Survey effort

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Overview

- When and why do field surveys
- Number of surveys
  - Temporal variations
- Surveys
  - Spatial
  - Habitats
- Survey effort
  - Proportion of species detected
  - Species accumulation
  - Trap numbers vs trapping duration
  - Feral and pest animals

When and why do field surveys

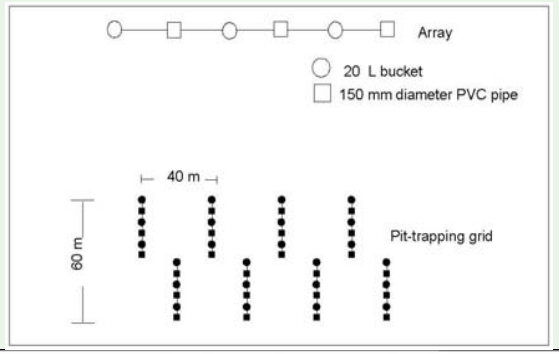
- Ecosystem function ⟹ fauna assemblage
- A field survey should:
  - Make a significant contribution to knowledge of the fauna assemblage
  - Provide significantly more information about the fauna assemblage than can be gleaned from:
    - AoLA
    - NatureMap
    - Fauna survey database
    - Fauna surveys in adjacent areas – privately held data
- Comprehensive field surveys are expensive and should only be done when there is a compelling case

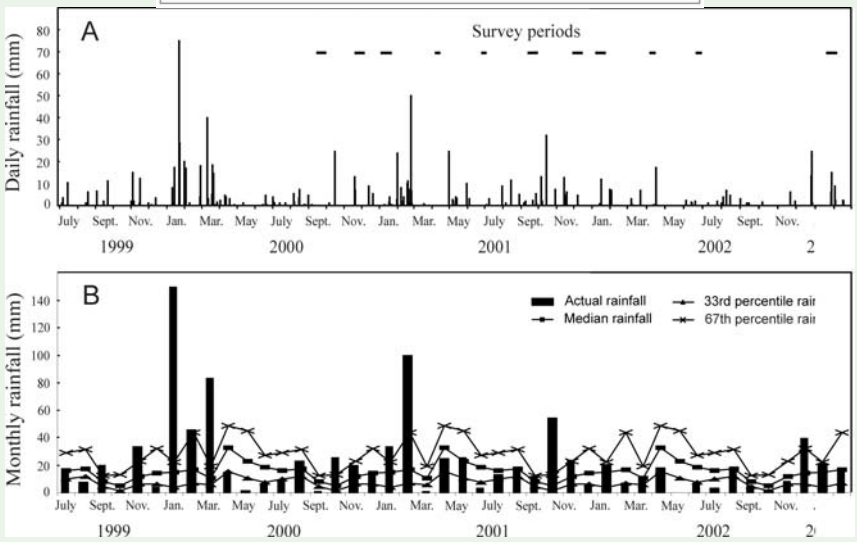
Temporal variations - seasonal

Goldfields

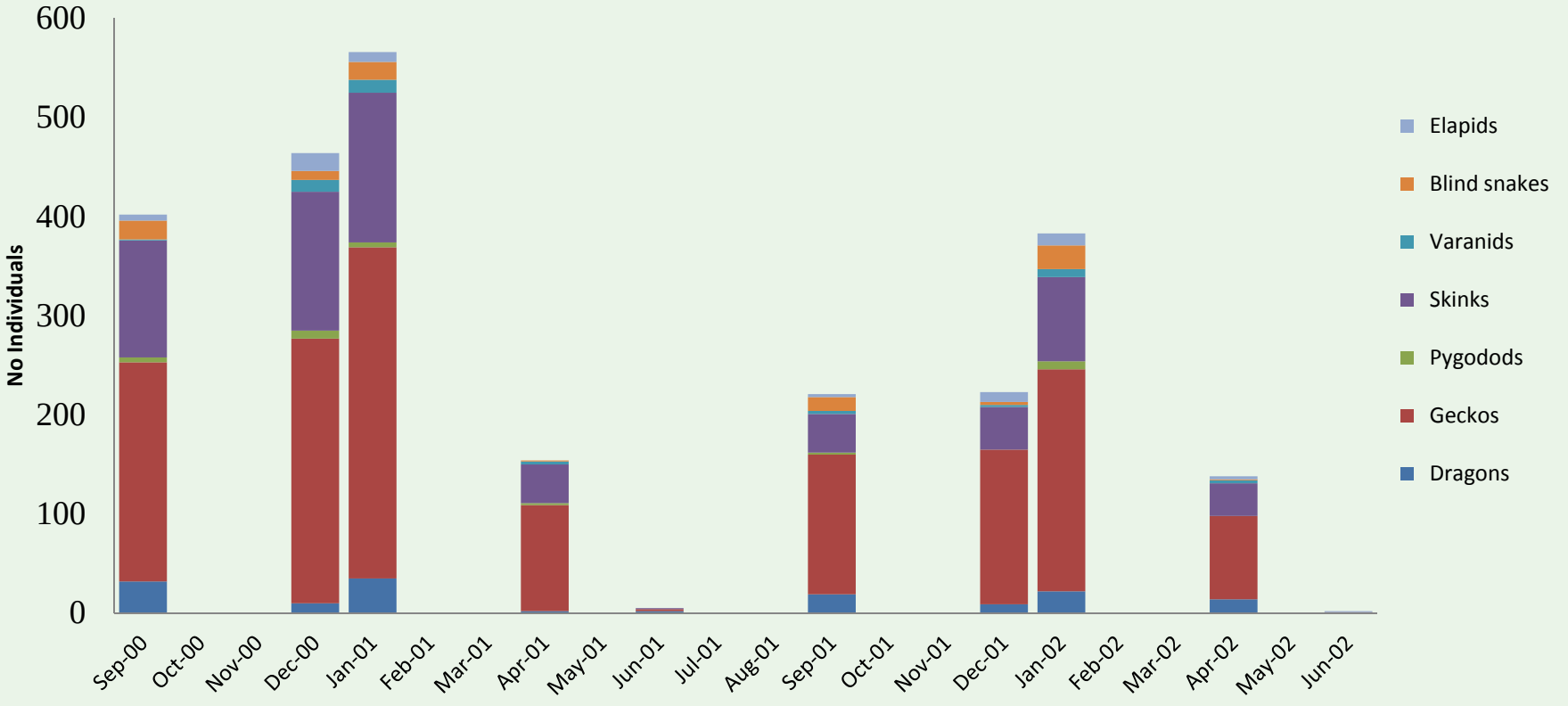
- 10 sites
- 8 trap-lines in natural areas and 12 trap-lines on rehabilitated waste dumps
- Each trap line contained 3 buckets and 3 pipes along a 30m drift fence
- 10 surveys, 5 per year for two years each of 7 nights duration
- 2,384 reptiles caught

Trap layout and rainfall





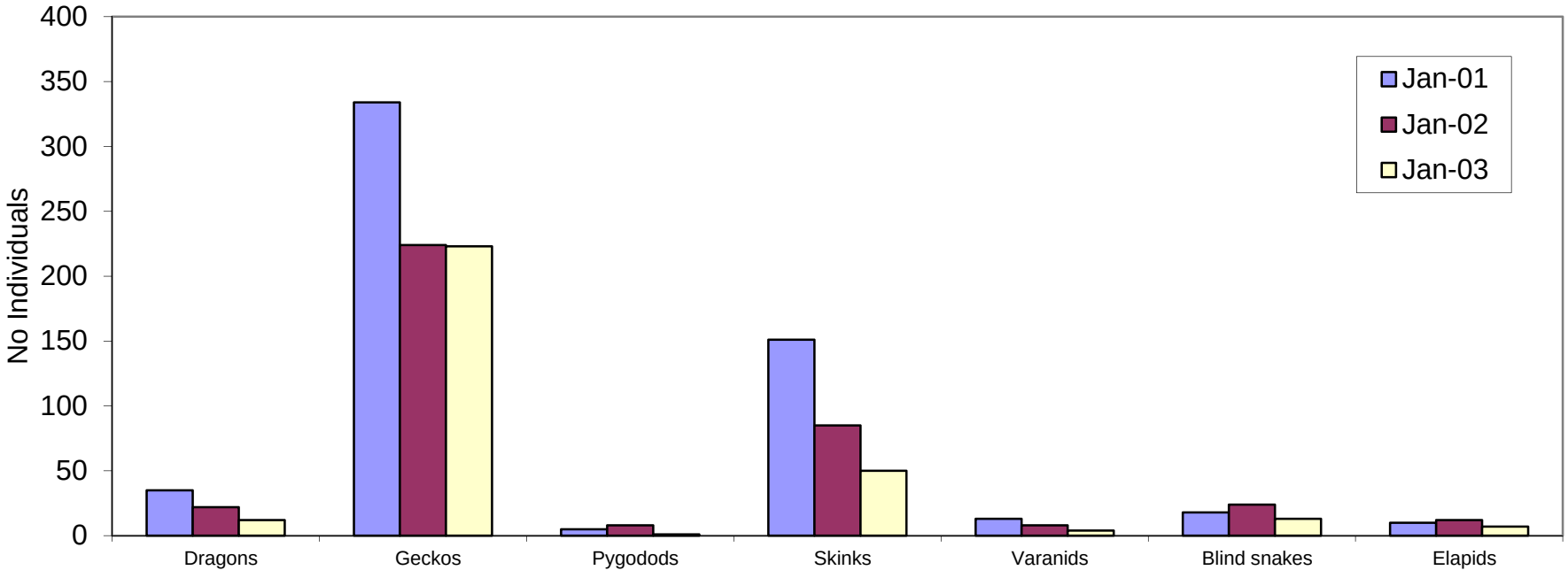
Seasonal variations - reptiles



Thompson and Thompson (2008) JRSWA, 212-228

Goldfields data – Jan. 01, 02, 03

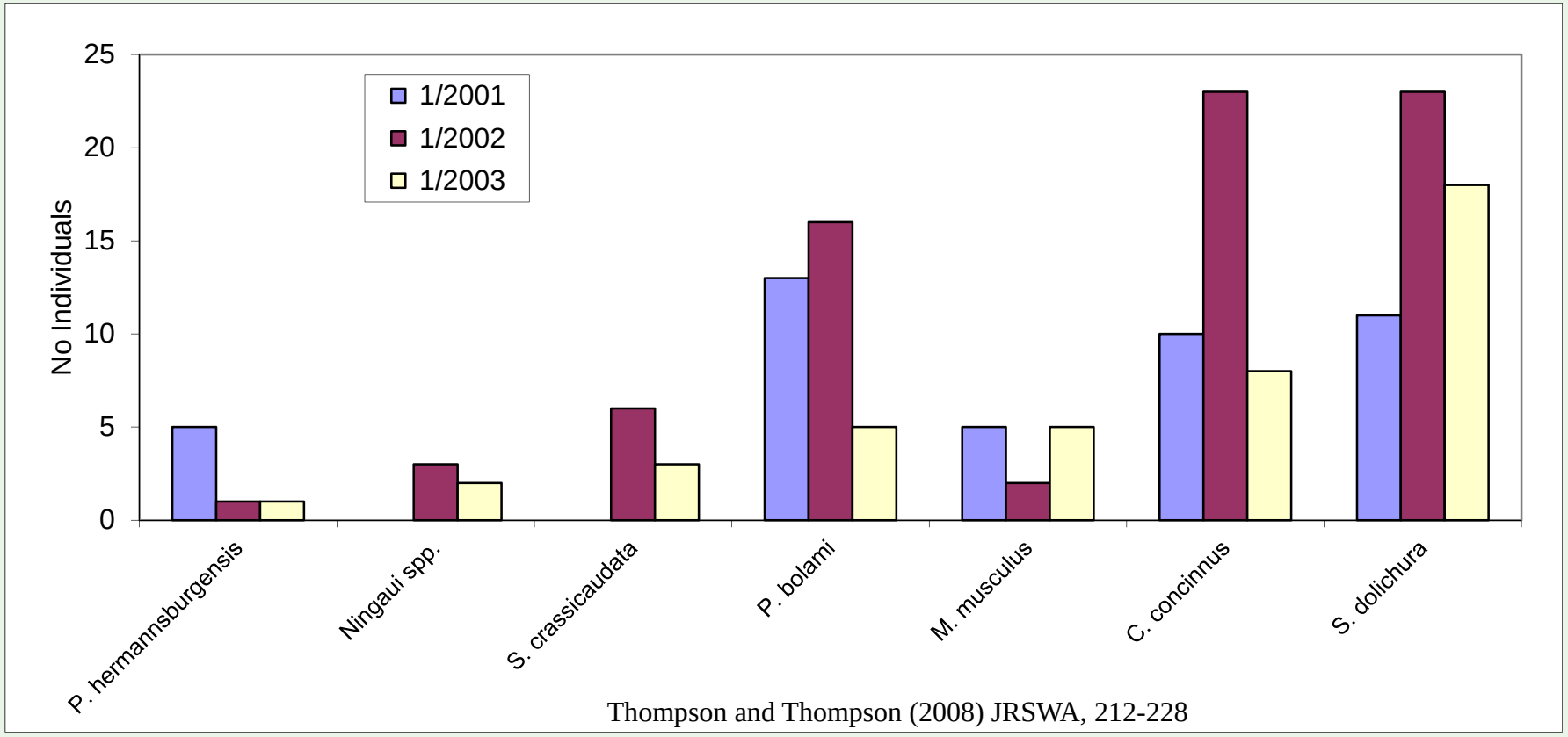
Reptiles by family



Thompson and Thompson (2008) JRSWA, 212-228

Goldfields data – Jan. 01, 02, 03

Mammals



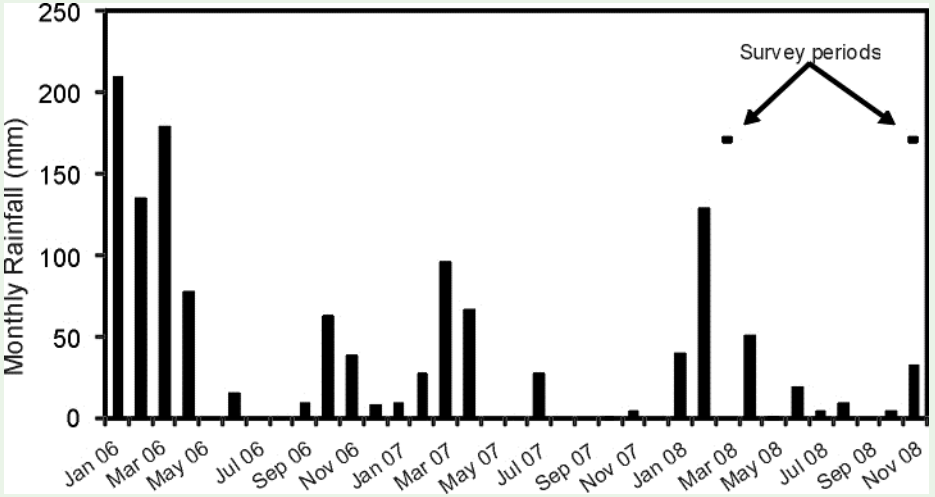
Thompson and Thompson (2008) JRSWA, 212-228

Pilbara survey

Hamersley Range

- Two surveys – different seasons
- 54 sites
- Four trap-lines in each site
- Each trap-line had 3 buckets, 3 pipes, 3 pair of funnel traps and 3 aluminium box traps
- 7 night survey duration
- Trap nights – 45,000
- 5,332 reptiles and mammals from 78 species caught

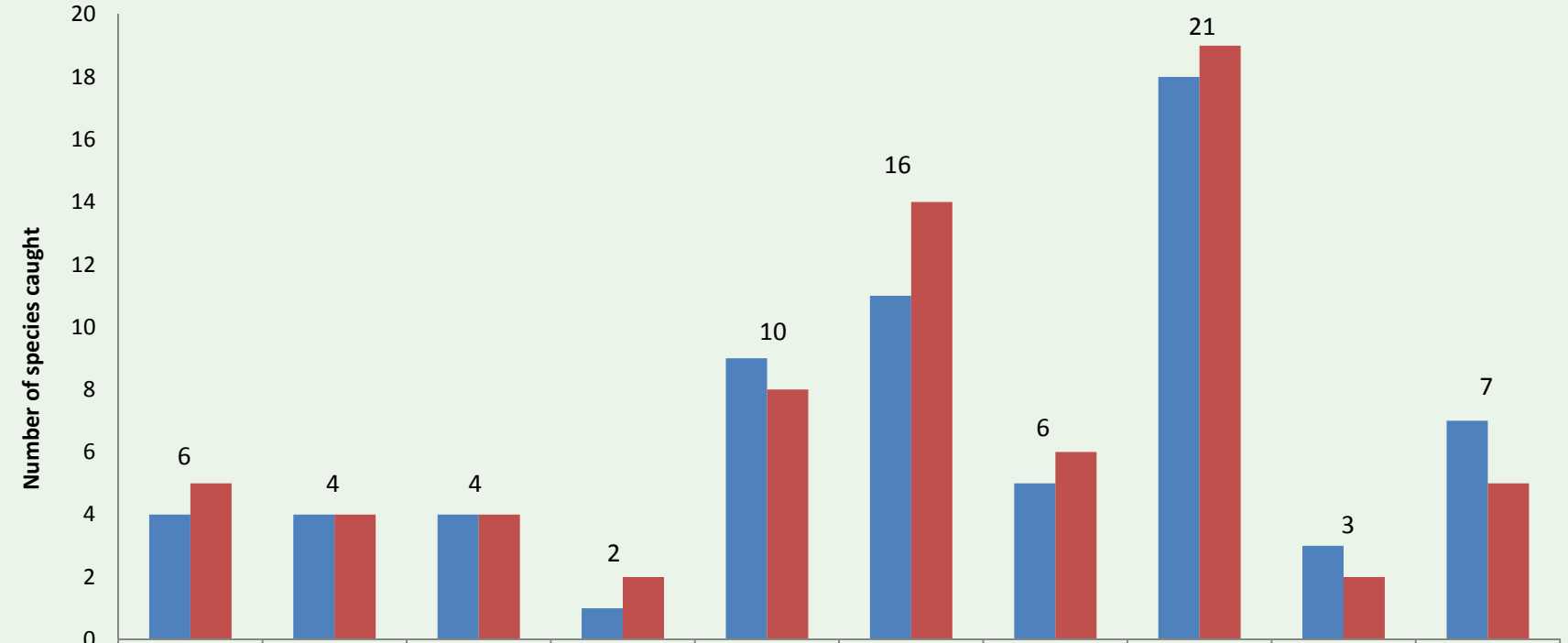
Rainfall



Thompson et al. (2010) JRSWA, 93, 51-64

Pilbara survey

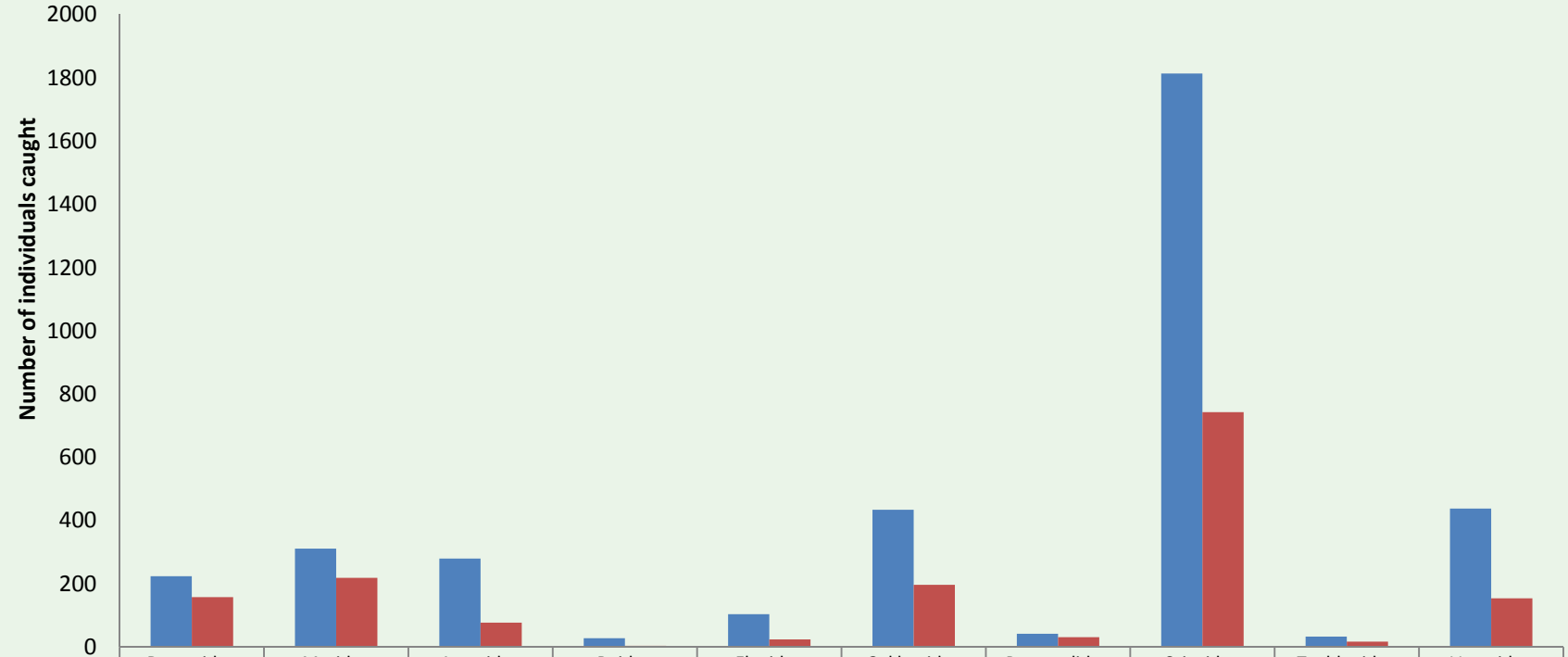
Nº Species



	Dasyuridae	Muridae	Agamidae	Boidae	Elapidae	Gekkonidae	Pygopodidae	Scincidae	Typhlopidae	Varanidae
March	4	4	4	1	9	11	5	18	3	7
November	5	4	4	2	8	14	6	19	2	5

Pilbara survey

Nº Individuals



	Dasyuridae	Muridae	Agamidae	Boidae	Elapidae	Gekkonidae	Pygopodidae	Scincidae	Typhlopidae	Varanidae
March	224	311	280	28	104	434	42	1814	33	438
November	158	219	77	4	24	197	31	743	17	154

Survey periods

Generic surveys

Region	Likely best result	Next best
Southern WA	Warm to hot weather (i.e. late November to end of February)	Late October/early November or March
Central WA	Warm to hot weather (i.e. December to March)	Late October/early November or March
Wet-dry tropics	Beginning of the wet (i.e. Dec. - Jan.)	Early in the dry (Apr. – Jun.)

If including amphibians

Region	Likely best result	Next best
Southern WA	Warm weather after rains	
Central WA	Immediately after heavy rains in summer	Heavy rains in spring or autumn
Wet-dry tropics	Immediately after the first major rains of the monsoon season	Early in the monsoon season

Pre- and during development surveys

- Major development in the Pilbara
- Habitat was coastal dunes or red sand plains with varying densities of vegetation
- PER, with a referral under the EPBC
- Level 2 assessment
  - ~1,000ha
  - 4 fauna habitats
  - 10 trapping sites in the project area
  - Single season survey
    - 6 nights trapping
    - either:
      - 60 pit-trap nights per site or
      - 60 pit-trap nights, 30 funnel trap nights and 100 Elliott trap nights per site
- Still collecting ‘during’ data and recording additional species

Pre and during comparison

		Pre	%	During	%
Hylidae	*Cyclorana maini*	6	0.34	1,086	6.34
	Cyclorana platycephala			1	0.01
	Litoria caerulea			2	0.01
Limnodynastidae	*Neobatrachus aquilonius*			171	1.00
	Neobatrachus fulvus			187	1.09
	Neobatrachus sp.			23	0.13
	Notaden nichollsi	1,323	74.75	16	0.09

Pre and during comparison

		Pre	%	During	%
Dasyuridae	*Dasykaluta rosamondae*			77	0.45
	Dasyurus hallucatus			2	0.01
	Planigale sp.	1	0.06	44	0.26
	Sminthopsis macroura			8	0.05
	Sminthopsis youngsoni			2	0.01
Felidae	*Felis catus*			50	0.29
Muridae	*Mus musculus*	3	0.17	279	1.63
	Notomys alexis			54	0.32
	Pseudomys desertor	2	0.11	1	0.01
	Pseudomys hermannsburgensis	34	1.92	10	0.06
Tachyglossidae	*Tachyglossus aculeatus*			18	0.11

Pre and during comparison

		Pre	%	During	%
Carphodactylidae	*Nephrurus levis*	11	0.62	143	0.83
Diplodactylidae	*Diplodactylus conspicillatus*	20	1.13	1,031	6.02
	Lucasium squarrosum			2	0.01
	Lucasium stenodactylus	8	0.45	20	0.12
	Strophurus jeanae	8	0.45	67	0.39
	Strophurus strophurus	4	0.23	108	0.63
Gekkonidae	*Gehyra pilbara*			**3,241**	**18.91**
	Gehyra variegata	1	0.06	**425**	**2.48**
	Hemidactylus frenatus			1	0.01
	Heteronotia binoei	9	0.51	**757**	**4.42**
Pygopodidae	*Delma haroldi*			37	0.22
	Delma sp.			127	0.74
	Delma tincta	2	0.11	**1,099**	**6.41**
	Lialis burtonis	7	0.40	57	0.33
	Pygopus nigriceps	2	0.11	160	0.93

Pre and during comparison

		Pre	%	During	%
Scincidae	*Ctenotus calurus*	1	0.06		
	Ctenotus grandis	8	0.45	517	3.02
	Ctenotus hanloni	9	0.51	1,559	9.10
	Ctenotus iapetus	8	0.45	502	2.93
	Ctenotus inornatus	4	0.23	389	2.27
	Ctenotus maryani			595	3.47
	Ctenotus pantherinus	19	1.07	404	2.36
	Ctenotus rufescens	6	0.34	37	0.22
	Ctenotus sp.			69	0.40
	Eremiascincus pallidus	17	0.96	32	0.19
	Lerista bipes	128	7.23	1,062	6.20
	Lerista clara	8	0.45	579	3.38
	Lerista onsloviana	27	1.53	47	0.27
	Lerista sp.			25	0.15
	Menetia greyii	9	0.51	74	0.43
	Tiliqua multifasciata	1	0.06	54	0.32

Pre and during comparison

		Pre	%	During	%
Boidae	*Antaresia stimsoni*			205	1.20
	Aspidites melanocephalus			58	0.34
Elapidae	*Acanthophis pyrrhus*			26	0.15
	Demansia psammophis	8	0.45	59	0.34
	Furina ornata	2	0.11	426	2.49
	Pseudechis australis	2	0.11	63	0.37
	Pseudonaja mengdeni	5	0.28	60	0.35
	Pseudonaja modesta	1	0.06	7	0.04
	Simoselaps anomalus	2	0.11	7	0.04
	Suta fasciata			1	0.01
	Suta punctata	1	0.06	166	0.97

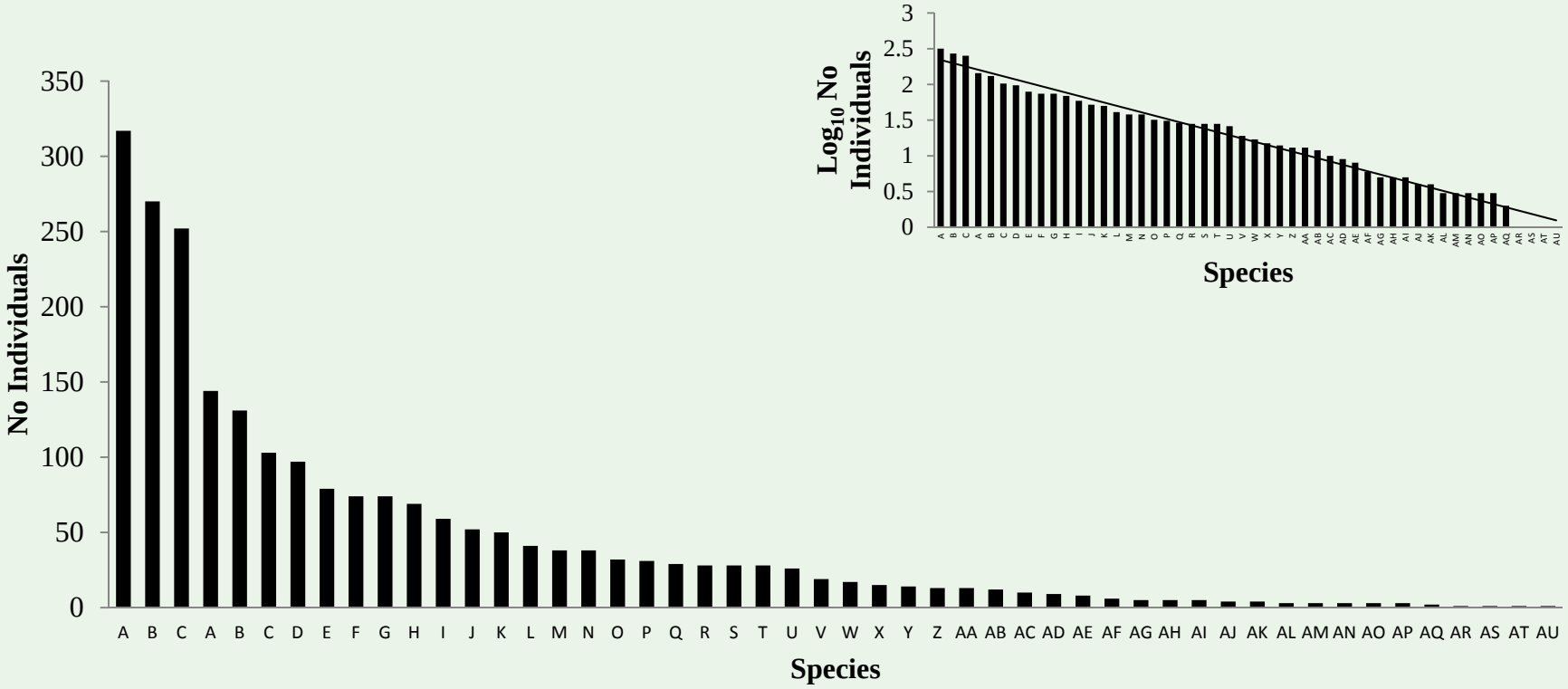
Pre and during comparison

		Pre	%	During	%
Varanidae	*Varanus acanthurus*			7	0.04
	Varanus brevicauda	3	0.17	1	0.01
	Varanus caudolineatus	13	0.73		
	Varanus eremius	7	0.40	178	1.04
	Varanus gouldii			56	0.33
	Varanus panoptes			11	0.06
Typhlopidae	*Anilios ammodytes*	2	0.11	13	0.08
	Anilios grypus	13	0.73	18	0.11
	Anilios hamatus	1	0.06	85	0.50
	Anilios sp.			30	0.18

Pre and during comparison

- Conclusions
  - Pre-assessment did not survey a significant micro-habitat, e.g. termite mounds
  - Presumed Northern Quolls were not present, based on previous capture locations, and were not surveyed
  - One-season survey!
  - Relied on fauna data from adjacent projects and online databases which all had significant limitations

Vertebrate fauna assemblages



Sampling relationships

- Nº species recorded generally increases with the area surveyed (species area relationship – SAR)
- SARs are generally fitted by a power function

- Nº species recorded generally increases with the time taken to survey (species time relationship – STR)
- STRs are generally fitted by a power function

- Nº species recorded generally increases with the sampling effort – SAC (also known as the sampling effort relationship – SER)
- Asymptotic SACs are generally fitted with negative exponential model

See Ulrich et al. (2015) Polish Journal of Ecology, 61, 197-205

Sampling relationship

- With a constant area and sampling time, sampling effort should be proportional to the number of individuals recorded
- Species richness should increase with sample size (or sampling intensity)
- Therefore, species richness should increase proportional to the number of individuals caught or observed

Maximising species richness

- To increase your species inventory:
  - Maximise the sampling area in each habitat type
  - Maximise the sampling time in each habitat type
  - Maximise the sampling effort in each habitat type

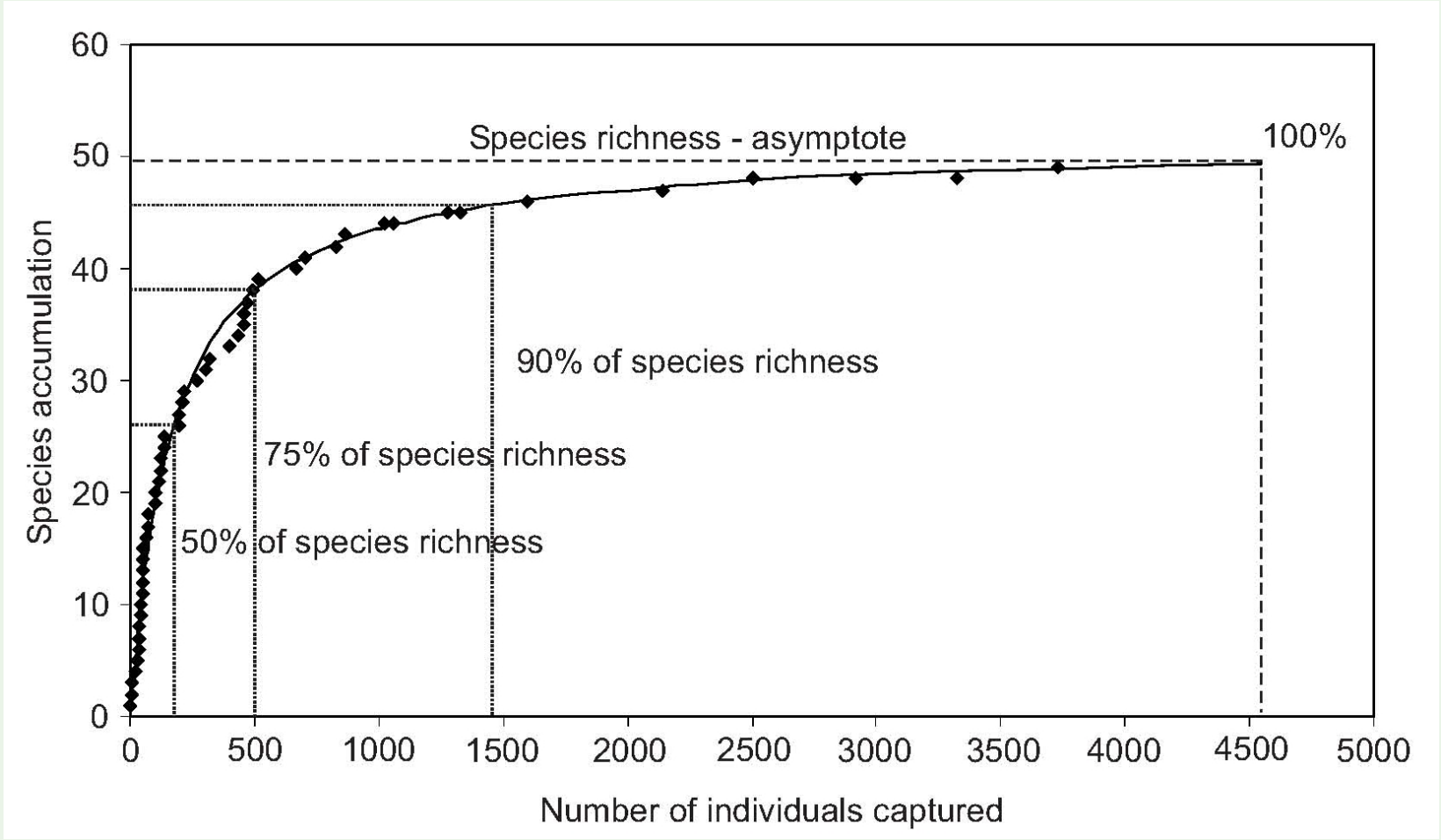
Species accumulation curves

(Collectors curves)

- SAC are used to indicate the completeness of a species inventory
- They have a slope that progressively declines as the trapping effort increases
- SACs form an asymptote, so that you can estimated the percentage of species you have recorded
- Not to be confused with rarefaction curves
- Insufficient data provides unreliable and spurious SACs
- Present SACs per habitat type (i.e. don’t combine data for multiple habitat types)

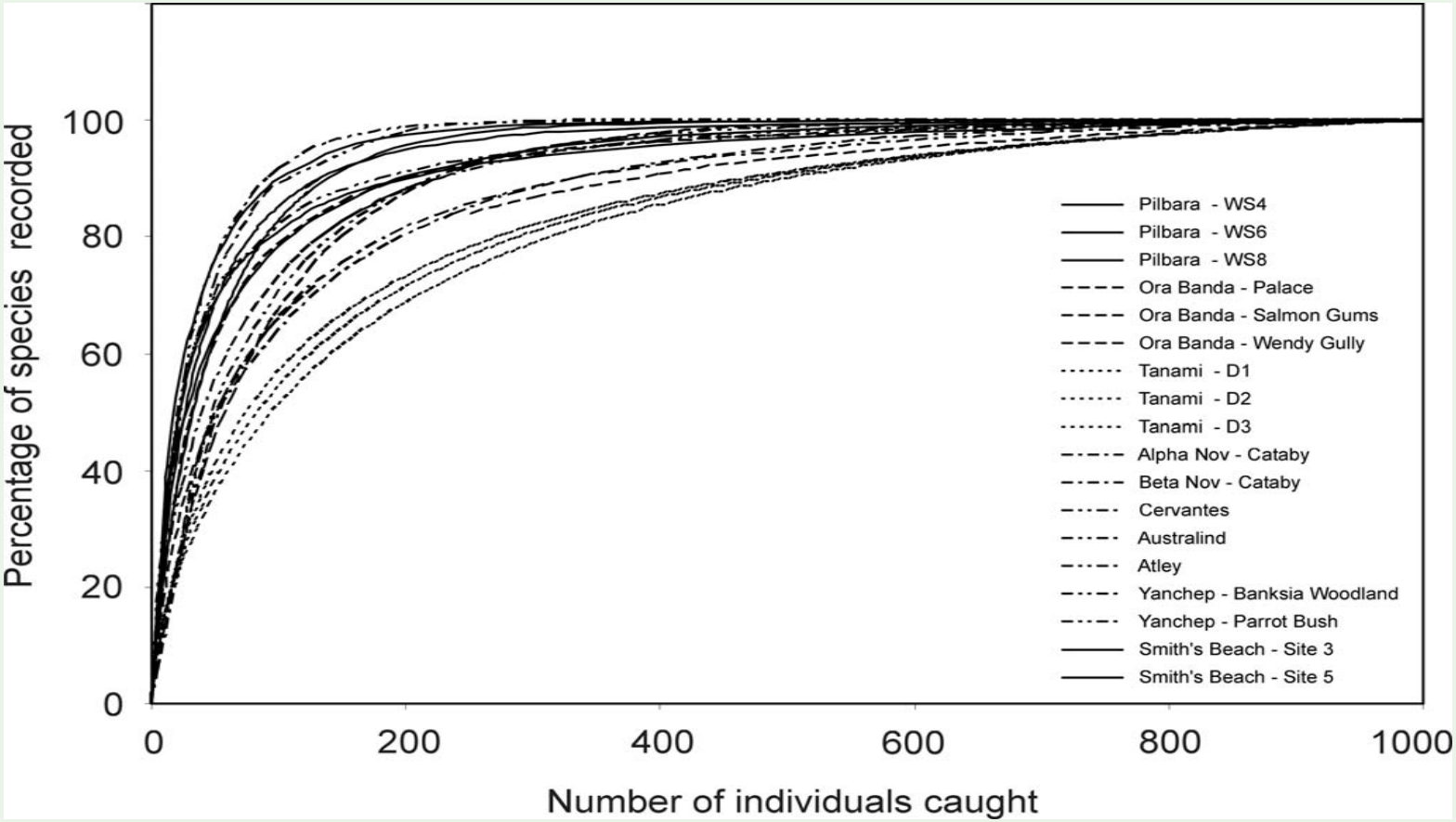
Species accumulation curves

(Collectors curves)



Species accumulation curves

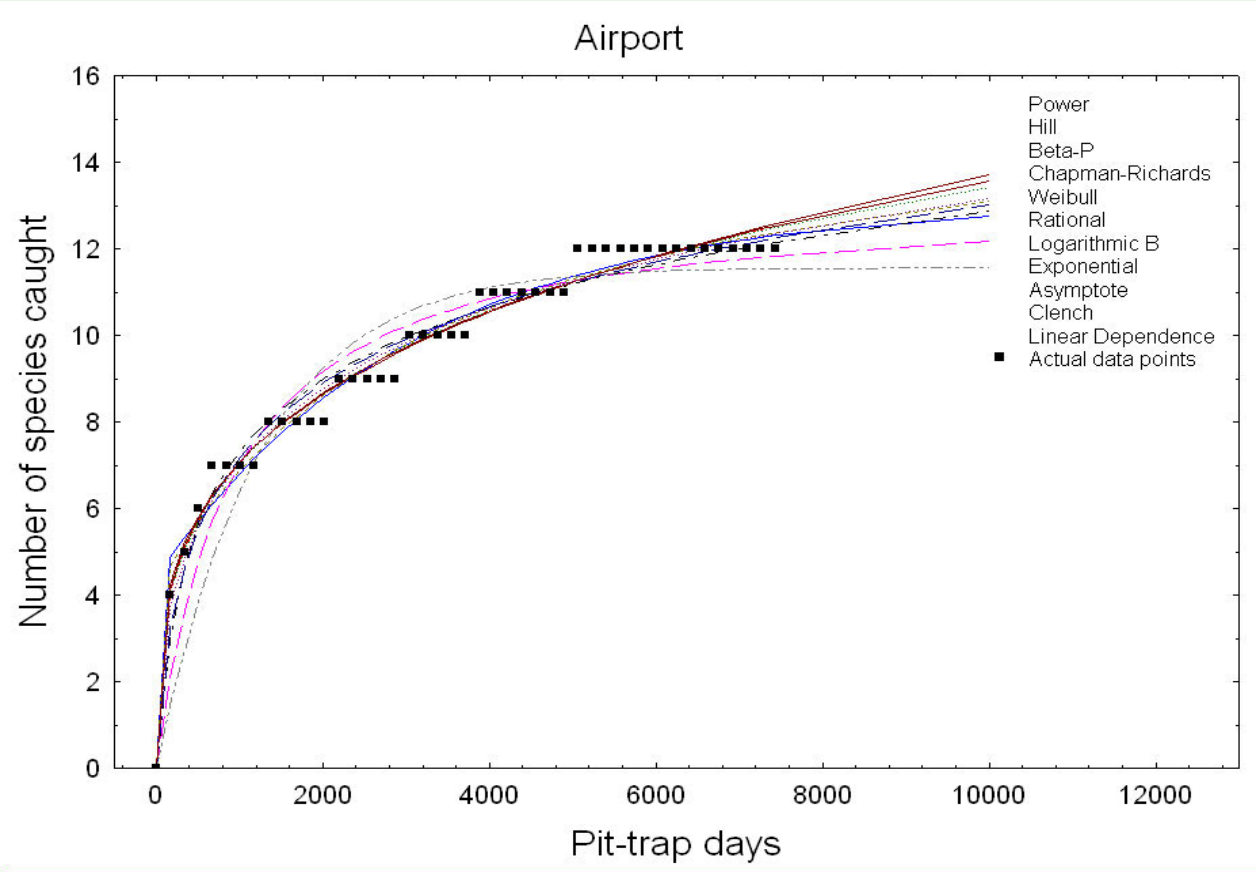
Shapes of SACs varies



Thompson et al. (2007) *Austral Ecology*, 32, 570)

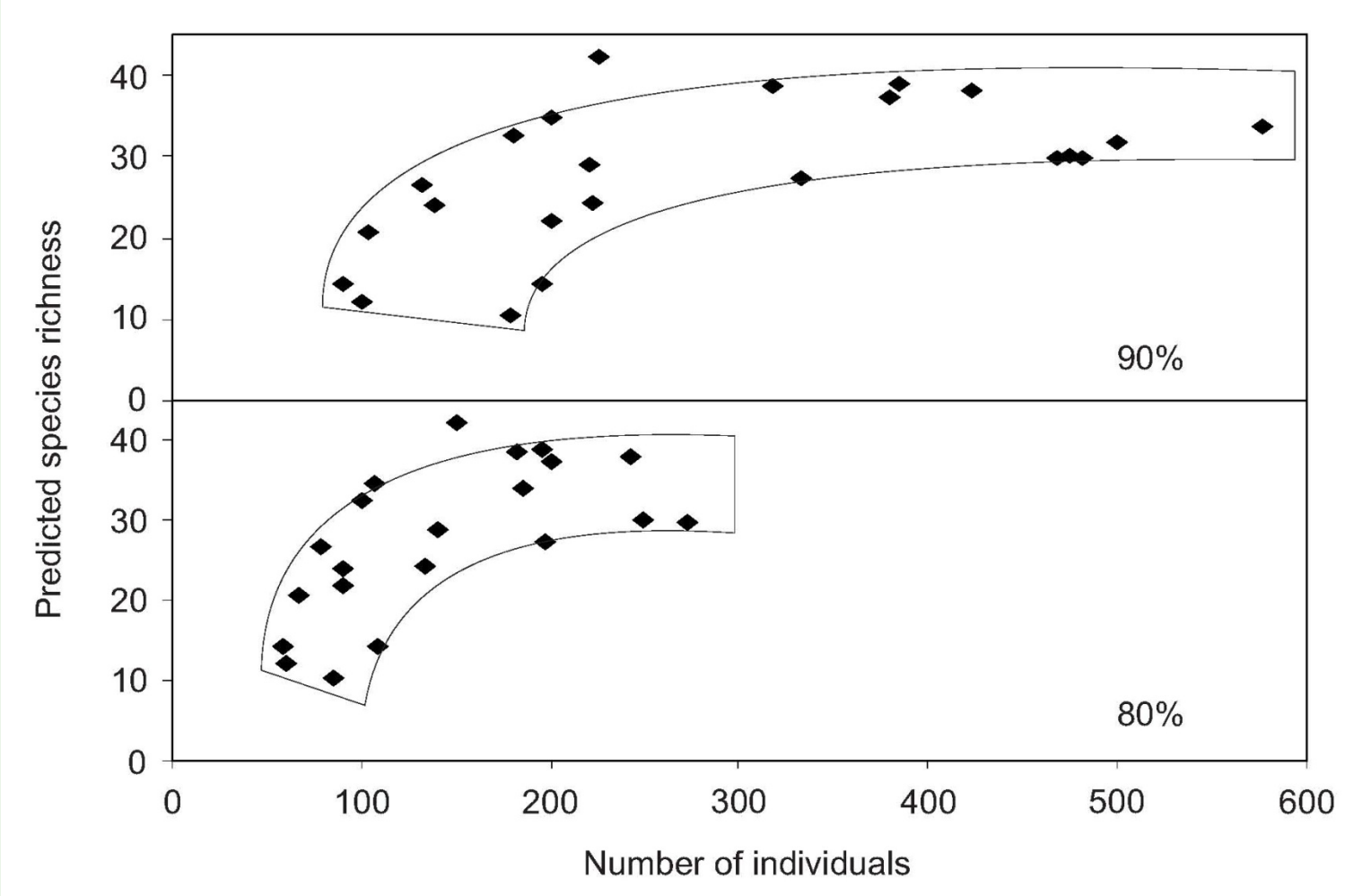
Species accumulation curves

Method of calculation – choose the method that matches your data best (e.g. highest r^2)



Thompson et al. (2003) *Austral Ecology*, 28, 361

How much survey effort?



Thompson et al. (2007) *Austral Ecology,* 32, 570-580

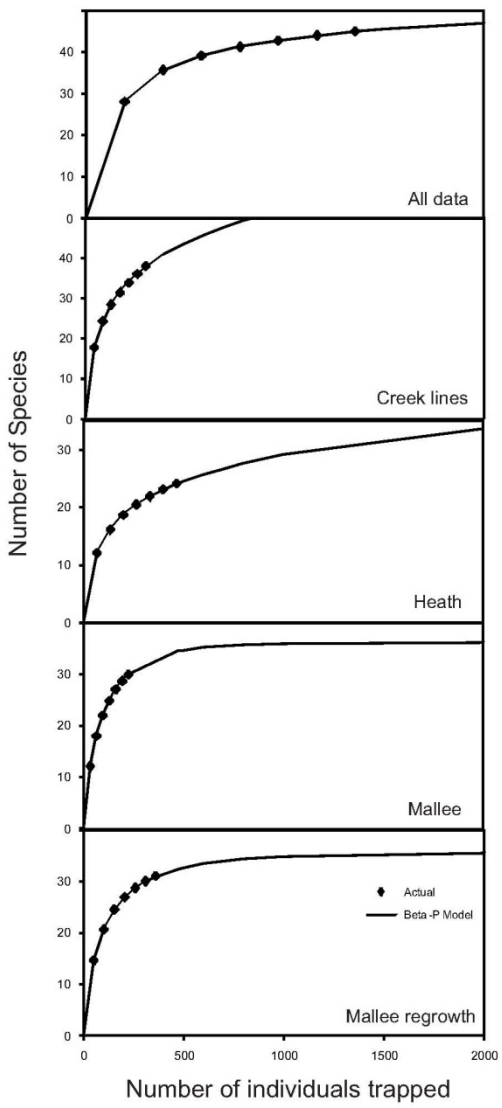
Calculation of SAC

- Select the most appropriate method for your data (i.e. don't use multiple methods)
- Do not present multiple curves
- Do not use rarefaction curves (unless using V9 of EstimateS, Colwell et al. 2012)
- SAC per habitat type
- Randomise your data
- Present the SAC and your data
- Report asymptote and comparative SR for a given trapping effort
- Provide correlation between SAC and your data (i.e. $r^2 > 97\%$) and if known the 95% confidence limits
- Know the uses and assumptions of the asymptotic species richness estimator that you use

Colwell et al. (2012) Journal of Plants Ecology, 5, 3-21

SAC example

		Species Richness			
Habitat Type	**Actual # Species Caught**	**Asymptote**	**Estimates # Species after 1000 Iterations**	**Estimates # Species after 2000 Iterations**	**r^2**
Creek lines	38		52		99.0
Heath	24		29		99.0
Mallee	30	36	36		99.0
Mallee regrowth	31	35	36		98.0
Combined sites	45	59		47	99.0



‘Back’ calculating SACs

- Knowing the number of individuals caught/observed and the number of trapping/recording periods you can calculate a SAC (see Thompson and Thompson 2007 Austral Ecology 32, 564-569)

- This approach enables regulators and readers of reports to quickly estimate species richness for various habitats and to check the accuracy of presented SACs

- This is a very useful tool in determining the comprehensiveness of a fauna survey, if SACs are not provided in the report

Trap numbers vs trapping duration

- To catch the required number of individuals, it is mostly to do with trapping effort, and trapping effort = traps Nº x duration

- Trap numbers ~ 1/ trapping duration
  - i.e. increase the number of traps at a site and you can reduce the trapping duration within reason to achieve the same sampling effort

Survey effort

Focus is on assessing **species richness**:

- Minimum of one survey
- Survey in each major habitat types
- Trapping effort to reflect the number of species (likely to be) present
- Species-specific targeted searches
- Hand-foraging and spotlighting searches
- Trap types to be used:
  - Buckets
  - Pipes
  - Funnels
  - Elliott traps
  - Cameras
  - Cage traps (where appropriate)

Suggested survey periods:

Southern WA

- Summer or late spring

Central WA

- Summer or late spring

Wet-dry tropics

- Beginning of the wet

Focus is on assessing **faunal assemblage**:

- Two surveys
- Survey in each major habitat types
- Trapping effort to reflect the number of species (likely to be) present
- Species-specific targeted searches
- Systematic hand-foraging and spotlight searches
- Trap types to be used:
  - Buckets
  - Pipes
  - Funnels
  - Elliott traps
  - Cameras
  - Cage traps (where appropriate)

Suggested survey periods:

Southern WA

- Summer, and late spring or early autumn

Central WA

- Summer, and late spring or early autumn

Wet-dry tropics

- Beginning of the wet and in the dry

Focus is on establishing **baseline monitoring** data:

- Minimum of two surveys (2 years)
- Survey in each major habitat types
- Trapping effort to reflect the number of species (likely to be) present
- May include species-specific trapping
- Trap types to be used:
  - Buckets
  - Pipes
  - Funnels
  - Elliott traps
  - Cameras
  - Cage traps (where appropriate)

Suggested survey periods:

Southern WA

- Summer or late spring

Central WA

- Late spring or summer

Wet-dry tropics

- Beginning of the wet and in the dry

Feral and pest animals

- Vegetation clearing and human habitation can lead to increased feral or pest animals, particularly cats
- Survey and report data for feral or pest animals
  - Similar survey techniques (i.e. tracks, scats, spotlighting, camera traps, etc)

- Deal with feral and pest animal management in impact mitigation recommendations

Thank you

Questions