

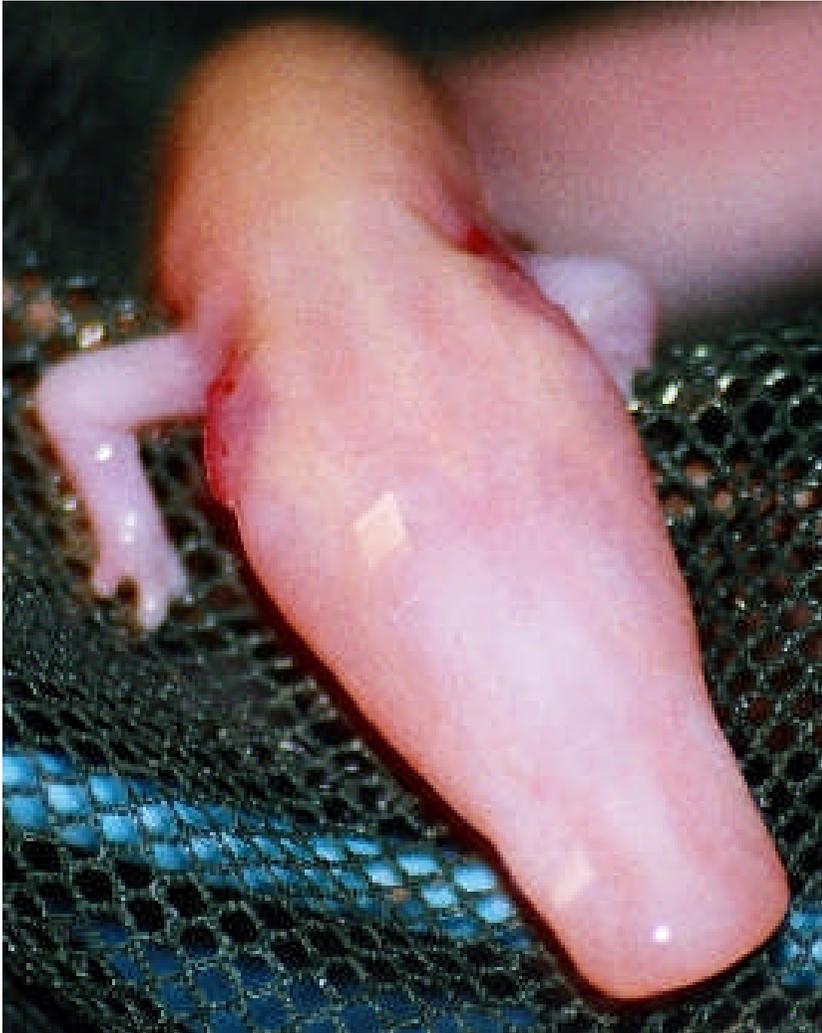
Cave dwelling *Elatostema*



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- Parallels between islands and caves with respect to the accumulation of species diversity and the raised tempo of morphological change have been demonstrated for obligate cave-dwelling animal groups
- The colonisation of a great number of caves in the limestone karst of S. China by *Elatostema* may be an example of such a phenomenon in flowering plants
- But are *Elatostema* obligate cave-dwellers or the relicts of a flora lost because of human impacts or climate change?

Cave dwelling organisms



Proteus anguinus



Speleonectes tulumensis



Macrocotyla glandulosa

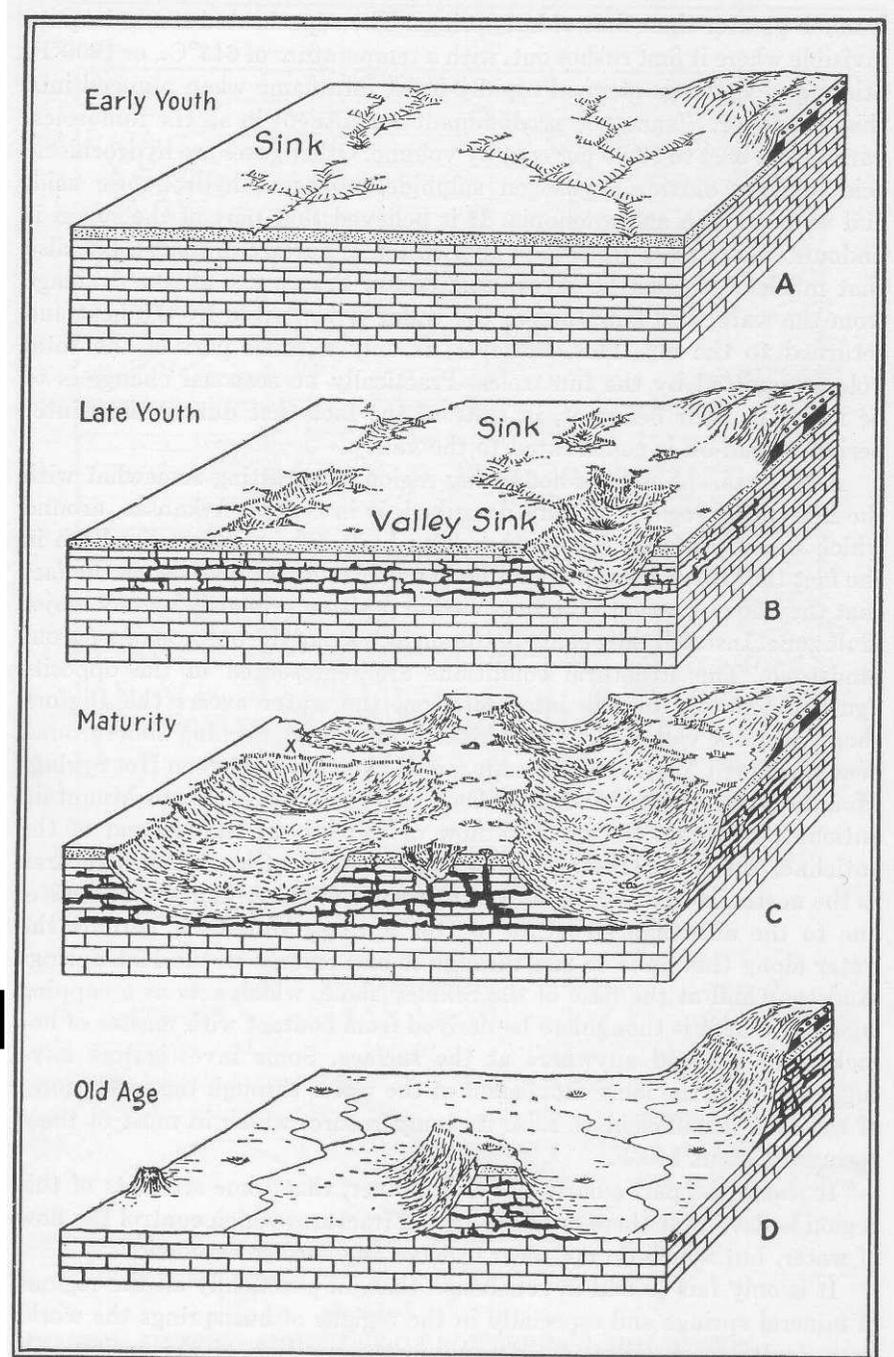
Outline

- Brief history of Limestone karst and caves of SW China Introduction to *Elatostema*
- Cave-dwelling *Elatostema*
- What are the research questions we are seeking to address

Karst formation

- SW China limestone first exposed ca 240 MY
- Most Karstification occurred in the last 23 MY
- Most large caves were well developed by the late Triassic/early Tertiary (65 MA)

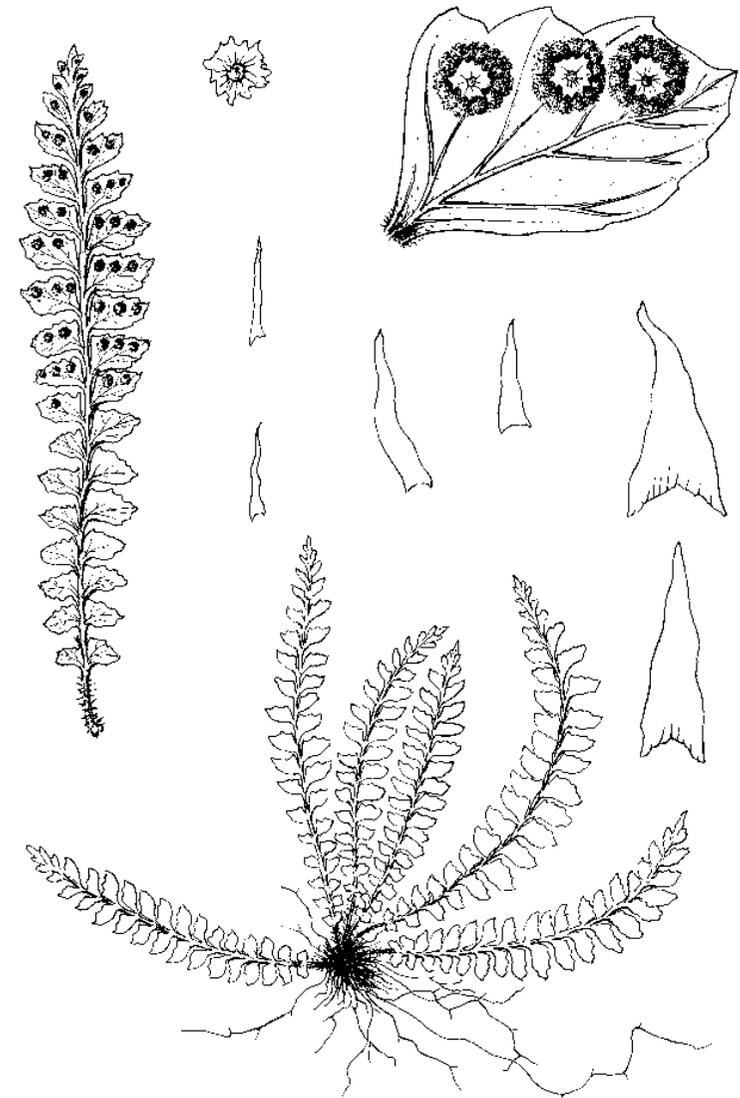
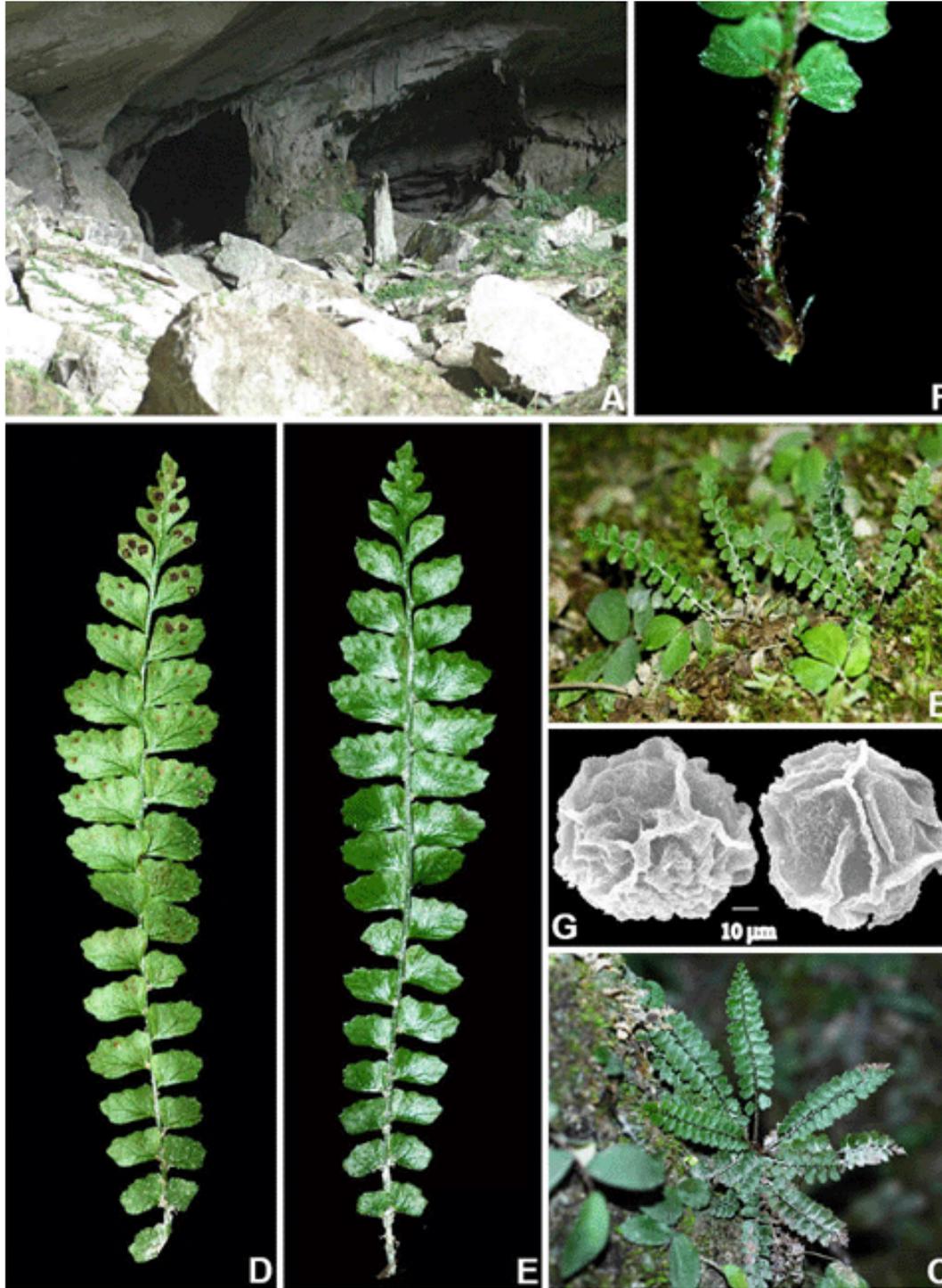
[Earliest Urticaceae fossils 59 MA]







Polystichum oblanceolatum



Elatostema

- Highly modified inflorescences
- Part of a monophyletic group including *Procris* and *Pellionia*
- Ca 350 spp., Africa, SE Asia, Australasia
- Shade loving herbs normally found in undisturbed forest
- Frequent strong sex-ratio bias towards females (apomictic species?)





Elatostema sublineare



Elatostema sp.



Elatostema sp.



Research questions we seek to address

- Origin of cave-dwelling *Elatostema*
- Are they a relict of past cooler climates in SE Asia, or...
- The product of human deforestation, caves representing the only remaining habitat
- Did cave-dwelling *Elatostema* evolve in caves- are there parallels with islands?

Sources of data

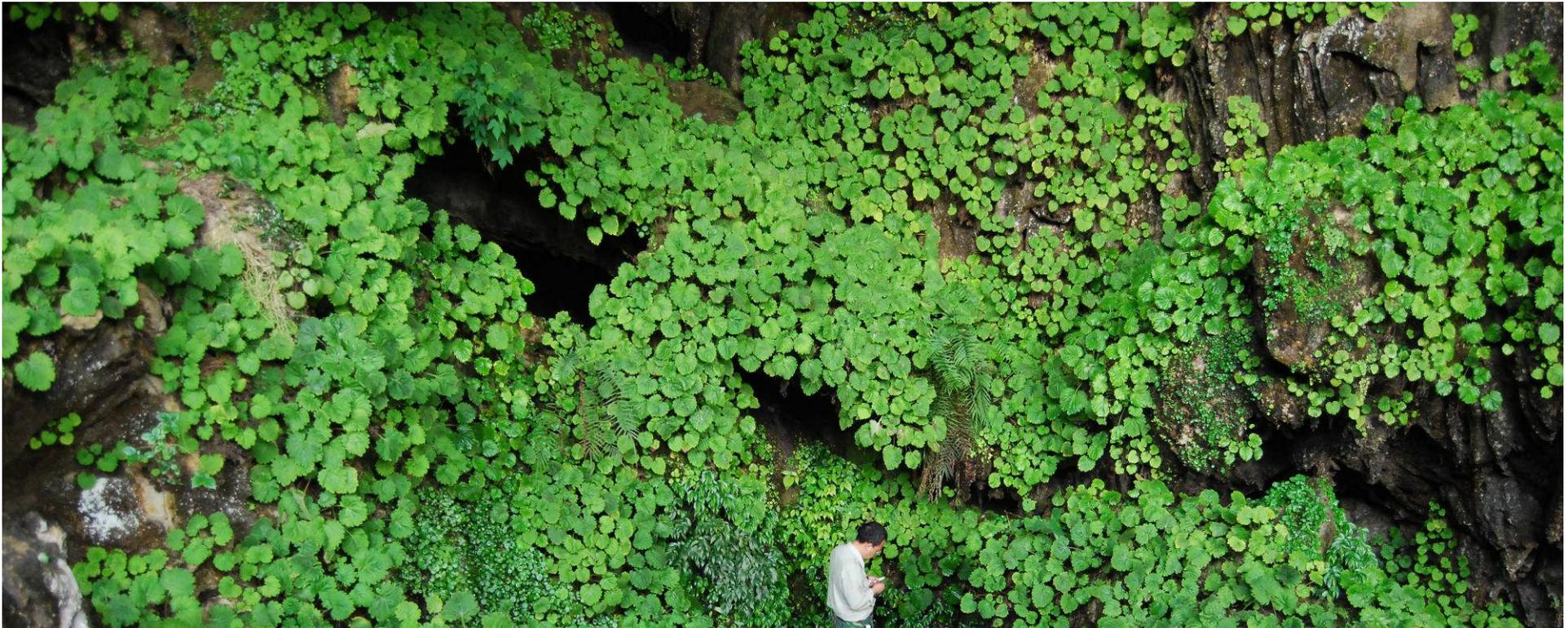
- DNA sequence data
- Species distributions
- Comparison of cave and forest understory habitat- are there similarities
- comparison of karst flora of neighbouring areas in N Vietnam, Malaysia and Sichuan where there is more original forest cover

DNA (First stage)

- Is it possible to study this system using hypervariable CP DNA regions?
- Specifically how much phylogenetically informative molecular variation is there between and within populations of cave-dwelling *Elatostema*
- How is this variation partitioned amongst cave-dwelling and free-living taxa

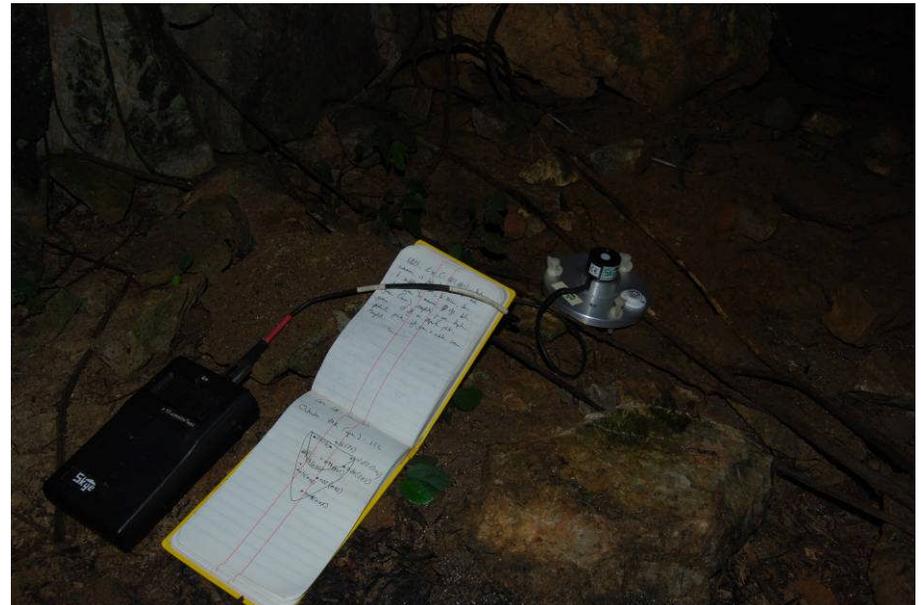
Species distributions information

- are there differences in the areas of occupancy of cave-dwelling vs open dwelling species
- are geographical patterns in the distribution of cave-dwelling species reflected in other cave-dwelling groups, *Polystichum*, *Begonia* etc



Comparison of cave and forest understory

- Photosynthetically active radiation
- Seasonality of temperature and humidity
- Nutrient availability and balance
- Potential for sexual reproduction and dispersal
- Viability outside of caves



Pilot study: 2010

Study area



Site 3

Site 1



Site 2



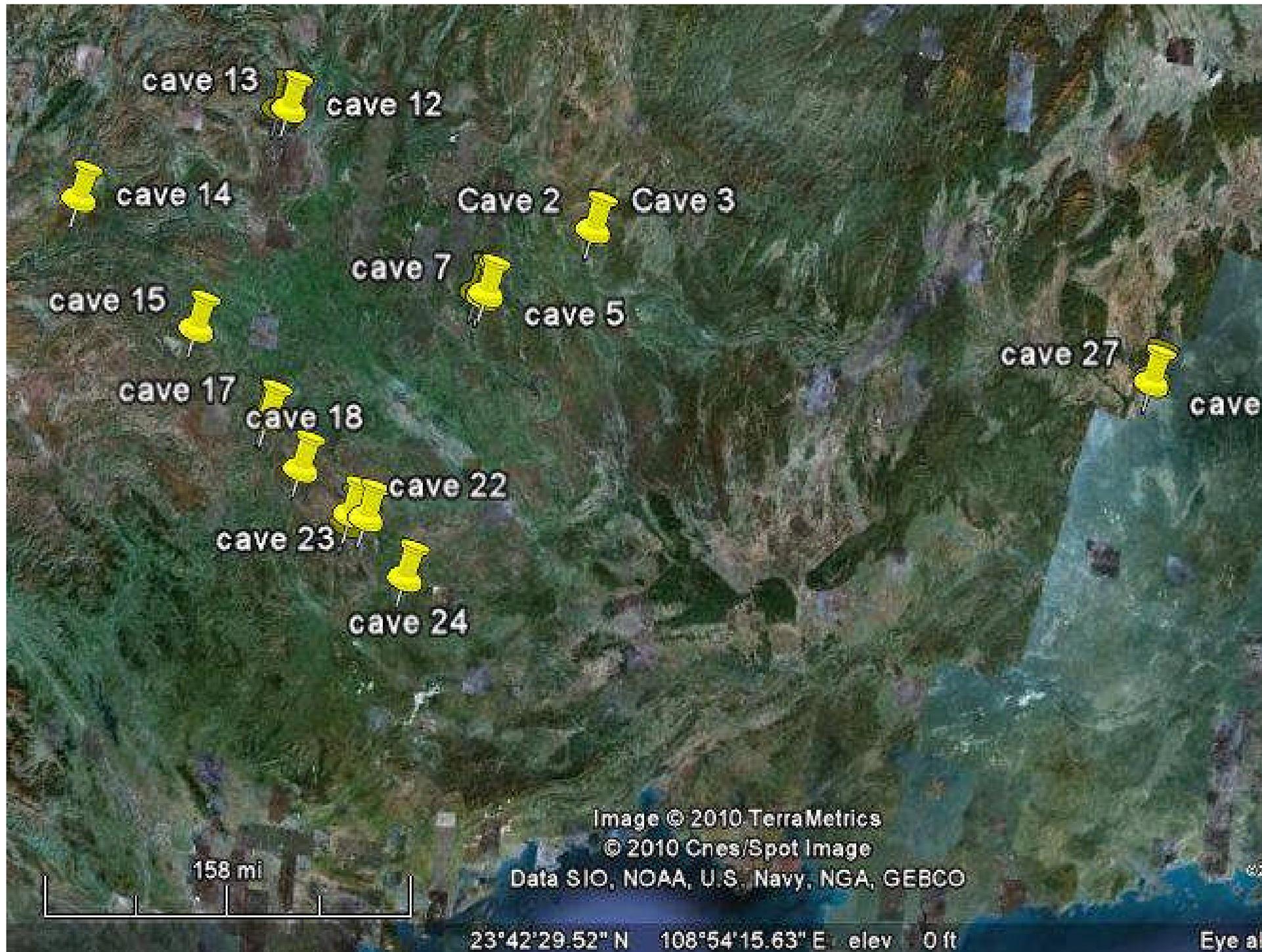
Site 4

158 mi

Image © 2010 TerraMetrics
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Data SIO, NOAA, U.S. Navy, NGA, GEBCO

23°42'29.52" N 108°54'15.63" E elev 0 ft

Eye



cave 11



cave 12



cave 13



Xiachang



下, ©2010 Mapabc.com

Baiyantuo



白岩陀

©2009

Image © 2010 DigitalGlobe

Imagery Date: Apr 3, 2003

25°18'51.70" N 105°35'45.58" E elev 0 ft

Eye alt



Species

- 97 *Elatostema* taxa for Guangxi
- 36 of these are known from caves
- 17 of these are known only from caves
- Some caves have many species, others few or none
- Most species occur in several caves, a few known from a single cave
- Appears to be an East-West trend in cave species-richness

Cave environment

- air temperature relatively constant, ca 1-2°C annual variation, (Fang & Lin, 1991)
- 17-19°C depending on latitude
- relative humidity high, ca 95% (Fang & Lin, 1991)
- Photosynthetically active radiation low but very heterogeneous: 0.02-12.0%



Acknowledgements

- The Royal Society Travel Grant
- Botany Department
- Foreign & Commonwealth Office

