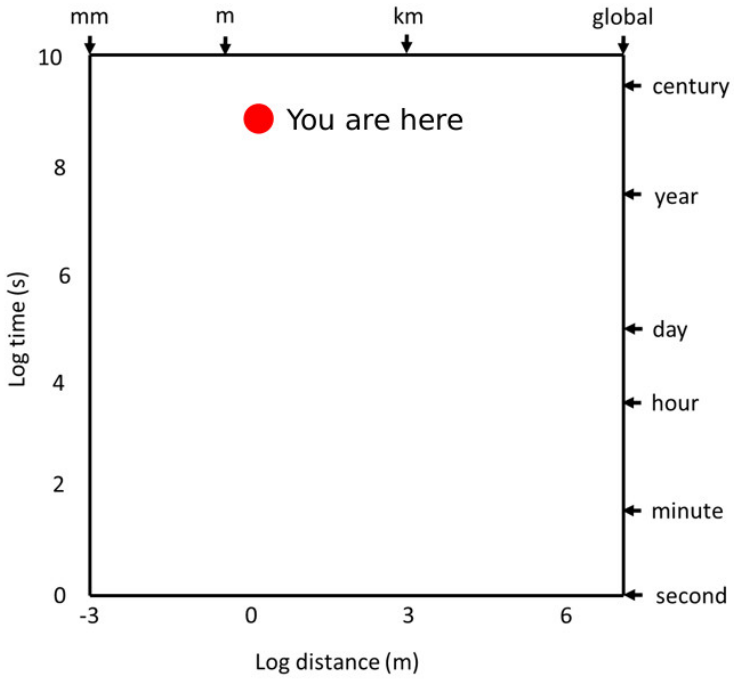
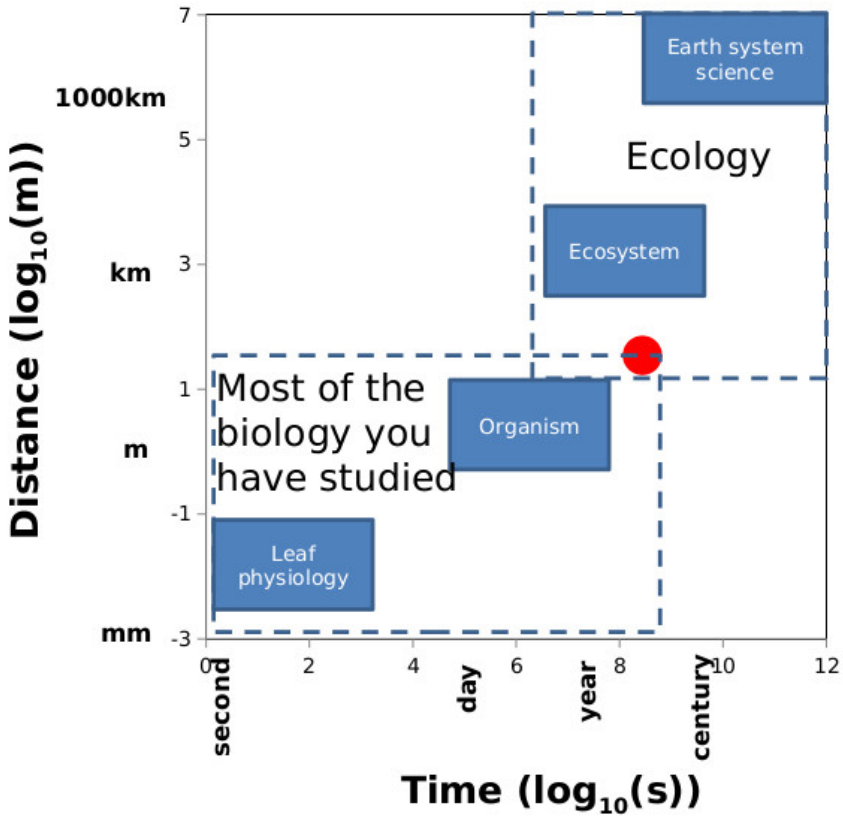
Background

A sense of scale

Stommel diagrams

Plot a log of time(s) against a log of space(m).





Reductionism

Describing or analysing complex phenomenon in terms of phenomena held to represent a simpler or more fundamental level, which if fully understood can provide a complete explanation/prediction for the complex phenomenon

Holism

The theory/position that the hole can be more than simply the some of the parts due to the interactions between the parts which lead to emergent properties. (emergent properties can only be observed at the right scale)

Scales in ecology

Ecosystem ecology

Biosphere Biome High level ecosystems Ecosystem

Community ecology

Community Population

Organismal ecology

Organism tissue Cell

Mathusianism

Organisms don't grow independently they are constrained by energy and material requirements which leads to regulatory feedback associated with thomas malthusian.

Classical economics

There are not limits to growth because human ingenuity will always outpace human expansion. Associated with Ester boserup

MEMORY DEVICE: talk between sex

Applications

Determining carrying capacity How much can be harvested from stock without upsetting cultivation environment Existential crisis, limits to growth.

Systems

Not systems

Single object with inputs and outputs Multiple objects which interact linear with each other, (ie no circular causality) The interactions of one object with another could just be thought of as a input to the object in question and it could be analysed in isolation.

(chaotic) systems

2 or more objects which interact with each other, this implies circular causality and non linear models must be used, and bifurcations often result

Complex systems

Complex system are not necessarily complicated in the conventional sense of the word, but they are very hard to predict. Characteristics

Multiple stable states

It is very hard to predict how to shift between stable states, or what parameters variables must remain within to sustain a given stable state.(threshold/sepratrics)

Multiple factor causes

Circular causality

Emergent properties

Definitions

Emergent properties

Properties which can only be observed at the correct scale as the result from interactions between parts which are not apparent when viewing those parts in isolation For example climate is a emergent property of weather, Clouds are an emergent property of water vapour particles in the atmosphere

Bifurcations

Small random changes in a system which can lead to large changes in the direction or ultimate stable state which the system settles at.

Argument forms

Dialectic argument

Thesis + antithesis (becomes) synthesis ## Exams

Questions list

Draw sommel diagram place an ecosystem. Define ecosystem and emergent properties.

Exams

In exams questions will be very broad requiring one to pick a stance and make a convincing case for it.

Test

Tests will have shorter more direct questions

Organisms and their environment.

definition: autecology

the view of an organism looking outwards on an environment.

requirements of an organism

response to a given factor.

In general the response on and organism to increasing amounts/concnetrations of any given factor shows humped shape growth curve. this growth curve can be split into several sections.

sub critical

bellow the minimum level of the factor which the organism needs to survive.

sub optimal

the organism can survive but is not yet operating optimally due to a shortage of the factor.

optimal

the organism has exactly the most beneficial amount of the factor and all other things being equal, is growing at the highest possible rate.

supra optimal

the organism is growing at below optimal rate because it has a detrimental excess of the factor.

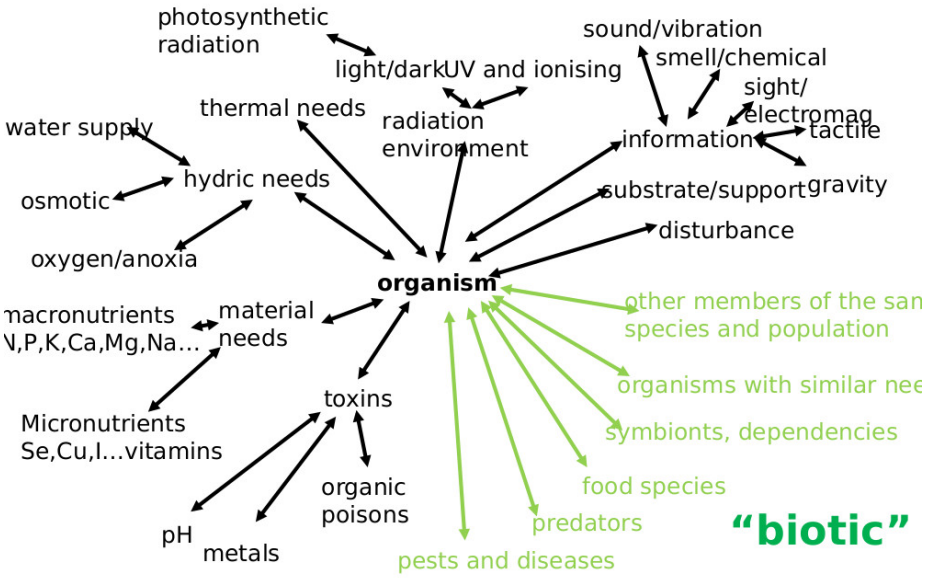


Figure 1: General

nutrient requirements

plants

animals

NOTE: animals can gain water from metabolism.

water needs

plants

Essential:

```
Non-mineral O, C, H
Macro N, S, Ca, P, K, Mg
Micro Cl, Fe, Zn, Cu, Mn
```

Beneficial:

```
Si, Na, Co, Se
```

Animals

Essential:

```
Bulk O,C,H,N,S
Macro Ca, P, K, Cl, Na, Mg
Trace Fe, Zn, Cu, I, Mo, Co, Se
```

Beneficial

```
Sn, Ni, Va, F
```

NOTE: Animals like salt so much, because plants (which don't really need it) don't store in it in large quantities, therefore animals must find mineral sources of salt to augment their plant diets.

water availability

97% of water is salt water of the remaining 3%, 70% is frozen, 29% is underground and 1% remains in rivers and lakes.

Plants (from saturated to dry) 1. Aquatic 2. Emergent macrophytes 3. Mesophytes 4. Xerophytes

Animals 1. Aquatic 2. Amphibious 3. Land-dwelling Water-dependent. 4. water independent.

LieBigs law of the minimum

growth is controlled not by the total amount of resources but by the amount of the scarcest resource necessary for growth.

example: redfield ration

biological entities/system show a very precise and constant element ratio or C:N:P:

```
126:16:1 in marine plankton
100:10:1 in Soil
100:5:1 in Leaves
19:3:1 Vertebrates
```

An increase in any element above that ratio will lead to no additional growth.

temperature requirements

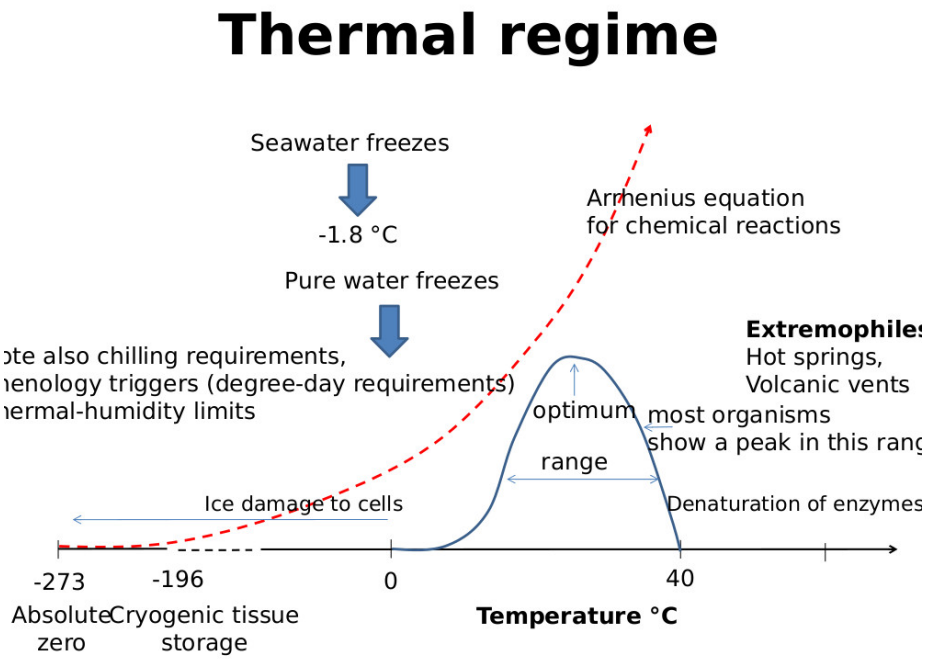


Figure 2: Responce to temperature range

plants

25 for C3 plants 28-30 for C4, tropical plants. ##### Earth as an environment. Earth lies in the goldilocks zone with regard to temperature, (and a number of) other conditions, not because of its location but more because it has an atmosphere which is capable of maintaining it at a stable temperature suitable suitable for life. the peculiar conditions found on earth result in part from the way the biosphere has acted to shape the climate, mineral distribution etc.

organisms interactions with each other

(copy slide)

Questions

exam requirements of organisms from their biotic and abiotic environment, including sub minimum optimal and supra optimal conditions.

test Liebig's law of minimums give and example of oversupply of an essential growth factor nitrogen, oxygen, water, temperature.

#Different Ecological Approaches

the extreme of this approach might be to see the earth as a (conscious, self preserving) entity in and of itself)

##Entities Higher than the organism

Basic Questions

- Can conscious entities greater than the organism exist.
- Can natural selection take place at entities above the organism level.

Friedric Clements (Clementian school)

Background

dominant in (continental) Europe.

Examples

the current felt management policy in South Africa is Clementian

Henry Gleason (Gleasonian School)

###Background Dominant in America

Jason

Complex systems

wicked problems

multiple complex systems all interacting

Super wicked problems

-

1. Time limits
2. No Centeral authority
3. The adjent responsible for fixing the problem is infact part of the problem
4. future irrationality

Complexity

1. Emergent properties
2. Nestedness
3. Feedback loops (positive or negative)
4. non linear relationships
5. thresholds (under the threshold value there is no/little change, above the threshold there is sudden dramatic change)
6. lags
7. multiple stable states

NOTE: within a complex system it is reasonable to suspect many surprises. Especially if you happen to be a human endoured with all of the primative problem solving techniques which humans are best at.

Models

1. aid in understanding
2. simplification of reality
3. systems change over time

Population models

expanential growth.

insert graph

Examples: 1. Elephants in the Kruger Park 2. Bacterial infections in humans

Exponential decay.

Often used when half lives are important.

Exponential Approaches

Decays to some lower (non zero) constant value

Examples 1. Acid mine drainage. Because some acidity is sequestered in the beds of rivers and streams even when the source is removed there will still be a reserve of acid to enter the water, so it will be very hard to reduce acid concentrations completely back to their ideal (zero) state.

S/ Sigma Shaped

Examples:
1. Growth of a population with a definate carrying capacity 2.

Overshoot

the system does not settle at a high eqillibrium.

Examples: 1. Delays responce to limiting factors. 2. damage to common resources.

Ocillations

Cycles in a sustained manner. Generally occur because of lags (delay responce to stimuli)

Examples: 1. heart rythms 2. preditor pre ocillations.

NOTE: amplitude of the ocillation can change

Systems Language

basic elements

Stock

an amount of something

Flow

A change in ammount

Connector

Show when one amount affects another

Converter

An outside variable which influences the system

Examples: Insert Diagrams.

Factors operating on the individual level.

What is an Individual

Especially in the case of gametes exaclty what cxonstitues one individual, and what constitues a group of individuals is unclear.

Life Cycles

Mammals

1. juvaniles
2. subadults (?)
3. adults
4. senescents

Trees

1. seeds
2. seedlings
3. saplings
4. adult trees

Insects

1. Eggs
2. larvae
3. Papa
4. instars
5. adults

NOTE: migration, survuval , reporiduction and other rates vary dependant on life cycle stages.

Unitary

Determinate forms

1. the size and shape will vary predictable, and life cycle stages will progress steadily and ordinally.

Modular

1. the form, growth and life cycle state of an organism is unpredictable.
2. modular organism are composed of many modules/ sub units. (which often display phenotypic plasticity)

Reproduction

reproductive cycles.

Annuals

grow mature reproduce and die off, once each year.

Copy Graph

iteroparous

Seasonal

long lived organisms which breed seasonally (eg Kudu or impala)

Continuous

Relatively long lived.

Semelparous

Similar life cycle to annuals but with a much longer juvanile period. (eg Salmon and centuary plant)

Sex

Individuals differ by sex.

NOTE: in mammals it is often the young males who must migrate from the place that they are born before they breed.

Quantity and Quality

Population level.

the basic definition of a population is a group of individuals living in the same place, at the same time, who can interbreed.

NOTE: this basic definition runs into a number of problems, Most commonly different species which can interbreed and populations which seem to be geographically separated but actually interact in important and predictable ways.

Functioning definition

A group of individuals for which it is meaningful to discuss: 1. birth rate death rate and abundance estimates. 2. Administrative boundaries 3. estimation approaches 4. population characteristics 5. compostion 6. favourable and non favourable environments,

Definitions

Genet

Organisms with distinct genetics

Ramet

Orgamsims with identical genetics but are non the less modular/separate in some regard.