

Analysing Results from Car-Based Bat Monitoring Schemes and How These Compare with Foot-Based Field Surveys

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Analysing bat surveys

- The ideal situation
- Real life problems and how to solve them
- Comparing foot surveys and car surveys

Ideal situation - Stabfostol

- Only Gt Horseshoe bats
- Only 6 possible roost sites, each with single entrance
- 6 keen bat volunteers who are never ill, too busy, etc.
- All bats come out every night



	1993	1994	1995	1996	1997	1998	1999
Roost 1	51	49	30	56	75	40	33
Roost 2	28	36	4	15	2	3	5
Roost 3	12	0	0	0	0	0	0
Roost 4	2	1	48	56	79	83	12
Roost 5	48	49	74	83	87	82	81
Roost 6	1	0	0	1	0	0	0

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Roost 6	1	0	0	1	0	0	0
Total	142	135	156	211	243	208	131
Average	23.7	22.5	26.0	35.2	40.5	34.7	21.8

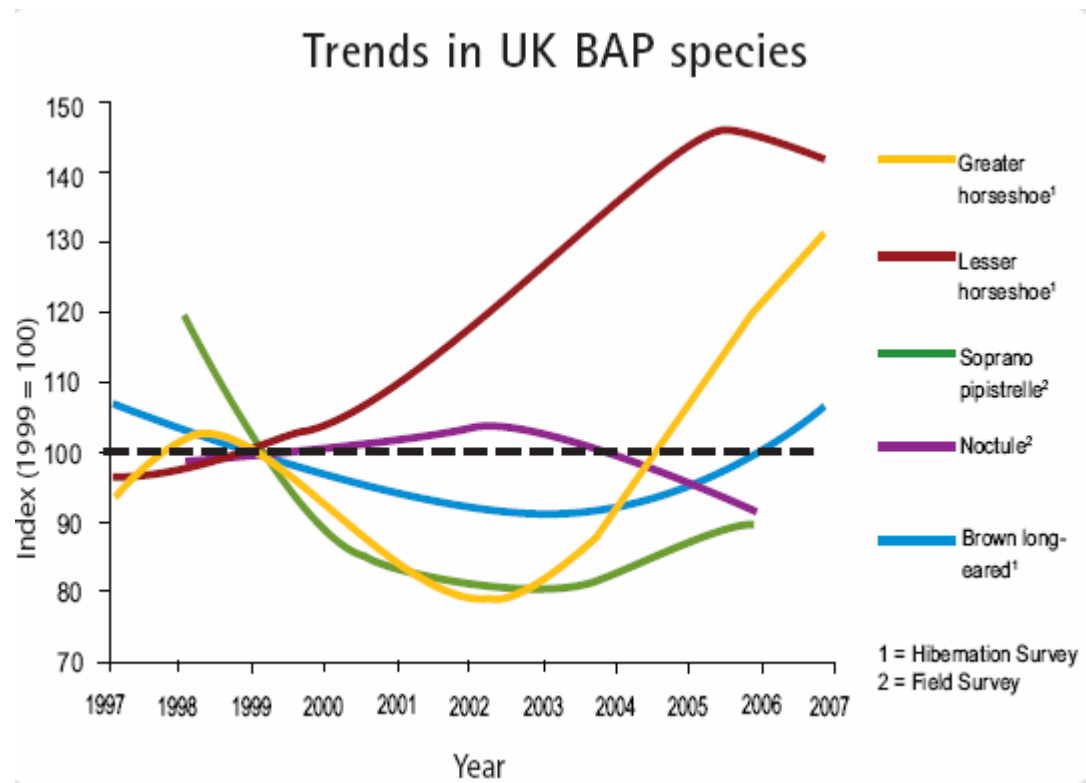
- The total number of bats is the best summary in this simple example.
- Use means if different numbers of roosts in different years
- No need for complex models.

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Average	23.7	22.5	26.0	35.2	40.5	34.7	21.8
Index	100.0	94.9	109.7	148.5	170.9	146.4	92.0

e.g. $243/142=1.709$ or 170.9%

Why use an index?

- Index allows easy comparison
- Combined graph from NBMP summary
- Sensible where absolute numbers unknown



What problems do we get in real surveys?

What problems do we get in real surveys?

- Missing data
- Year-to-year variability
- Variability between counts (random and e.g. temperature)
- Can't visit all roosts/sites – need to sample
- May count passes not individual bats

Missing Data

Suppose observers get fed up with seeing no bats

	1993	1994	1995	1996	1997	1998	1999
Roost 1	51	49	30	56	75	40	33
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Average	23.7	22.5	26.0	35.2	40.5	52.0	32.8
Index	100.0	94.9	109.7	148.5	170.9	219.4	138.2
Model	23.7	22.5	26.0	35.2	40.5	37.9	18.7

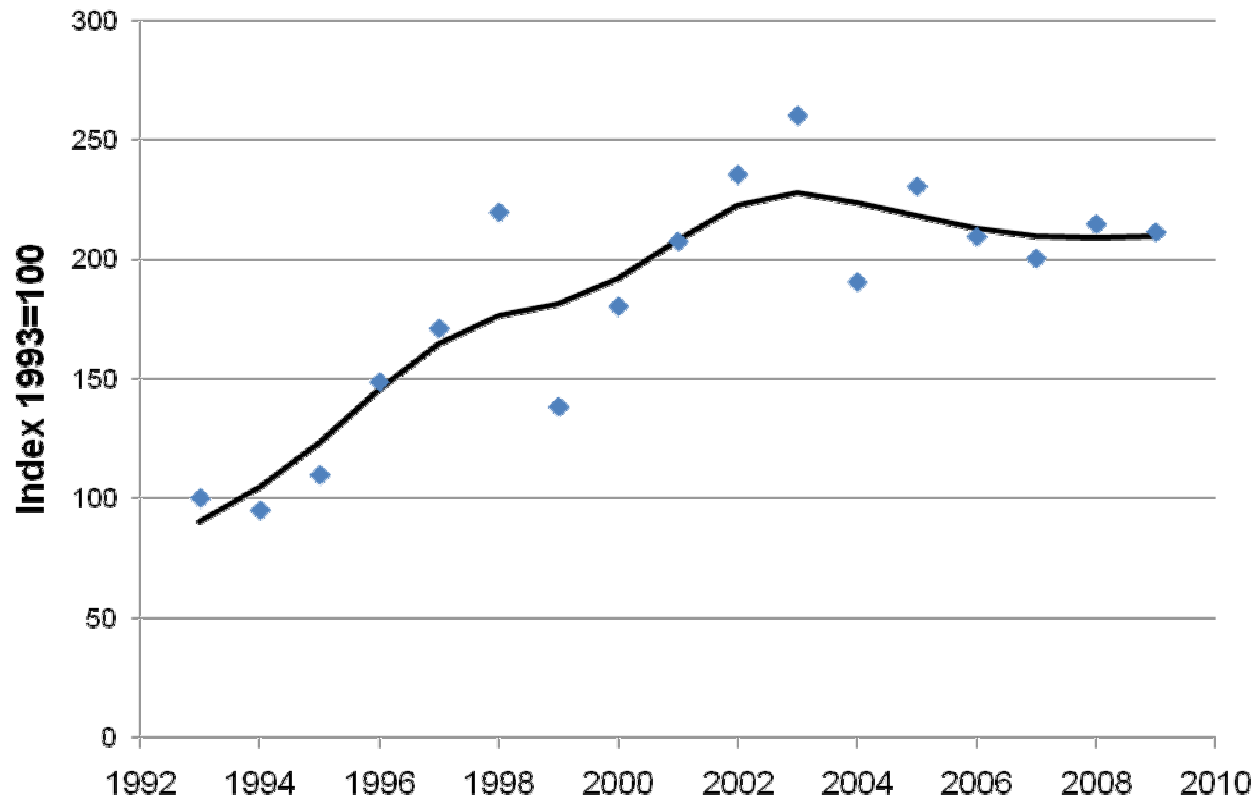
- Use a statistical model to find averages allowing for which roosts missed

Year-to-year variability

- Population may vary from year to year
 - e.g. due to high winter mortality, or successful breeding year.
- May also get variation in annual counts without genuine population change
 - e.g. If unusual weather changes time of breeding season.

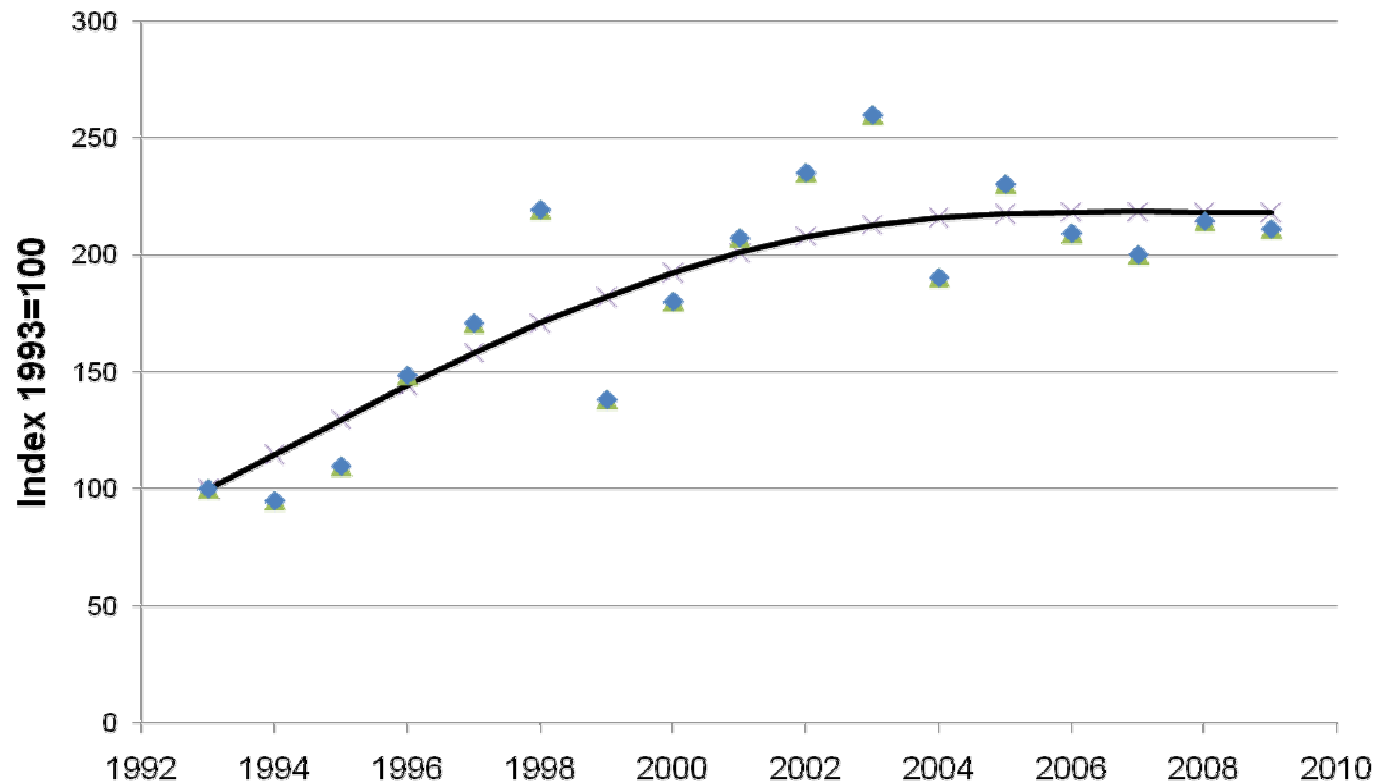
Year-to-year variability - GAMs

- It may be useful to smooth out the trends using a Generalised Additive Model



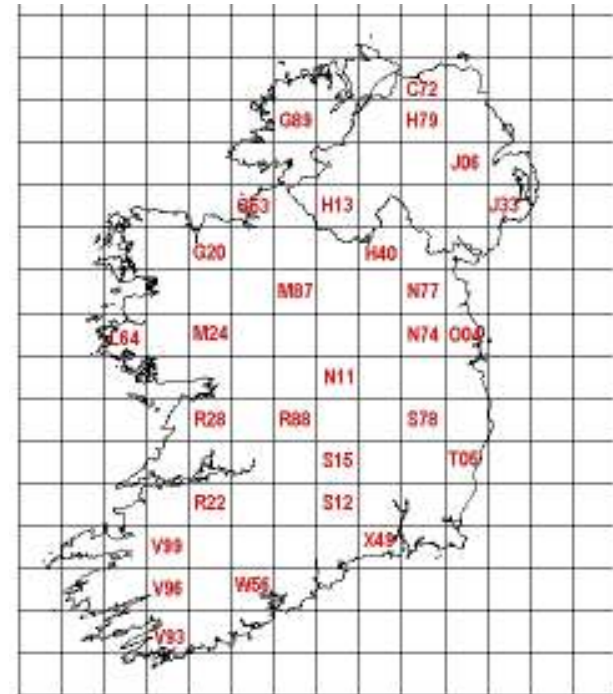
Year-to-year variability - GAMs

- Can vary the degree of smoothing
- Not yet used for Ireland



Sampling sites

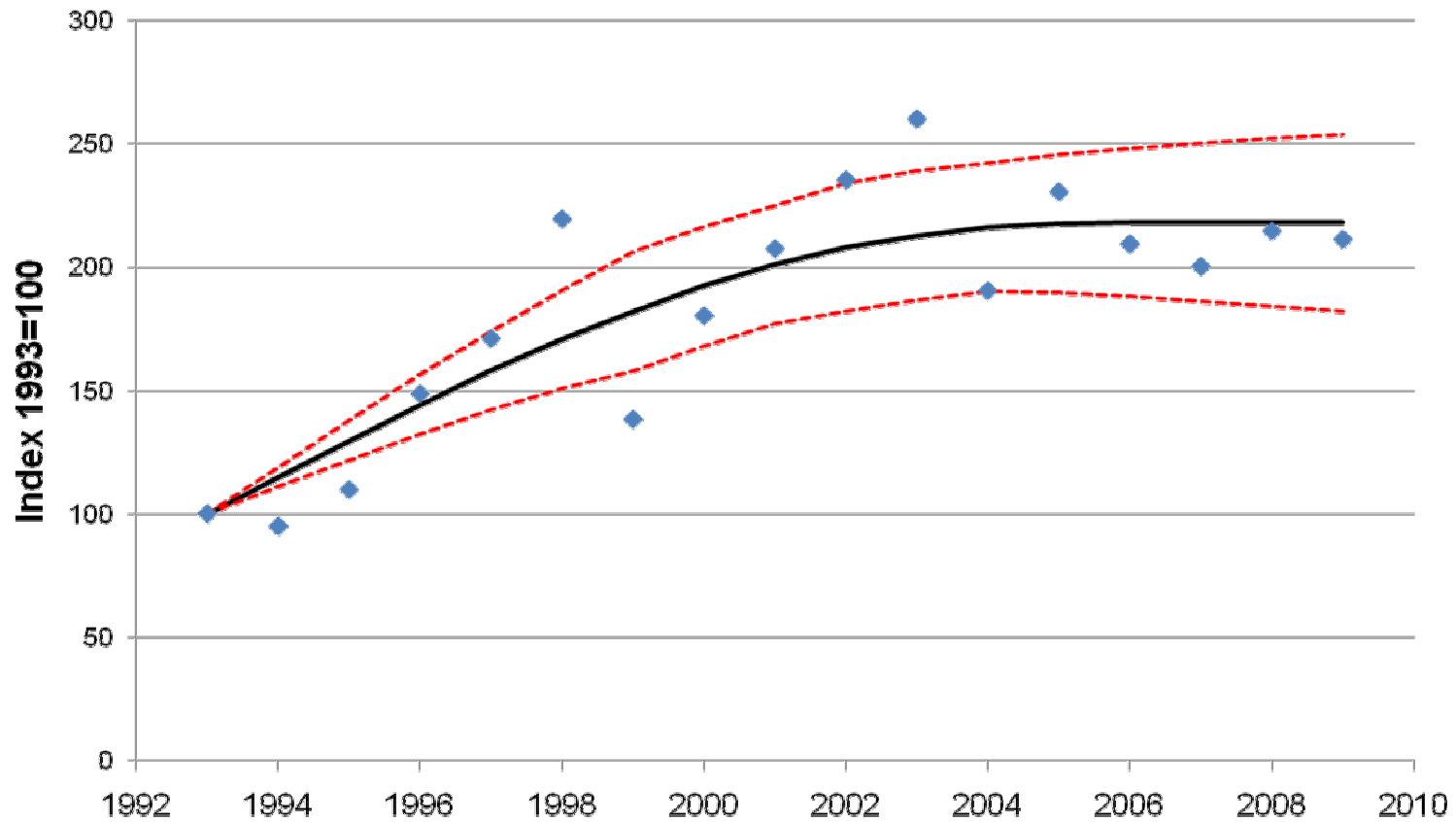
- Can't do all possible squares so sample
- Ideally at random
- Can correct for bias by weighting, but not ideal
- Estimates will vary slightly depending on sites selected.



Sampling sites – confidence limits

- Need to estimate uncertainty in population estimate as a result of sampling
- Shown as confidence limits on a graph
- For example, 95% confidence limits will enclose the true value 95% of the time.

Confidence limits for trend



Car surveys – pros & cons

Advantages

Disadvantages

Car surveys – pros & cons

Advantages

- Good coverage of wide area
- Allows use of untrained volunteers
- Good data for habitat associations

Disadvantages

- Roadside habitats not typical of wider countryside.
- Equipment costs

Alternative: NBMP foot survey

- Use 'random' 1km square
- Ideally walk triangular route with 12 observation points >150m apart
- In practice as near as possible to this
- Walk with heterodyne bat detector 25kHz recording Noctules/Serotine passes
- Stop at points and record pips for 2 minutes tuned to 50kHz.

Foot surveys – pros & cons

Advantages

- Good coverage of all habitats
- Low equipment costs
- Could record calls for subsequent analysis
- Relatively quick

Disadvantages

- Depends on ID skills of observer
- Multiple passes create problems
- Only one 1km square per observer per night

Comparing foot and car surveys

- Some differences cannot easily be compared statistically
 - esp bias in terms of habitats
- But can look at precision of trend estimates using the two approaches
- Use 'power analysis'
 - probability of detecting a decline (or increase) if one really exists

How does power analysis work?

- Take real car survey data and see how varies between surveys, between years, etc
- Simulate data on computer with similar properties, but add a known trend
 - red alert (50% decline over 25 years)
 - or amber (25% decline over 25 years)
- Repeat this process hundreds of times
- See how often trend is statistically significant.

Power analysis results

- Bat Conservation Ireland design
- Table below shows number of years to detect trend 90% of time.

Squares	Common pipistrelles		Soprano pipistrelles		Leisler's	
	Amber	Red	Amber	Red	Amber	Red
10	>25	11	>25	11	>25	12
15	19	10	24	10	>25	11
20	16	9	20	9	24	10
25	15	7	17	8	19	9

Comparing car and foot surveys

- Use British data from car surveys and NBMP foot survey
- Car survey slightly different design
- Compare in terms of volunteer time as well as number of sites
 - car survey 15 hours per route per year
 - foot survey 10.5 hours per site per year
- Two analysis methods for foot surveys
 - show best one here only

Comparing surveys - results

- Table below shows number of years to detect trend 80% of time.

Volunteer hrs/year	Common pipistrelles		Soprano pipistrelles		Noctules	
	Foot	Car	Foot	Car	Foot	Car
315	10.1	11.1	17.5	14.9	19.6	26.1
525	8.9	10.1	14.1	12.5	15.1	21.5
1050	8	7.1	11	10.8	12.4	14.4
2100	*	6.2	9	8.3	9.2	10.7

Comparing surveys - conclusions

- Car survey marginally better for equivalent effort (possibly more so with Irish design)
- But greater risk of bias so prefer foot survey if have enough skilled volunteers
- Don't change established survey unless have resources to run both in change over period