorum		

Selected metrics

Hallett, C.S., Valesini, F.J., Clarke, K.R. (In review). A method for selecting health index metrics in the absence of independent measures of ecological condition.

Reference conditions

- 'Best-available' reference...

- Long-term data set with good but varying spatial coverage

- **Offshore waters** (> 2 m)
Consistent sampling regime and methodology

- **Nearshore waters** (< 2 m)
Multiple sampling methods

- Loneragan *et al.* 1989 (1977-81) ● ●
- Sarre unpubl. (1993-94) ●
- Kanandjembo *et al.* 2001 (1995-97) ● ●
- Hoeksema 2006 (2000-01) ● ●
- Valesini *et al.* unpubl. (2003-04) ● ●

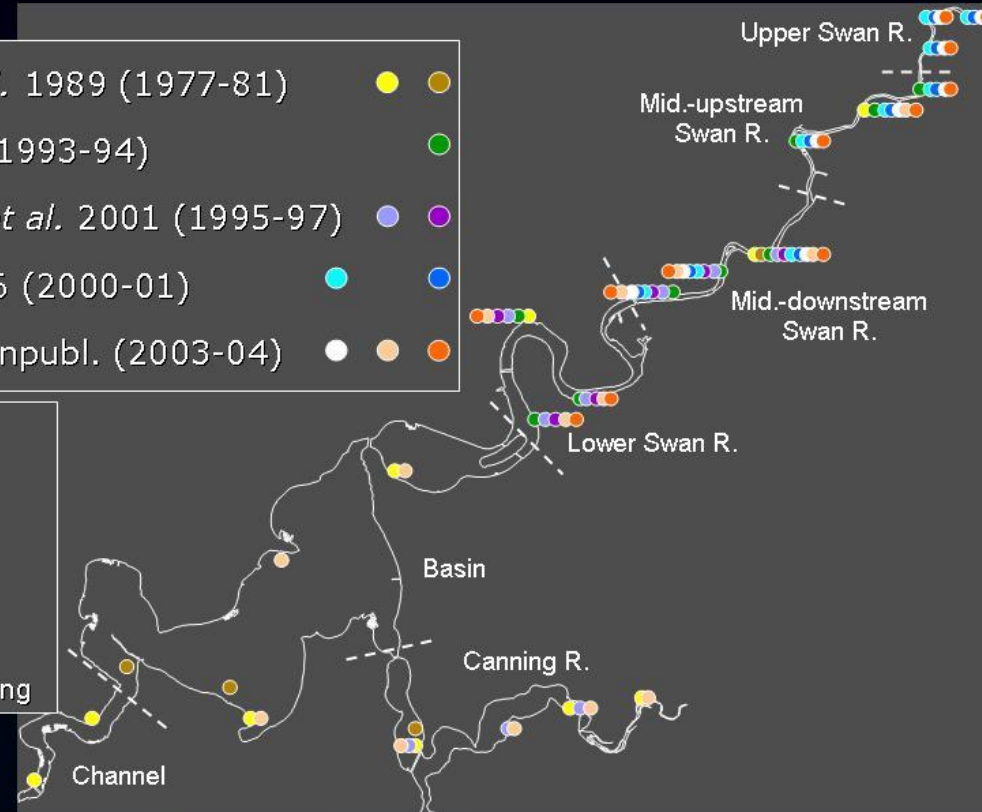
Sampling methods:

■ Nearshore

- 21 m seine
- 41 m seine
- 133 m seine

■ Offshore

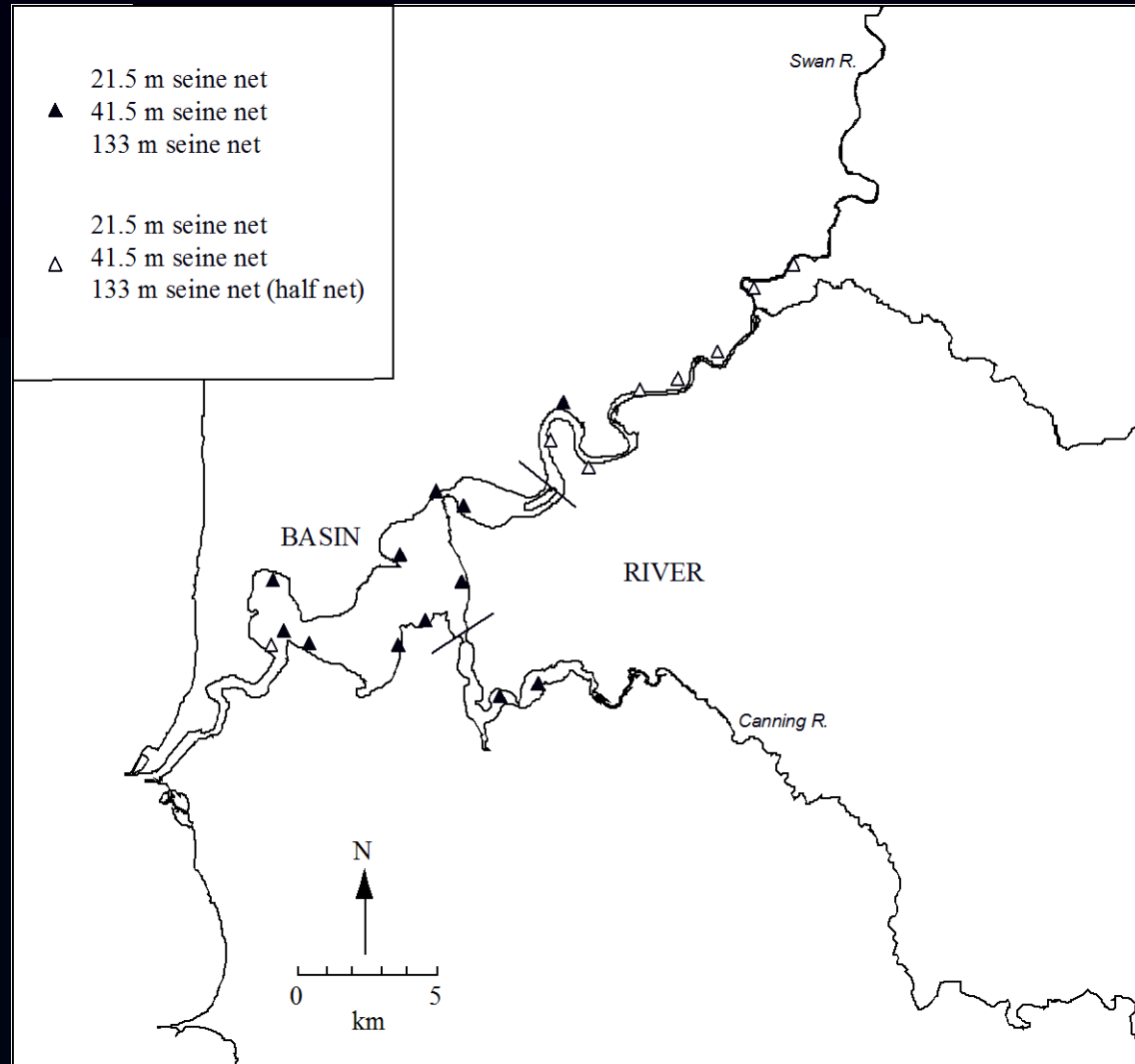
- Multimesh gillnetting



Need to **standardise** nearshore fish community data to account for effects of differential net biases, before we can compare or collate data from different periods to establish 'best-available' reference conditions

Net comparison study

- Two estuarine 'regions':
'Basin'
'River'
- Ten sites across each region
- Two **seasons**:
Spring 2008
Autumn 2009
- Three seine **nets**
21.5 m (116 m²)
41.5 m (274 m²)
133 m (2815 m²)
(half of 133 m net used at some sites)
- One sample collected with each net, deployed in a randomised order



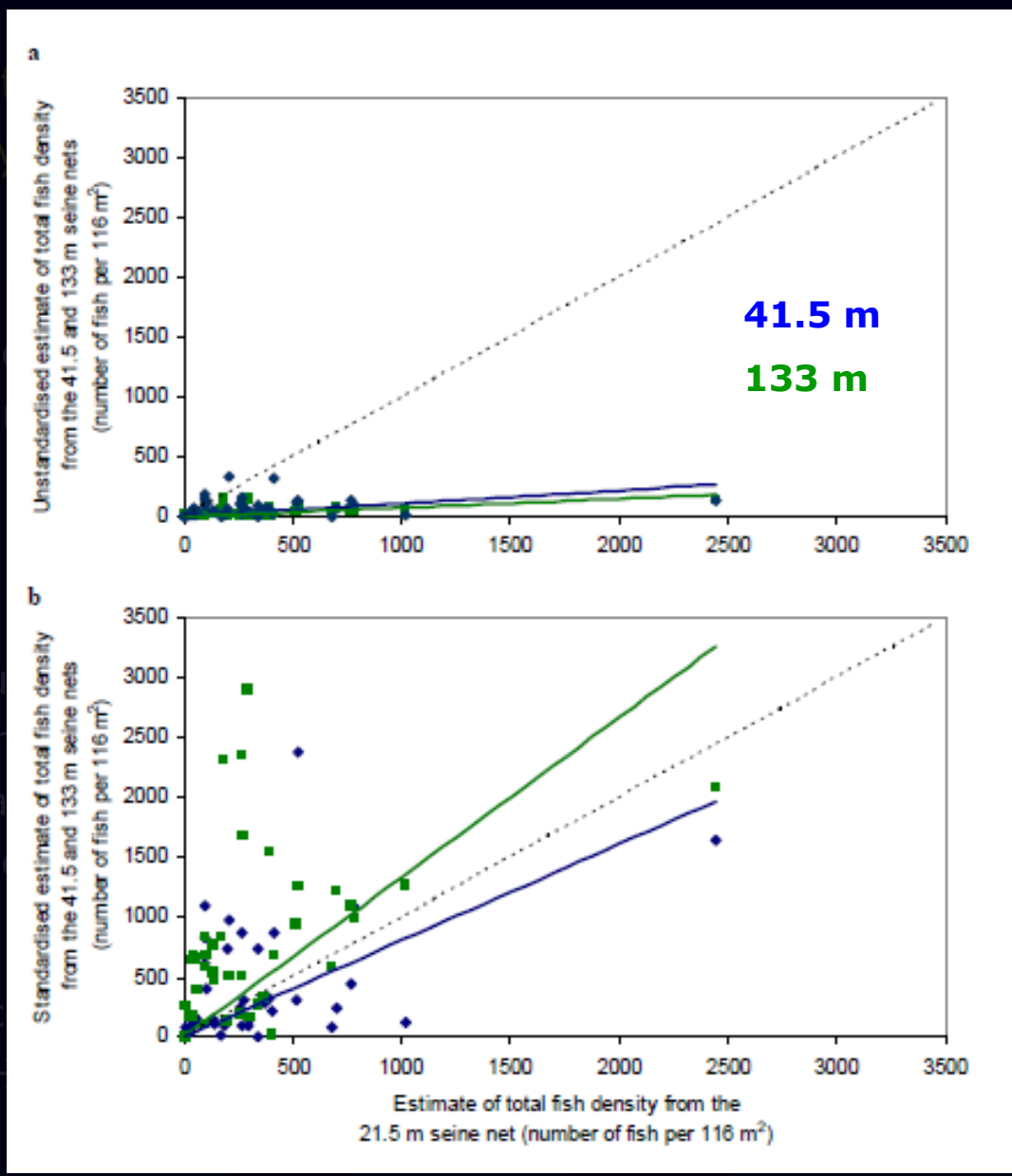
Net standardisation

Current and historical data sets are not directly comparable due to differences in net size and fishing effort.

1. Generalize the data from the study

2. Derive equations for adjusting historical data (>100 m and 21 m net)

3. Equivalence of data sets



Standardised to ensure

Habitat guild		
Benthopelagic	Pelagic	Small benthic
NA	0.03	1.20
NA	0.11	1.81
NA	0.01	0.79
NA	NA	1.17
NA	NA	1.79
NA	NA	0.77
NA	NA	1.98
NA	NA	3.01
NA	NA	1.30
NA	NA	4.69
NA	NA	7.15
NA	NA	3.07

counts in historical data sets (2009)

Reference conditions and scoring

- Reference conditions for each metric determined statistically from 95th percentiles (negative metrics) or 5th percentiles (positive metrics) of standardised data
- Specific reference conditions established for each region of the estuary in each season
- Metrics scored (0-10) according to the available reference
- Quantitative Index score (0-100) calculated from metrics
- Index score can then be used to allocate Status:

Good

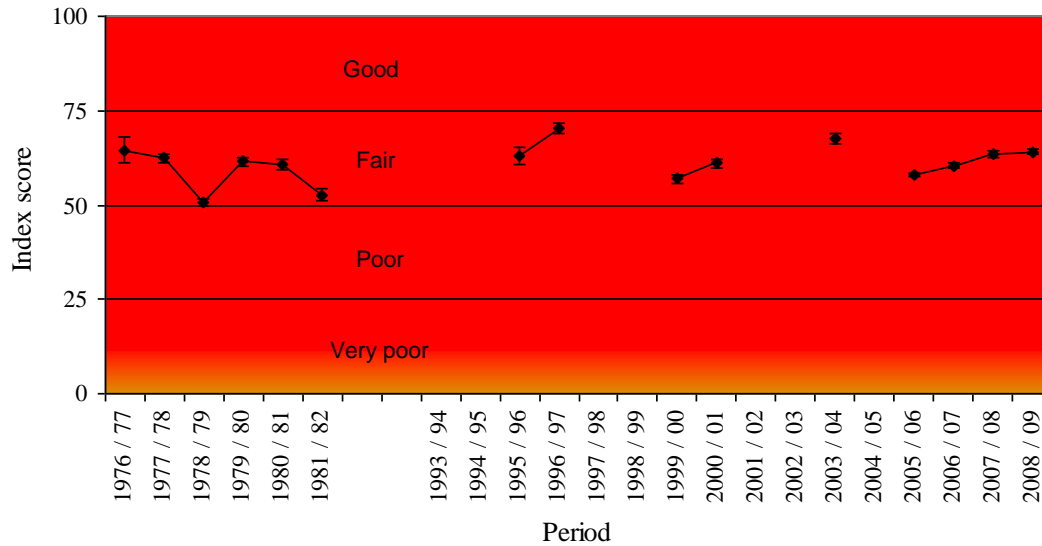
≥ 75

Fair

≥ 50 < 75

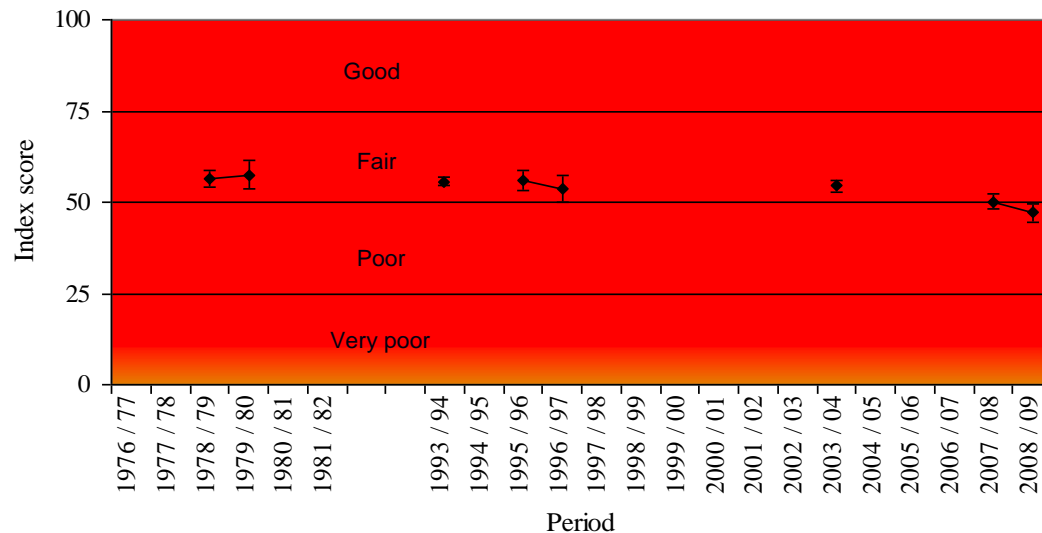
Region*season	n	Metric										
		No species (-)	Prop trop spec (-)	No trop spec (-)	No trop gen (+)	Prop detrit (+)	Prop benthic (-)	No benthic (-)	Prop est spawn (-)	No est spawn (-)	Prop P. olorum (+)	Total P. olorum (+)
LSCE*summer	174	11	0.99	8	1	0	1.0	9	0.96	5	0	0
LSCE*autumn	156	13	0.99	8	1	0	1.0	9	0.83	5	0	0
LSCE*winter	173	8	1.0	6	0	0	1.0	6	0.79	4	0	0
LSCE*spring	179	11	0.98	7	1	0	1.0	8	0.76	5	0	0
CELCR*summer	66	14	0.99	9	1	0	1.0	9	1.0	9	0	0
CELCR*autumn	68	13	0.99	8	0	0	1.0	6	1.0	7	0	0
CELCR*winter	79	10	0.99	5	0	0	1.0	5	1.0	6	0	0
CELCR*spring	84	12	0.98	8	1	0	1.0	7	1.0	8	0	0
MSE*summer	119	14	0.96	8	1	0	1.0	9	1.0	9	0	0
MSE*autumn	123	14	1.0	9	0	0	1.0	9	1.0	8	0	0
MSE*winter	115	10	0.98	6	0	0	1.0	7	1.0	6	0	0
MSE*spring	144	13	0.93	8	1	0	1.0	9	1.0	8	0	0
USE*summer	108	10	0.98	6	1	0	0.98	7	1.0	8	0	0
USE*autumn	111	9	1.0	5	0	0	1.0	6	1.0	7	0	0
USE*winter	99	5	0.99	3	0	0	0.95	3	1.0	4	0	0
USE*spring	132	9	0.98	5	1	0	1.0	6	1.0	7	0	0

Analysing trends: 1. Estuary-wide



Mean (± s.e.) nearshore health index scores

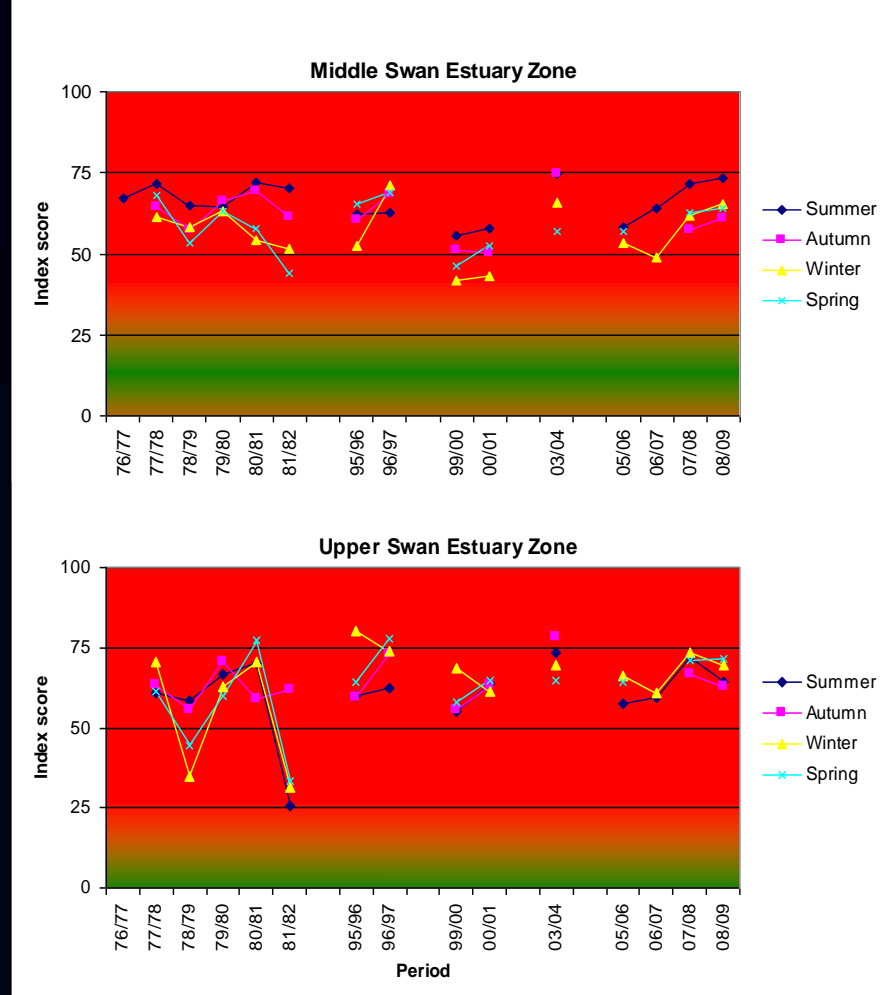
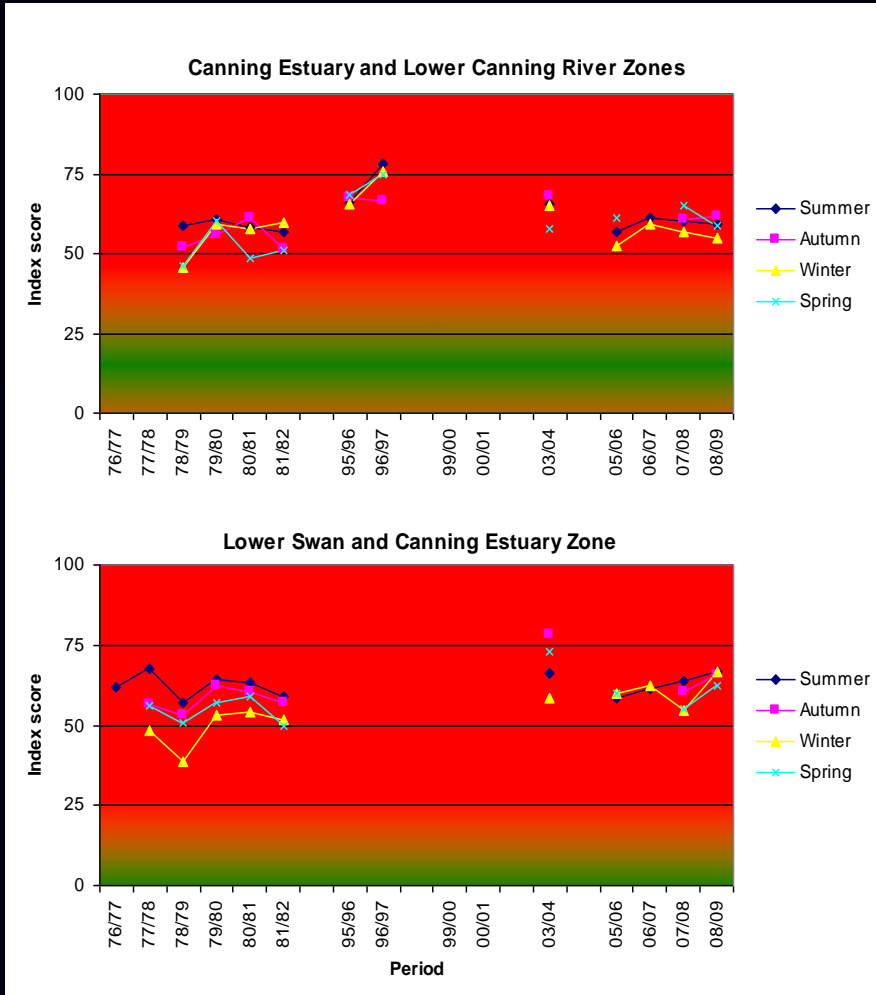
- Health of nearshore waters 'fair', although...
- Historical nearshore scores less reliable
- Reliable evidence of recent increase in nearshore health index scores



Mean (± s.e.) offshore health index scores

- Offshore scores more reliable
- Health of offshore waters has declined:
 - 'Poor' for first time in three decades
- Evidence of fish shifting to nearshore waters in recent years?

Analysing trends: 2. Zone-by-zone



(Nearshore index scores)

Challenges

- Gaps in sampling regime hinder interpretation of trends
- Impossible to adjust between data sets for differences in species absence
- Different sampling methods have their own pro's and con's, but trend towards smaller nets

Summary



Benefits

- Novel standardisation method enables a degree of comparison across sampling methods
- Illuminate long-term changes
- Analysis of multiple temporal and spatial scales
- Maximises data to provide more reliable 'best-available' reference conditions

Long-term, annual monitoring via a consistent methodology is key to maximising the utility of ecological health indices for estuarine management

Acknowledgements:

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Images courtesy: F. Valesini, D. Morgan, M. Allen, T. Linke, S. de Lestang, M. Hourston

