ADAPTIVE SAMPLING STRATEGY
FOR ASSESSMENT OF AVIAN DIVERSITY

A.P.Gore, S.A.Paranjpe, Department of Statistics, University of Pune

Kenneth Gerow, Department of Statistics, University of Wyoming, USA.

Chaitanya Joshi, Department of Mathematics, IIT Kanpur

P.Pramod ,Salim Ali Center for Ornithology and Natural History, Coimbatore

K. Subramaniam, Center for Ecological Science, IISc ,Bangalore

Gore,A.P. and Paranjpe, S.A. (1997)
Effort needed to measure biodiversity.
International Journal of Ecology and Environmental Sciences,
Vol. 23, Dec. 1997, pp 173-183.

How many individuals to observe to get good estimate of diversity

Which estimates?
Diversity Indices:
Simpson, Shannon Winner
Species Richness

Criterion for ‘good estimate’?
low bias, low standard error

Procedure: Simulation
Draw random observations from data base.
Compute index, Repeat exercise
Compute bias, standard error

Data bases:

Bird ringing by BNHS
Trees in western ghats (Dr. Erich Bharucha)
Mussels in estuary

Results:

1000 individuals enough to estimate
diversity indices

To estimate species richness
effort needed, at least one order of magnitude larger

Limitation: random sample

Species encounter probability proportional to abundance

Cryptic species, similar species

Paper 2: Current work

Study of birds only

Given total effort how to distribute it to maximize species accumulation ?

- Time of the day (Morning / evening)
- Seasons of the year (Migratory / Non- migratory)
- Habitats in a locality

Reference data used for simulation :

P. Pramod- Silent Valley- 144 transects over 2 years,
three habitats- evergreen, semi-evergreen, teak plantation
180 species seen, over 4000 birds

R. Daniels- Uttar Kannada- 107 transects,
10 habitats, 271 species seen, over 15,000 birds
Mpuzza- 72 transects, 6 habitats, 92 species, 1800 birds

Simulation: Draw a transect randomly from reference set

All birds recorded on it ‘seen’

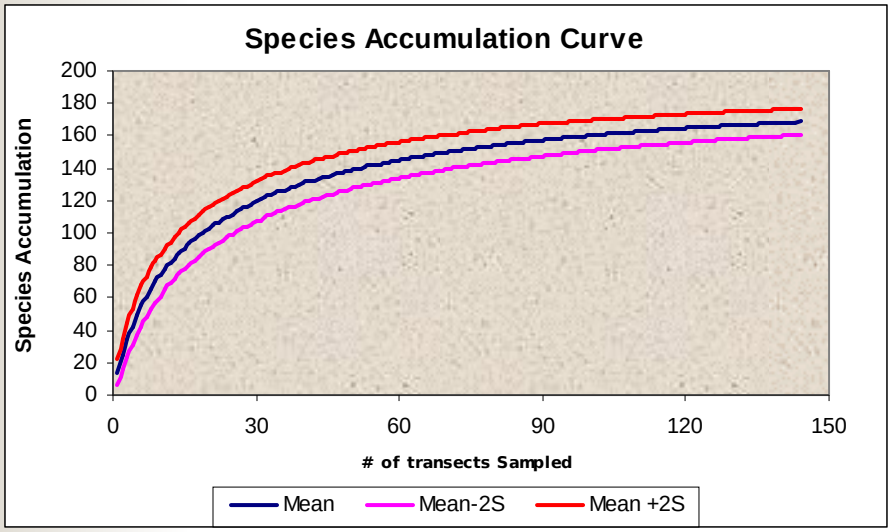
Update species accumulation data, Repeat the exercise

When to stop?

a. accumulation curve plateaus

b. most species are seen

Silent Valley data



Our choice of effort level: 72

1. 151 (84%) species seen
2. Error bars parallel beyond 72
3. Effort half of 144

For lower level of expertise,
Increase effort level somewhat
Round figure 100 transects

Stratification : 3 aspects- time of day, season of year, habitat

Stratified random sampling 1

Morning or evening?

Proportions tried : (total effort 72 transects)

Morning : Evening	Mean richness	S.D.
100:0	133	3.8
67:33	152	4.9
50:50	151	5.2
33:67	147	5.1
0:100	148	4.4

50:50 is a reasonable strategy

Stratified random sampling 2

Migratory or non migratory season

Conclusion:

most effort in migratory season
(72 transects, 143 species seen)

a small supplement from non- migratory season
(24 transects, 15 new species added)

Recommendation: concentrate effort on migratory season

Stratified random sampling 3: distribution over habitat

First thought:
Effort in a habitat proportional to # species supposed to be there.

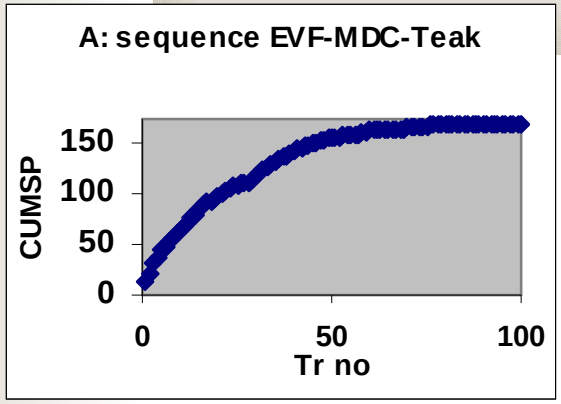
Western Ghats

HB	Spcount
EVF	145
MDC	183
Bamboo	90
High Altitude	118
Desert	212
Manmade	215
Riverine	188
SEA	14
BCH	66
Total	477

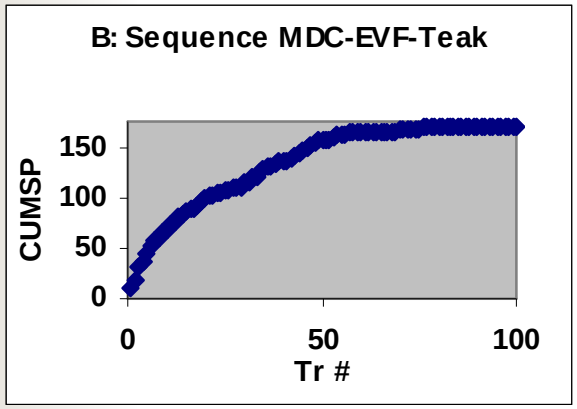
Allocation in silent valley

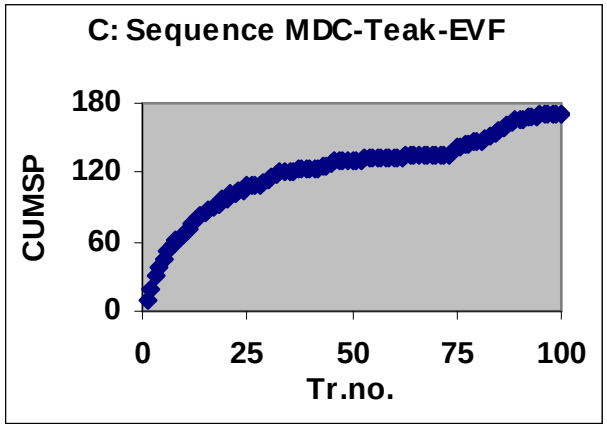
EVF:MDC:Teak 27:34:39

Which sequence?



Saturation reached at
Graph A: 82 transects, Graph B: 92 transects, Graph C: 100 transects.





Sequence matters.

EVF- MDC- Teak best

New locality: best sequence unknown

Alternative: cyclic sampling

How many transects in a habitat in a cycle?

fewer the better

When to stop? Drop a habitat if redundant

What is redundant?

Less than one new species / transect in a cycle

Stop when

a) All habitats become redundant
b) total effort reaches preplanned limit

whichever is earlier

Cycle sampling in Silent Valley

Cycle number	1			***2***			3	
#Transects visited	4	8	12	16	20	***24***	28	32
Habitat	EVF	MDC	Teak	EVF	MDC	***Teak***	EVF	MDC
New species seen	38	23	6	12	12	***3***	12	8
Cumulative # seen	38	61	67	79	91	***94***	106	114
Cycle number	4		5		***6***		***7***	
#Transects visited	36	40	44	48	52	***56***	***60***	
Habitat	EVF	MDC	EVF	MDC	EVF	***MDC***	***EVF***	
New species seen	15	8	4	5	7	***3***	***2***	
Cumulative # seen	129	137	141	146	153	***156***	***158***	

Teak dropped after cycle 2

MDC dropped after cycle 6

Termination after cycle 7

Total effort 60 transects (42% of 144)

Species seen 158 (88% of 180)

Cycle sampling in Mpuzza

Cycle number	1			***2***		
#Transects visited	4	8	12	16	20	***24***
Habitat	Plant	MDC	Scrub	Plant	MDC	Scrub
New species seen	44	10	8	3	4	***3***
Cumulative # seen	44	54	62	65	69	***72***
Cycle number	3		4		5	
#Transects visited	28	32	36	38	42	
Habitat	Plant	MDC	Plant	MDC	Plant	
New species seen	4	6	6	0	3	
Cumulative # seen	76	82	88	88	91	

Scrub dropped after cycle 2, MDC dropped after cycle 4

Termination after cycle 4

Total effort 42 transects (58% of 72)

Species seen 91 (99% of 92)

Cycle sampling in Uttar Kannada

Cycle number					1										2						
# Transects visited					1	2	3	4	5	6	7	8	9	10	11	12	13	14			
Habitat					**MDC**	**EVF**	**WCL**	**EST**	**MSC**	**UHB**	**BCH**	**MDC**	**EVF**	**WCL**	**EST**	**MSC**	**UHB**	**BCH**			
New species seen					42	21	31	18	8	5	5	9	5	12	11	7	1	2			
Cumulative # seen					42	63	94	112	120	125	130	139	144	156	167	174	175	177			
Cycle number					3							4									
# Transects visited					15	16	17	18	19	20	21	22	23	24	25						
Habitat					***MDC***	**EVF**	**WCL**	**EST**	***MSC***	**UHB**	**BCH**	**EVF**	**EST**	**UHB**	**BCH**						
New species seen					*0*	1	9	2	*0*	1	4	1	1	1	0						
Cumulative # seen					*177*	178	187	189	*189*	190	194	195	196	197	197						

MDC, MSC dropped after cycle 3, WCL transects exhausted

Termination after cycle 4

Total effort 25 transects (23% of 107)

Species seen 197 (73% of 271)

Conclusions

1. Current practice of equal effort in Morning/evening is reasonable
2. Current practice of concentrating effort in migratory season is OK
3. Cycle sampling is economic
4. Data analysis should be concurrent with field work
5. Results likely to be widely applicable