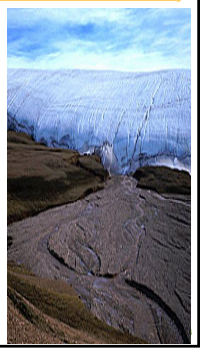
~ GIS research example~

Pleistocene glaciations in the UK

- Last glacial period ended 11k years ago



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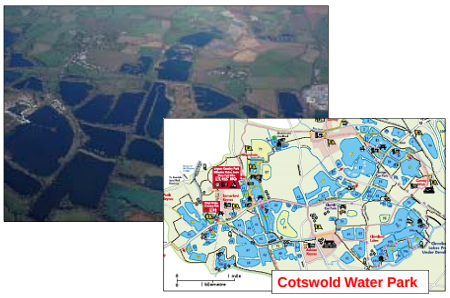
Cotswold Water Park



Cotswold Water Park

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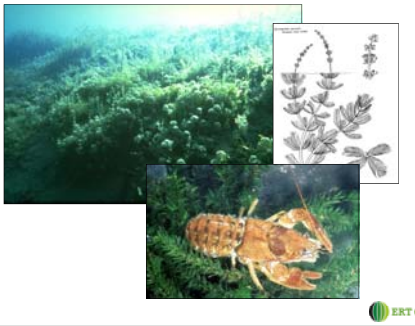
Cotswold Water Park – Marl community



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Cotswold Water Park – waterbird populations & community

Cotswold Water Park – statutory wildlife designations

Local Nature Reserve
National Parks and Access to the Countryside Act 1949

National Nature Reserve
WCA 1981, CROW Act 2000, NERC Act 2006

SSSI
WCA 1981, CROW Act 2000, NERC Act 2006

Special Protection Area (SPA)
EU Birds Directive 1979

Ramsar Site
Ramsar Convention 1971

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Cotswold Water Park – development pressures

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Growing 'conflict' ?

How to develop sustainable management of the lakes for the benefit of wildlife *and* people ?

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Management issues: characteristics of the CWP

1. Large number & variety of 'stakeholder' groups
   - Land owners
   - Aggregate companies
   - Recreational organisations
   - House owners
   - Countryside agencies
   - Planning authorities
   - Conservation organisations

2. Diversity of cross-sectoral actions
   - Species & habitat management
   - Planning regulation & consent
   - Management of countryside access
   - Management of industrial activities
   - Management of urbanisation processes

PLANNING POLICY STATEMENT 9

" Local planning policies & decisions should be based on sound ecological information, including well-informed assessments of the impacts of any potential development"

3. Wide range of information needs

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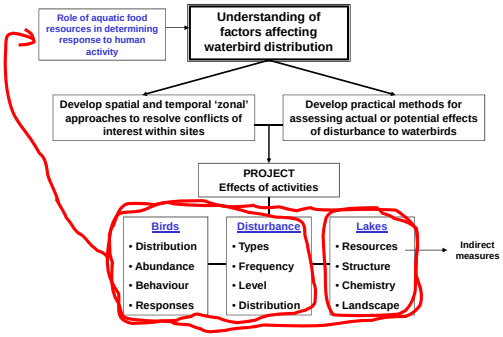
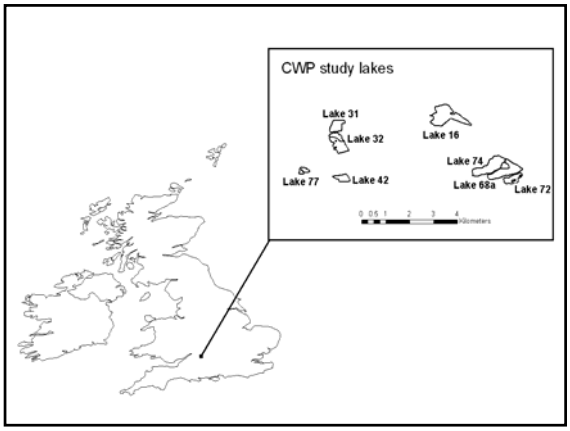
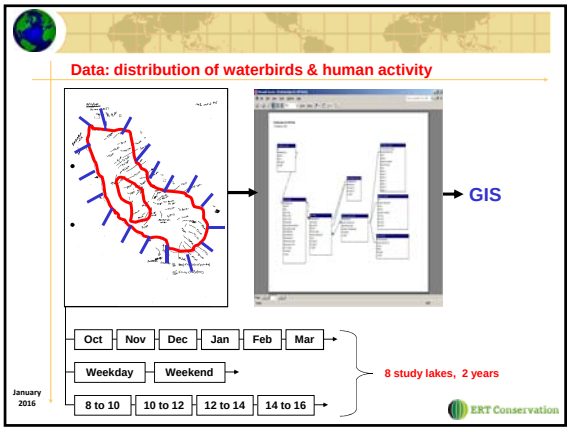
Servicing cross-sectoral information needs






Data: distribution of waterbirds & human activity
GIS
Oct
Nov
Dec
Jan
Feb
Mar
Weekday
Weekend
8 to 10
10 to 12
12 to 14
14 to 16
8 study lakes, 2 years
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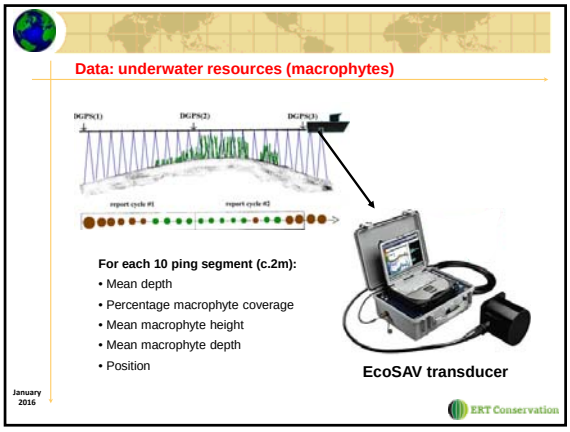
Data: underwater resources (macrophytes)
For each 10 ping segment (c.2m):
• Mean depth
• Percentage macrophyte coverage
• Mean macrophyte height
• Mean macrophyte depth
• Position
EcoSAV transducer
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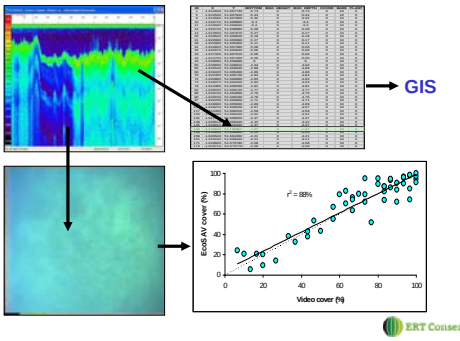
Hydroacoustic data



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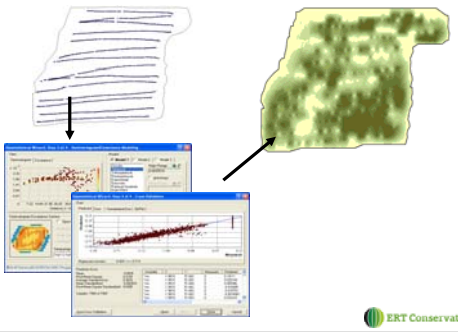
Interpolation of transect data



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~ GIS tools ~

How the data were analysed

2016

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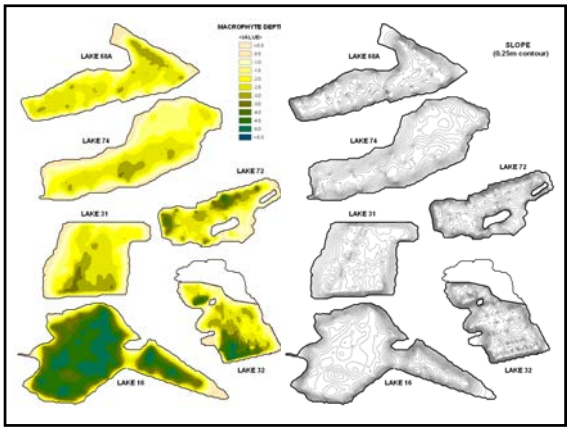
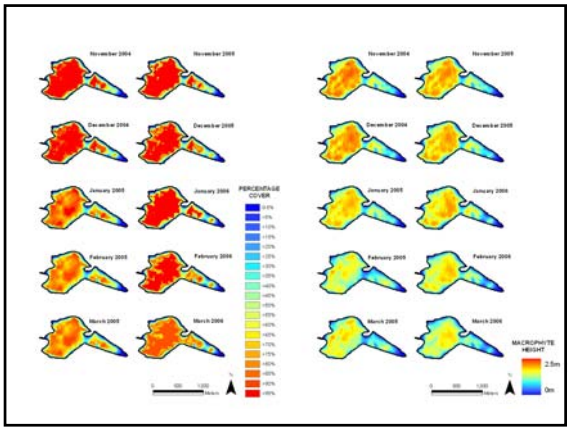
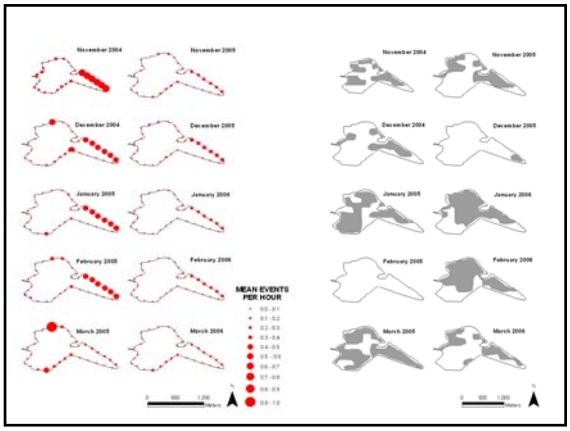
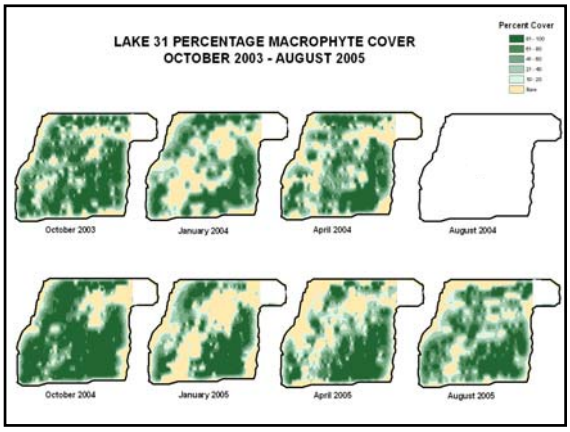
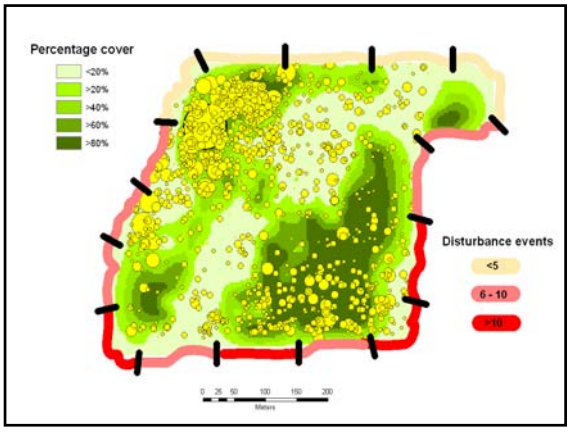
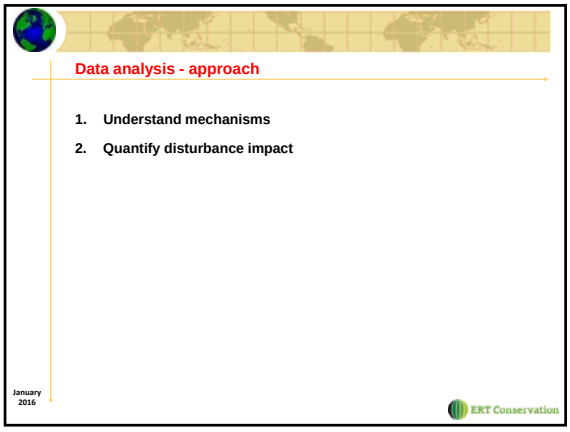

MACROPHYTE DEPTH
SLOPE
(0.25m contour)
LAKE 66A
LAKE 74
LAKE 72
LAKE 31
LAKE 16
LAKE 32


PERCENTAGE COVER
MACROPHYTE HEIGHT
2.5m
0m


MEAN EVENTS PER HOUR


LAKE 31 PERCENTAGE MACROPHYTE COVER
OCTOBER 2003 - AUGUST 2005
Percent Cover
October 2003
January 2004
April 2004
August 2004
October 2004
January 2005
April 2005
August 2005


Percentage cover
<20%
>20%
>40%
>60%
>80%
Disturbance events
<5
6 - 10
>10


Data analysis - approach
1. Understand mechanisms
2. Quantify disturbance impact
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Data analysis – statistical methods

1. Understanding mechanisms

- ✓ Generalised Linear Models (GLM)
- ✓ Repeat measures – estimating equations
- ✓ Poisson error structure
- ✓ Interaction terms
- ✓ 'Best fit' estimator

2. Quantifying impact

- ✓ Generalised Additive Models (GAMs)
- ✓ GRASP spatial predictor

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Results – understanding mechanisms

- GLM model output – significant variables influencing numbers of feeding birds using a patch

LAKE	SPECIES	PARAMETER	B	*P*
74	Tufted Duck	Number of aquatic gull events	-16.47	0.006
		Percent macrophyte cover	-0.07	0.001
		Water depth	-11.48	0.008
		Percent macrophyte cover * Month	0.01	0.006
		Water depth * Percent volume infestation of water column	0.48	0.026
		Number of aquatic gull events * Percent macrophyte cover *	-0.79	0.011
		Number of aquatic gull events * Water depth	102.58	0.002
		Number of aquatic gull events * Number of terrestrial events	232.04	0.038
		Number of terrestrial events * Percent macrophyte cover	3.96	0.001

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Conversion to 'general' rules

Tufted Duck….

- ✓ Prefer to feed in shallow areas of a lake.
- ✓ Select barer areas of the lake floor, particularly in areas of higher terrestrial human activity.
- ✓ Do not avoid utilising resources in areas with aquatic human activities (boating *etc.*), but in these areas they select higher quality patches.
- ✓ Are sensitive to terrestrial human activities (even where these are infrequent) and where humans are 'apparent' to the birds (e.g. walking and dog walking). However, at higher levels of vehicle based disturbance, birds demonstrate considerable levels of habituation.
- ✓ Are very sensitive to 'disturbance' by gulls, increasingly so as the winter progresses.
- ✓ Are more sensitive to the negative influence of terrestrial disturbance where gulls also have a high influence.

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Results: conversion to management recommendations

1. Aquatic resource sampling
2. Aquatic resource management
3. Waterbird management:
   - Zonation
   - Shielding

Site managers

Planning authorities

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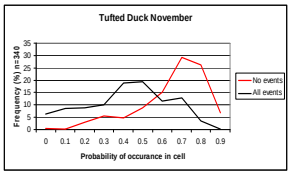
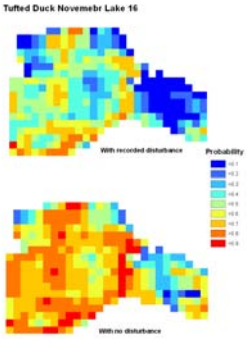
Results – quantifying impact

- GAM outputs





The power of GIS !!

1. Data representation = VERY visual
2. Defendable (robust) conclusions = use statistics
3. Great for both monitoring & research
4. Generates new information and ideas

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