Ecological Monitoring Techniques

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24sins* that evade ecological monitoring nirvana!

- Not knowing why you are censusing/monitoring/collecting data
- Not knowing your species/parameter/variables
- Complacency about your species/parameter/variables
- Thinking that heap of data will reveal the result
- Accepting and adopting the methods, without questioning
- Not sampling randomly

***Inspired and Modified from Sutherland's Ecological Censusing Techniques: A handbook**
Image source: http://onlyshruti.wordpress.com

Sins continued…

- Not storing information where it can be retrieved in the future
- Not giving precise information as to where sampling occurred
- Counting in one or a few large areas rather than a large number of small ones
- Not being honest about the methods used
- Collecting far more samples than can possibly be analysed
- Changing the methodology in monitoring

Sins continued…

- Believing that the density of trapped individuals is the same as the absolute density
- Not thinking about how you will anlayse your data before collecting it
- Ignorance of Scale: Spatial and temporal (pay scale also counts!!!)
- Assuming sampling efficiency is similar in different habitats
- Thinking that someone else will identify all your samples for you
- Perishing before publishing! Procrastination about publishing the findings

Sins continued…

- Deviating from transect routes
- Not having a large enough area for numbers to be meaningful
- Assuming others will collect data in exactly the same manner and with the same enthusiasm
- Counting the same individual in two locations and counting it as two individuals
- Not having controls in management experiments
- Believing the results

Why EM(p)T(y)…before that, What is EMT?

- Ecological monitoring is about the systematic collection of ecological data in a standardized manner at regular intervals over time, related to a specific problem.
- Ecological data can be…physico chemical and biological
- So…why empty will follow soon

Why EMT?

- Key areas of interest…Bangalore! Western Ghats!! Or Bylalu??? Or Forest
- Estimating population size
- Population change
- Habitat requirement
- Determining why species are declining
- Habitat management
- Population dynamics

Further ahead…

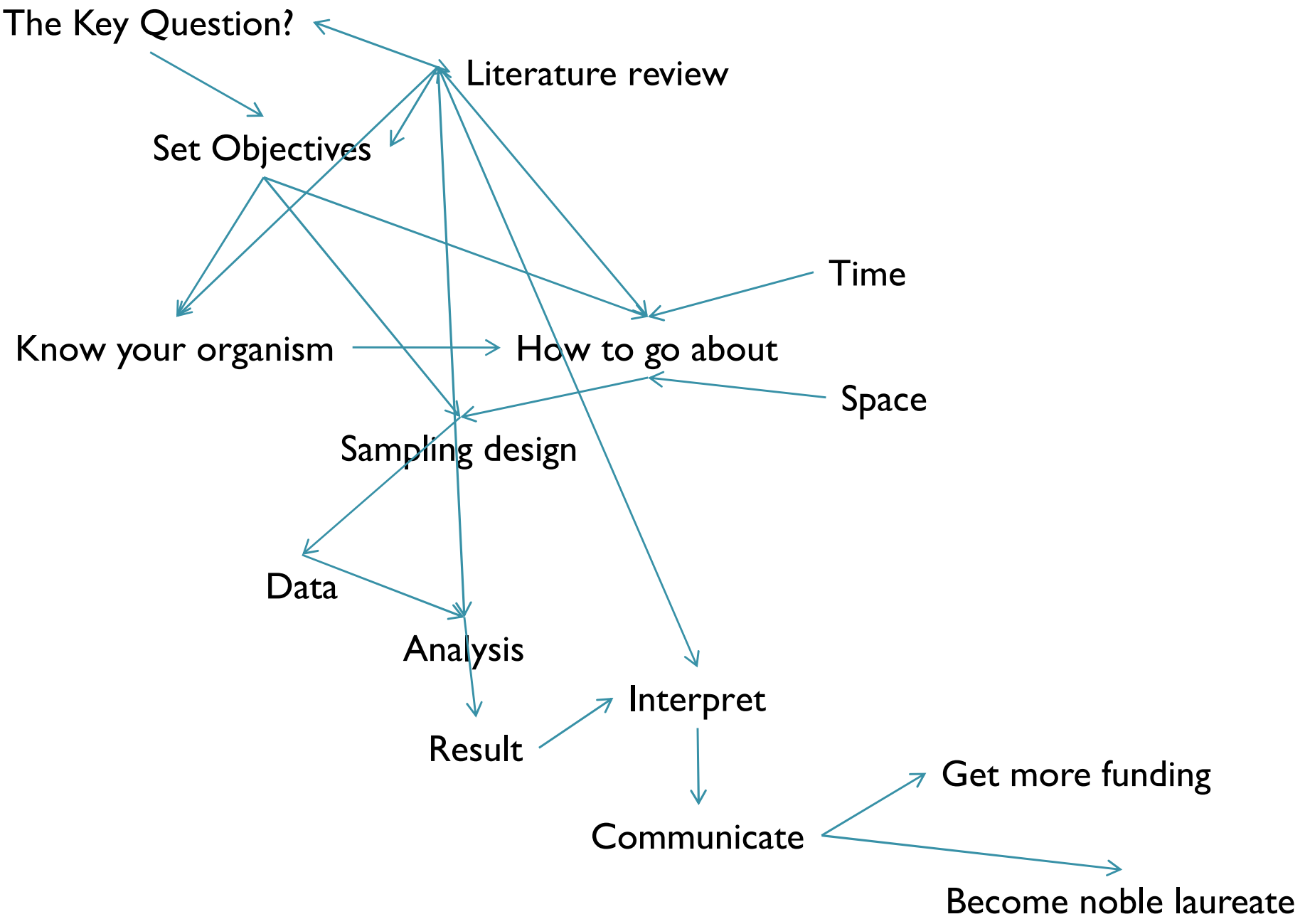
- EM provide basic ecological knowledge about those processes.
- Management of ecosystems, requires a baseline, which can only come from EM.
- Human induced changes have long-term effects (synergistic and/or cumulative), hence long-term EM required.
- Data from such long-term studies are basis for early detection of potentially harmful effects on components of ecosystems.

Where to EMT

Ecological Monitoring needs to occur in:

- Regions where there are greatest impacts caused by humans so that the effects of land use can be managed in a sustainable manner
- Regions not greatly affected by humans so that baseline information can be obtained; this would include biological communities for which there were comparable communities that had been affected by human activities
- Regions where there has previously been little ecological monitoring but where we need to know if environmental degradation does occur

Ecological Monitoring…



Start off…

- Objectives
- Know your organism
- Review of Literature!!!
- Population or sample?
- Reliability of estimates
- Source of bias
- What if, biased!

Amphibian monitoring: A case study from Sharavathi River basin

- Key question: Do amphibians indicate landuse change?
- Objectives:
  - Amphibian diversity and distribution in various landuse
  - Variables influencing the landuse
  - Conservation priority regions based on the outcome
- Why amphibians? Which group to look for?
  - Salamanders! Frogs and Toads or Caecilians
- Which area?
  - Sharavathi river basin
- How to sample? Where to Sample? Time?
  - Population or diversity? Mark recapture? Toe clip?
- Which statistical application?
  - Relationships, Multivariate

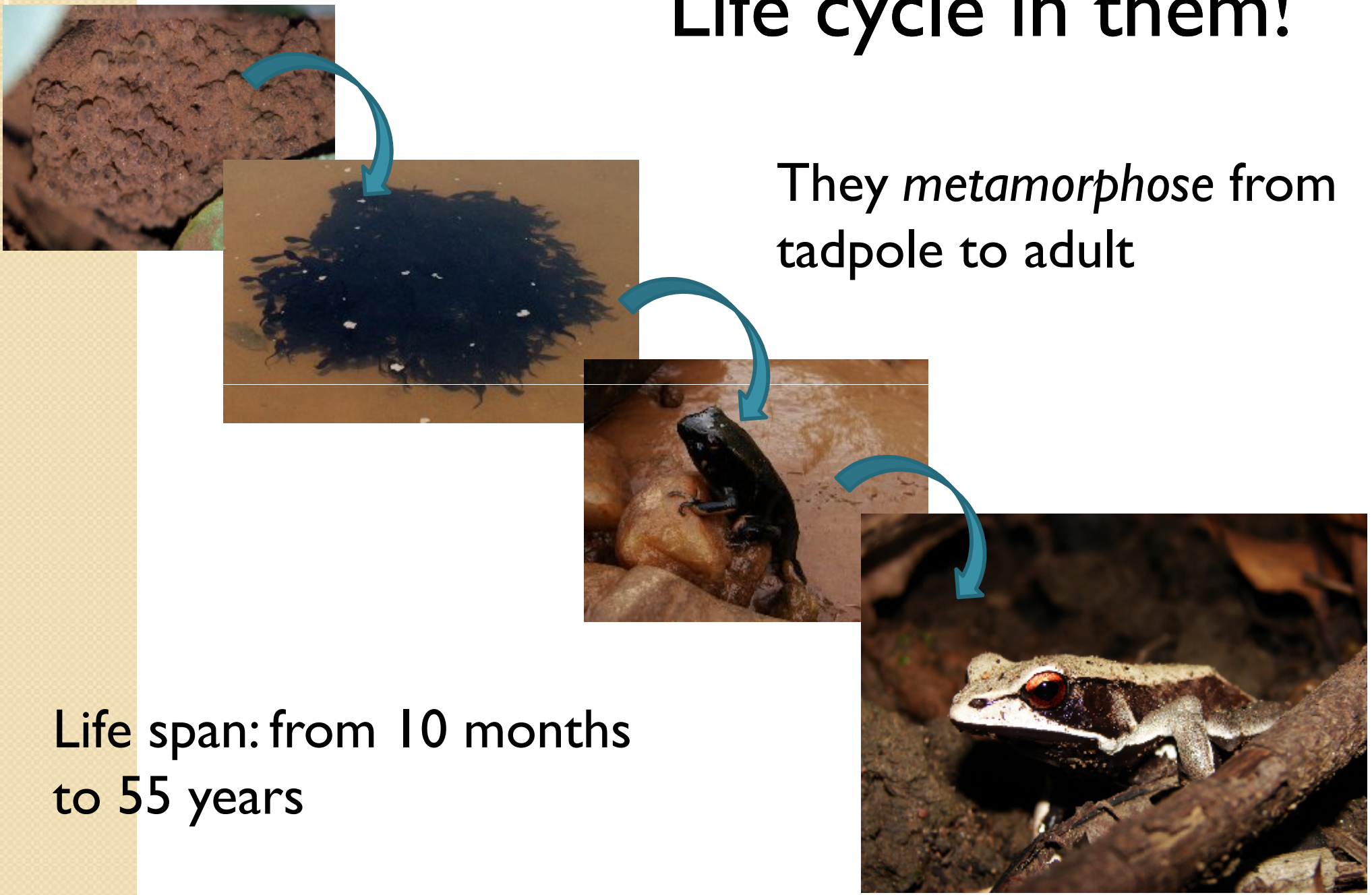
I must know my species!
So Amphibians are ...

- Dual lifers ...
  - Two stages in life – a tadpole stage and an adult stage (Greek, *Amphi* – dual, *bian* – life forms)
  - Majority Nocturnal and Seasonal, harmless (beautiful!!!)

Knowing better...

- Generally, aquatic and terrestrial inhabitants, Some are arboreal, and some fussorial too

Life cycle in them!



They *metamorphose* from tadpole to adult

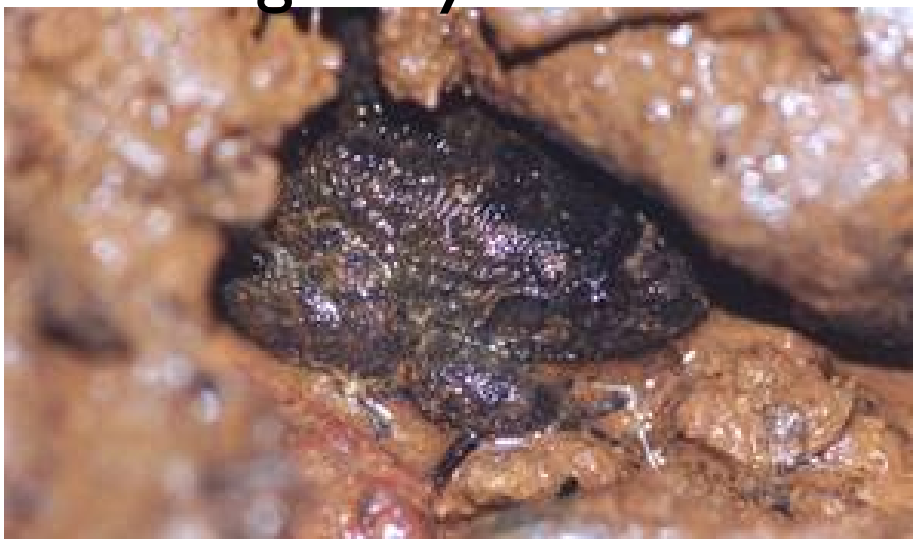
Life span: from 10 months to 55 years

Ectotherms

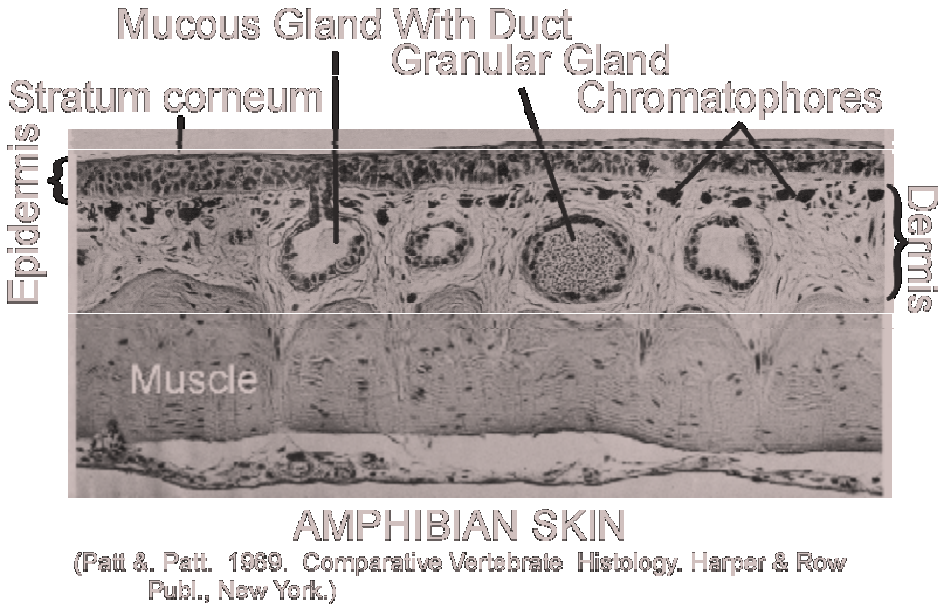
- Body temperature externally maintained

Basking in Sun

Hiding away from Sun

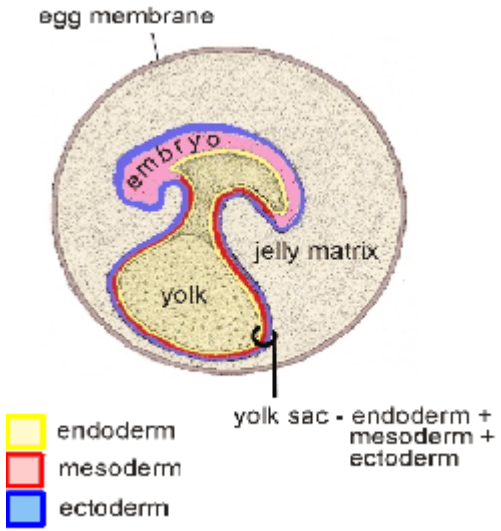


Skin breathers and anamniotes



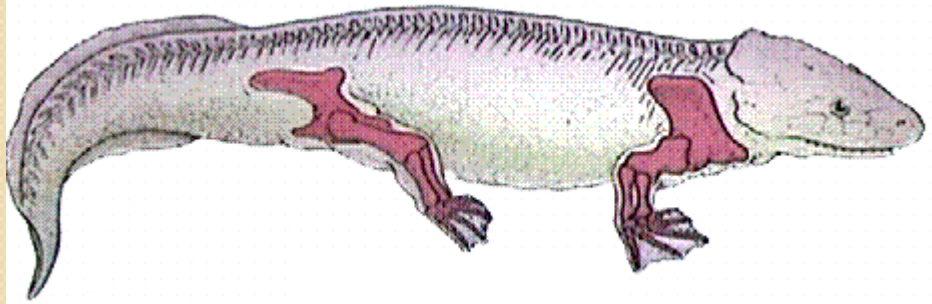
AMPHIBIAN SKIN

(Patt &. Patt. 1969. Comparative Vertebrate Histology. Harper & Row Publ., New York.)

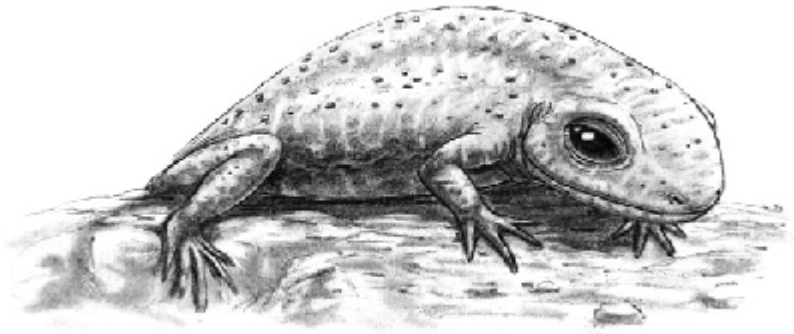


Evolution

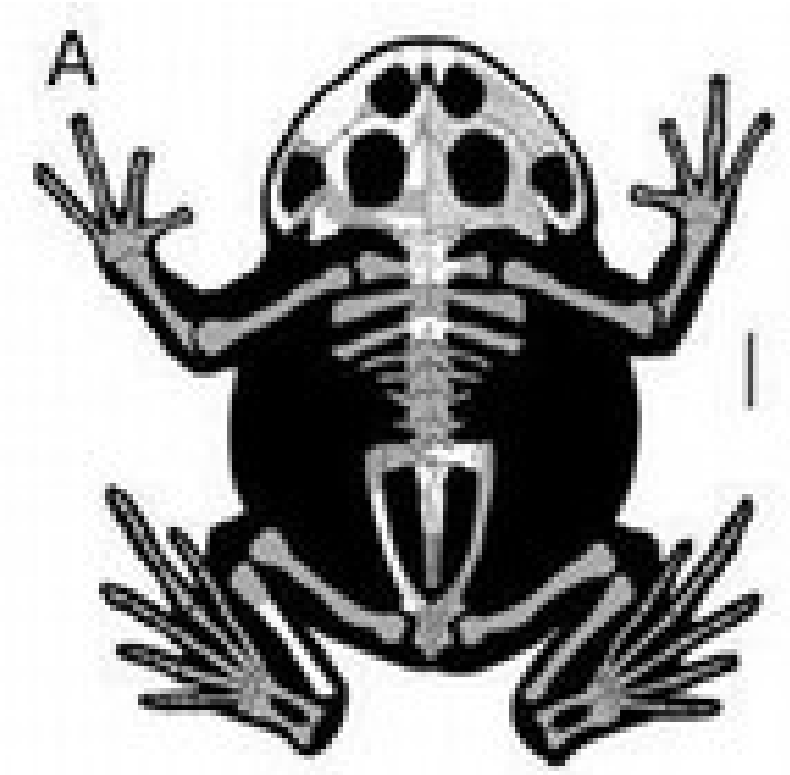
About 360 million years ago, late Devonian period



Early amphibian!!!



Triadobatrachus



Beelzebufo ampinga

Ecosystem function

- prey and predator

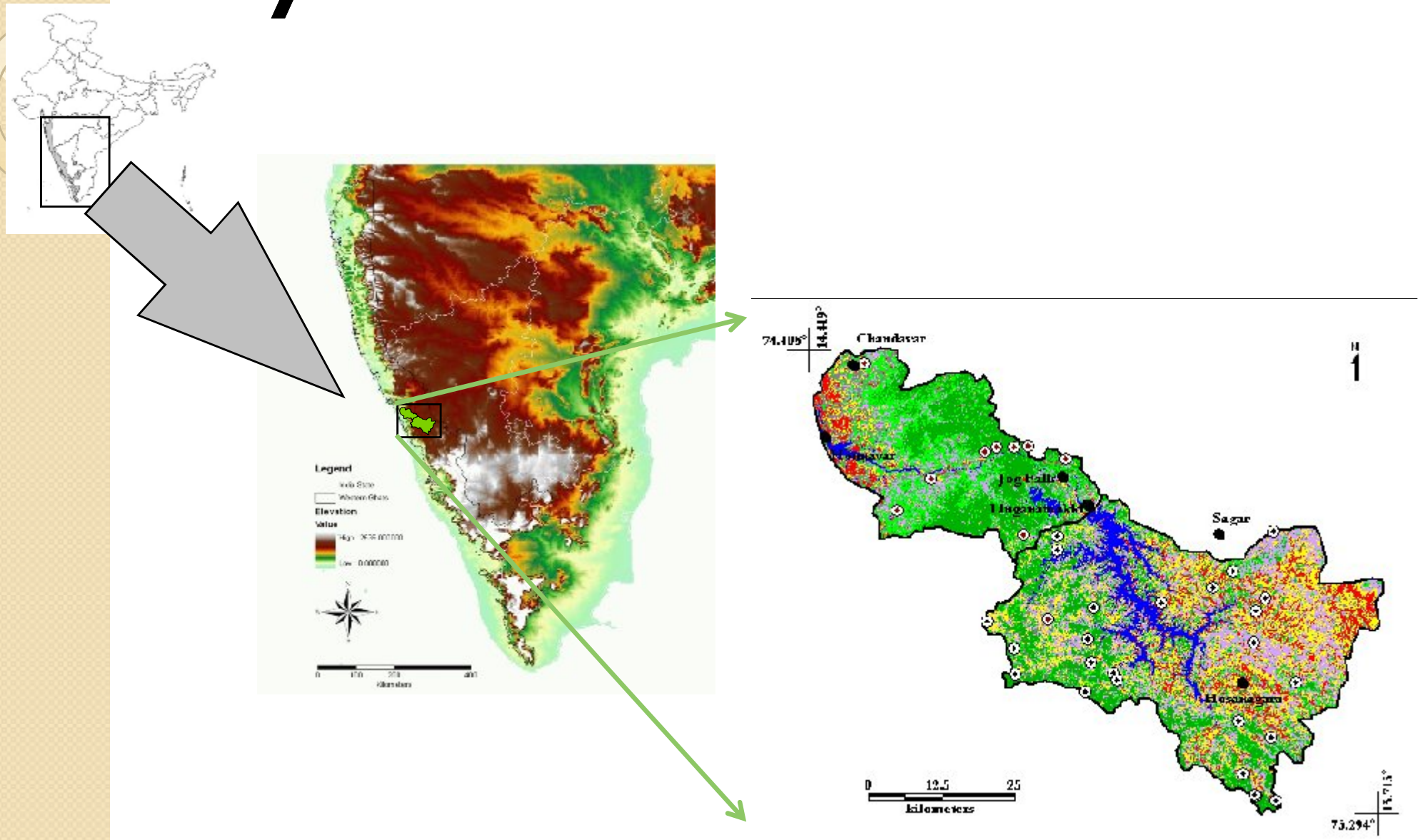
So also for US ...

- Human Welfare
  - Biocontroller of Pests
  - Skin extract – pain killer: Bufotonin, Epibatidine
  - Media for microbial culture
  - Delicacy
  - Indicators of change in environment
  - Culture, Rig Veda, verse 7, shloka 103,
  - Biogeographic linkage ...

Amphibians indicate …

Factors	Process(es)
Climate change	Temperature and precipitation patterns are altered so as to cause disruptions in micro or macro-climatic conditions
Habitat modification	Deforestation and agriculture; drained and filled wetlands, land filling
Habitat fragmentation	Roads, introduced species, and low pH dissect habitats, creating barriers to dispersal.
Introduced species	Introduced predators, prey on/or compete with native amphibians.
UV-B radiation	UV-B damages and/or kills cells, causing egg mortality, lesions, malformations and increased susceptibility to disease and low pH.
Chemical contamination	Toxins cause direct mortality of eggs and adults, mimic endocrine harmones, reduce the prey base, pesticidal effect; fluoranthene.
Acid precipitation and soil	Toxins create barriers to dispersal and cause high egg and larval mortality.
Disease	Disease often causes death in amphibians (*Chytridiomycosis*)

Study area


Legend
Elevation
Value
Chandavar
Jog Falls
Linganamakki
Sagar
Honnavar
0
12.5
25
Kilometers
74.405°
14.419°
75.294°

Methods

- Systematic stratified random sampling
- Night survey with torch lights (17:30-20:30 hr), from 2003 – 2006, seasonal, search for all (including calls, tadpoles), in all micro habitats
- Identify and record species, numbers etc.
- Secondary data on Vegetation studies, RS and GIS
- Opportunistic observations also included for overall diversity in the region
- Shannon's index ($H' = - \Sigma p_i \ln p_i$),
- Simpson's index ($D = 1/ \Sigma p_i^2$)

For population studies

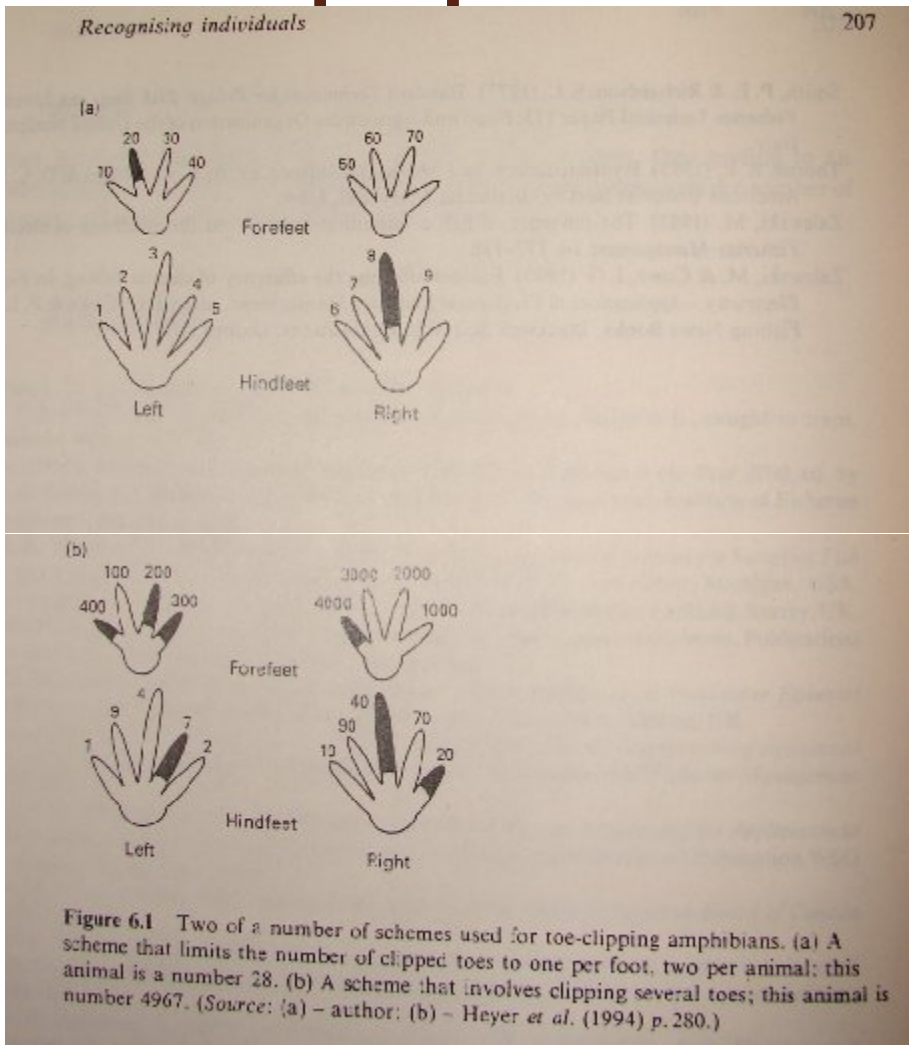


Figure 6.1 Two of a number of schemes used for toe-clipping amphibians. (a) A scheme that limits the number of clipped toes to one per foot, two per animal: this animal is a number 28. (b) A scheme that involves clipping several toes; this animal is number 4967. (*Source*: (a) – author: (b) – Heyer *et al.* (1994) p. 280.)

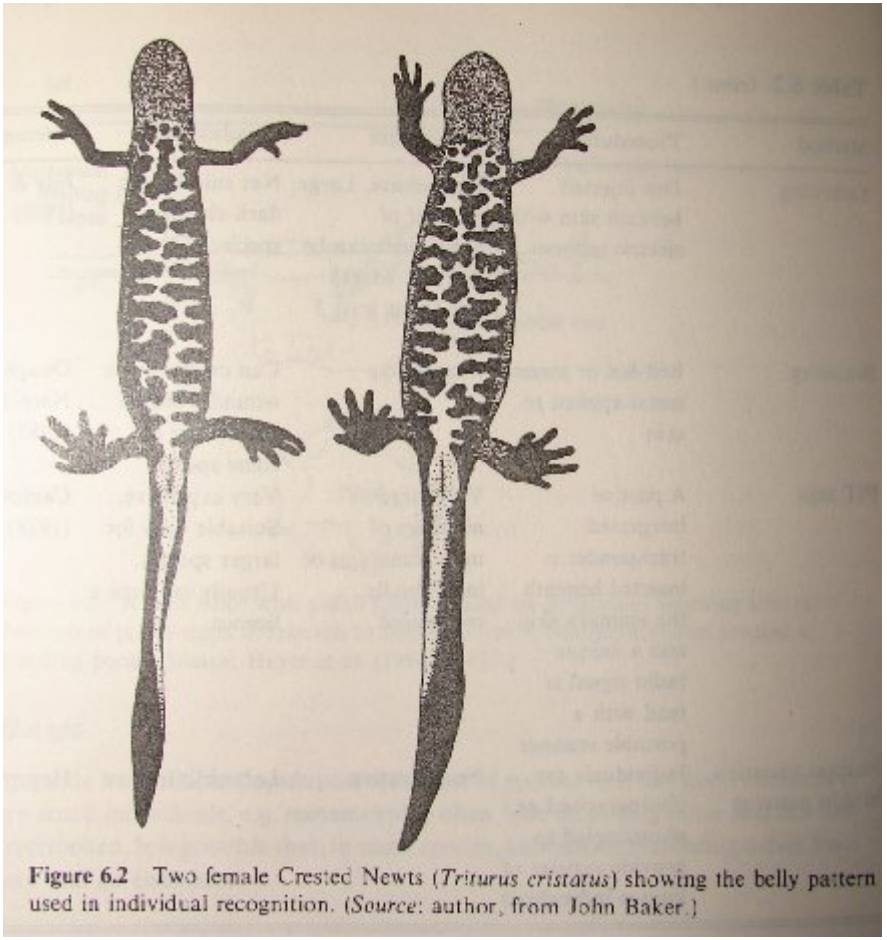


Figure 6.2 Two female Crested Newts (*Triturus cristatus*) showing the belly pattern used in individual recognition. (*Source*: author, from John Baker.)

Table 6.2. *Methods used for marking and recognising individual amphibians*
Note: most of these methods have been used successfully for only one or a few species (see references) and it should not be assumed that any method is suitable for any given species

Method	Procedure	Advantages	Disadvantages	References
Toe-clipping	One or more digits cut from hands or feet	Inexpensive. Large numbers of individuals can be recognised (not so many if number of digits removed is limited)	Digits of urodeles regrow. May cause tissue damage or reduced survival	Martof (1953)
Elastic waistbands	Fitted to individuals according to their size. Can be colour-coded or numbered	Inexpensive. Large numbers of individuals can be recognised at a distance	Suitable only for short-term studies (a few days or weeks)	Emlen (1968) Davies & Halliday (1979)
Knee-tagging	Small tag tied to knee with stretchable thread	Inexpensive. Large numbers of individuals can be marked	Suitable only for anurans	Elmberg (1989)
Fluorescent colour marks	Coloured fluorescent dust applied to skin with compressed air	Large numbers of individuals can be recognised at a distance and in the dark	Relatively expensive. Marks temporary, lasting 1 to 2 years	Nishikawa & Service (1988)
Skin transplants	Small piece of ventral skin exchanged for piece of dorsal skin	Permanent. Inexpensive	Time-consuming. Requires expertise. Relatively few animals can be marked. Suitable only for species with contrasting dorsal and ventral colours	Rafinski (1977)
Skin staining	Dye sprayed onto skin with dental (panjet) injector	Inexpensive	Can cause injury. Relatively few animals can be marked. Marks short-lived	Wisniewski *et al.* (1980) Gittins *et al.* (1980)

Table 6.2. (*cont.*)

Method	Procedure	Advantages	Disadvantages	References
Tattooing	Dye injected beneath skin with electric tattooer	Inexpensive. Large number of individuals can be marked. Marks last for at least 3 years	Not suitable for dark-skinned species	Joly & Miaud (1989)
Branding	Red-hot or frozen metal applied to skin	Inexpensive	Can cause severe wounds. Marks short-lived in some species	Daugherty (1976) Nace & Manders (1982)
PIT tags	A passive integrated transponder is inserted beneath the animal's skin and a unique radio signal is read with a portable scanner	Very large numbers of individuals can be individually recognised	Very expensive. Suitable only for larger species. Usually requires a licence	Camper & Dixon (1988)
Natural variation in skin patterns	Individuals are photographed or photocopied to provide register of known individuals	Non-invasive	Labour-intensive	Hagstrom (1973)

Searching

- All out search/scan search
- Netting
- Drift fencing
- Trapping
- Transect and patch sampling
- Removal studies

Thank you!

- Questions….most welcome???