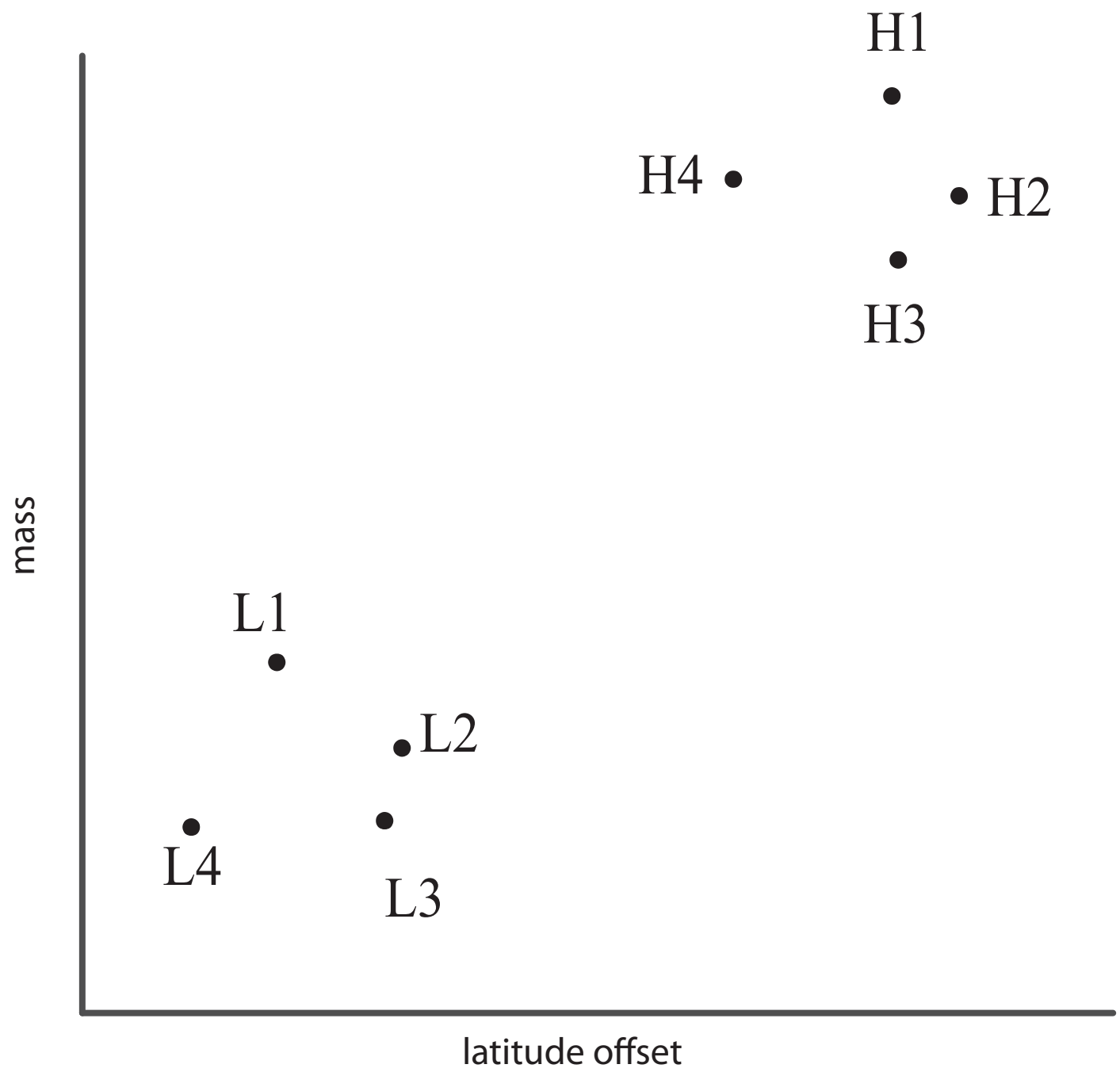


Simple test of Bergmann's rule: comparing latitude and mass (I made these data up)

lat. offset = degrees north of the 49th parallel.

species	lat. offset	mass
L1	3.1	5.9
L2	5.4	4.3
L3	5.1	3.1
L4	1.8	3.6
H1	13.5	15.2
H2	14.6	13.5
H3	13.6	12.4
H4	10.8	13.7

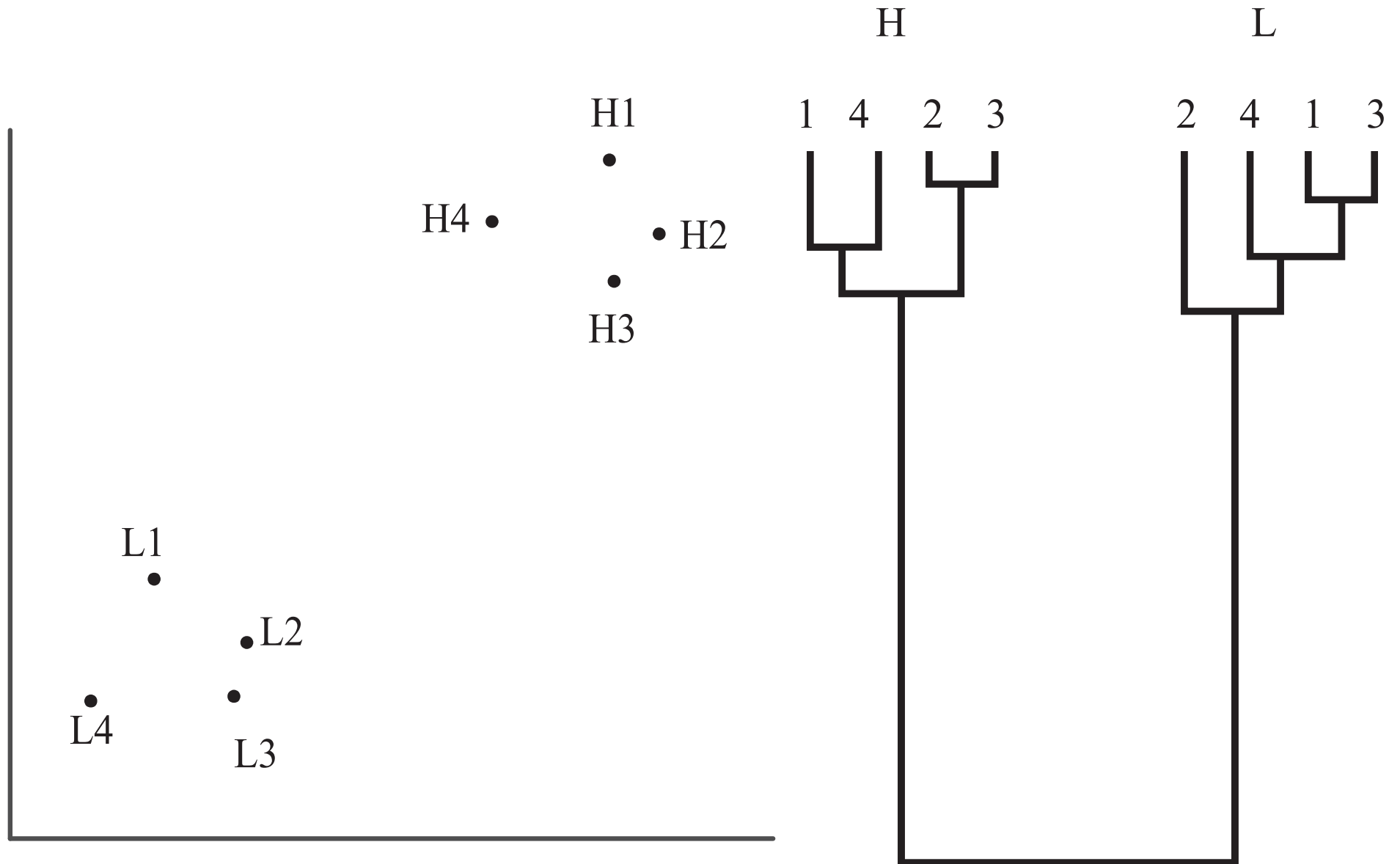


A standard correlation analysis is not appropriate

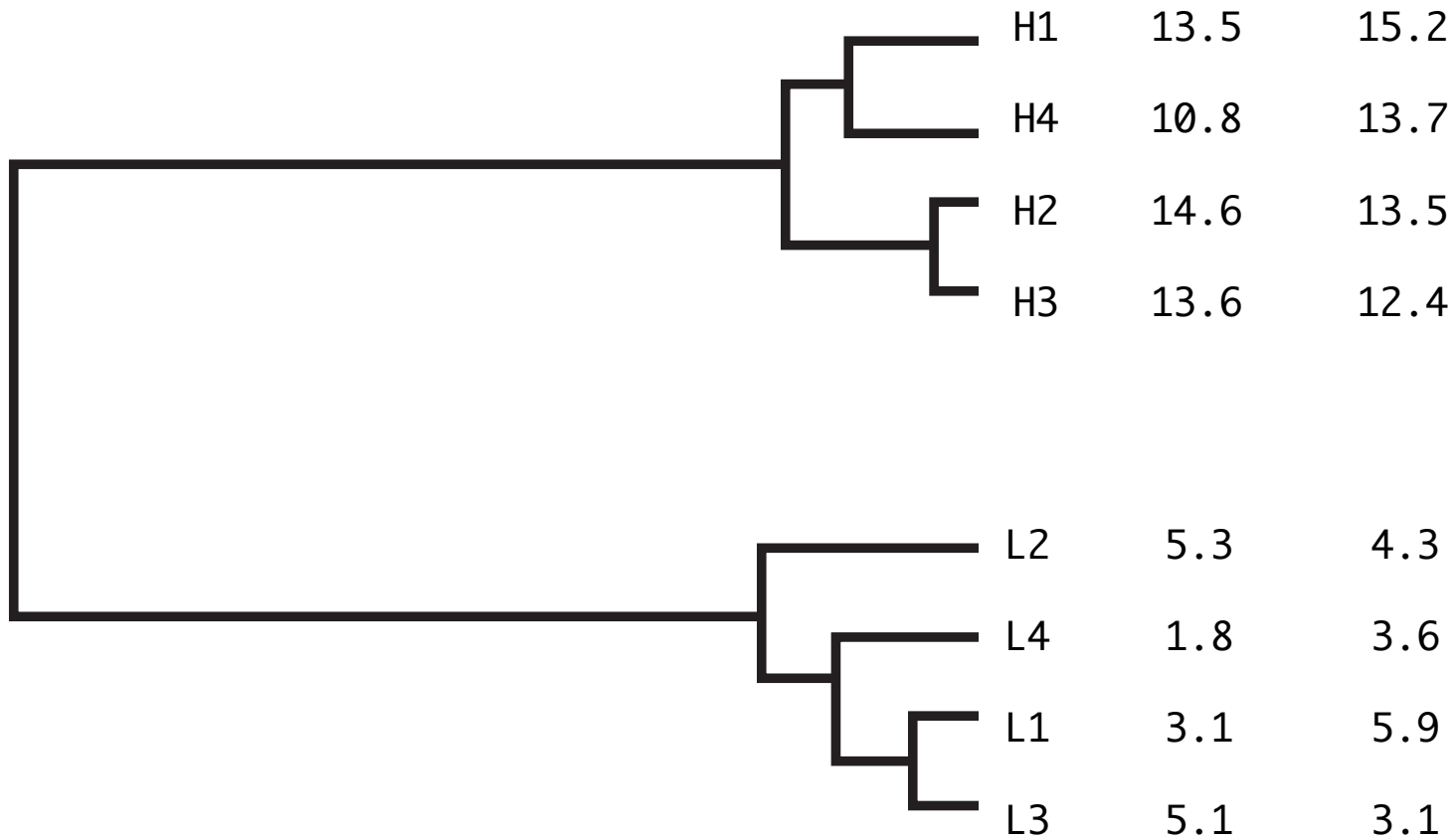
The 8 species are not 8 independent data points!

Some of those species are more closely related to each other – measuring one tells us something about the other.

No (or little) evidence for correlation

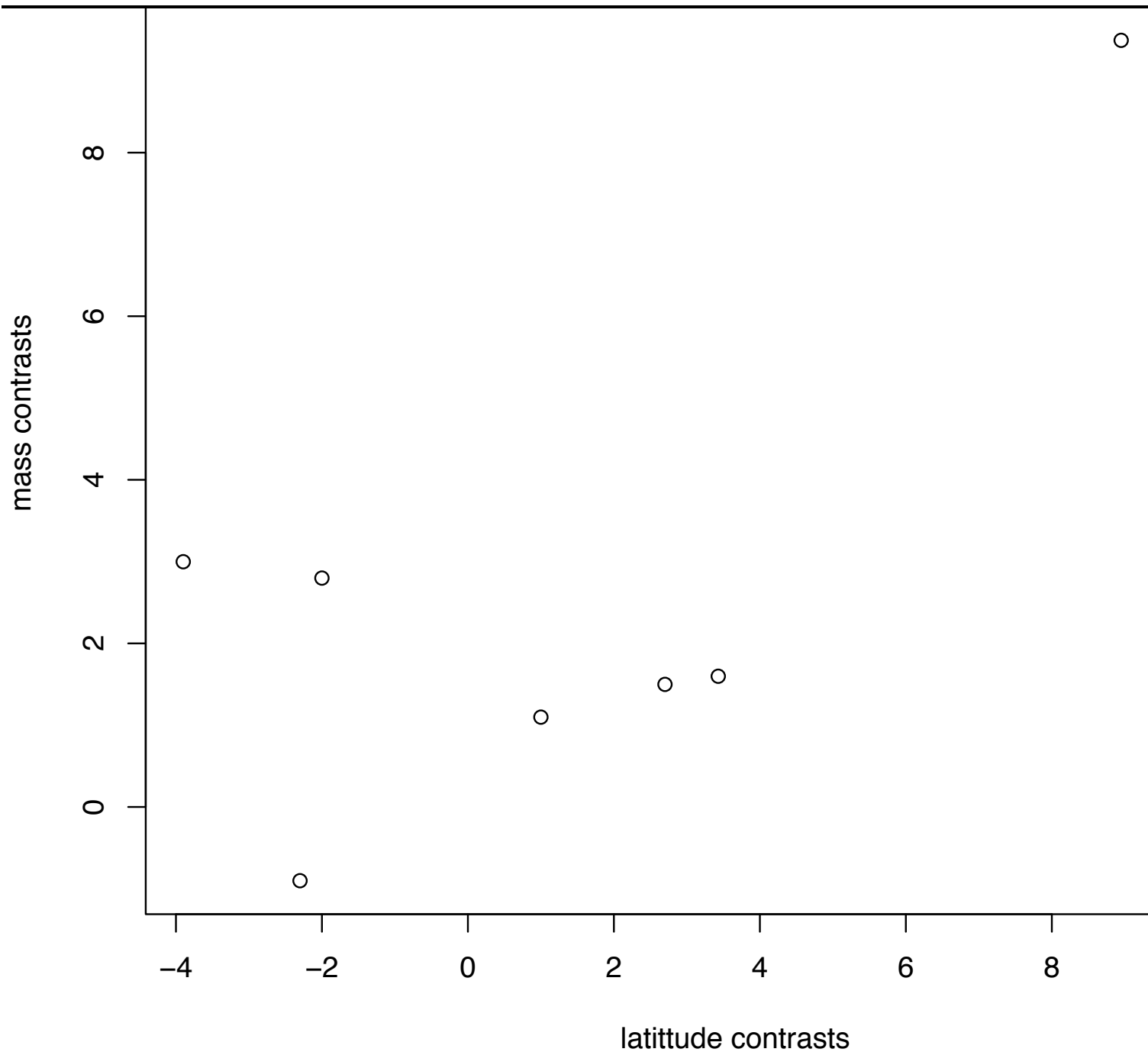


No (or little) evidence for correlation

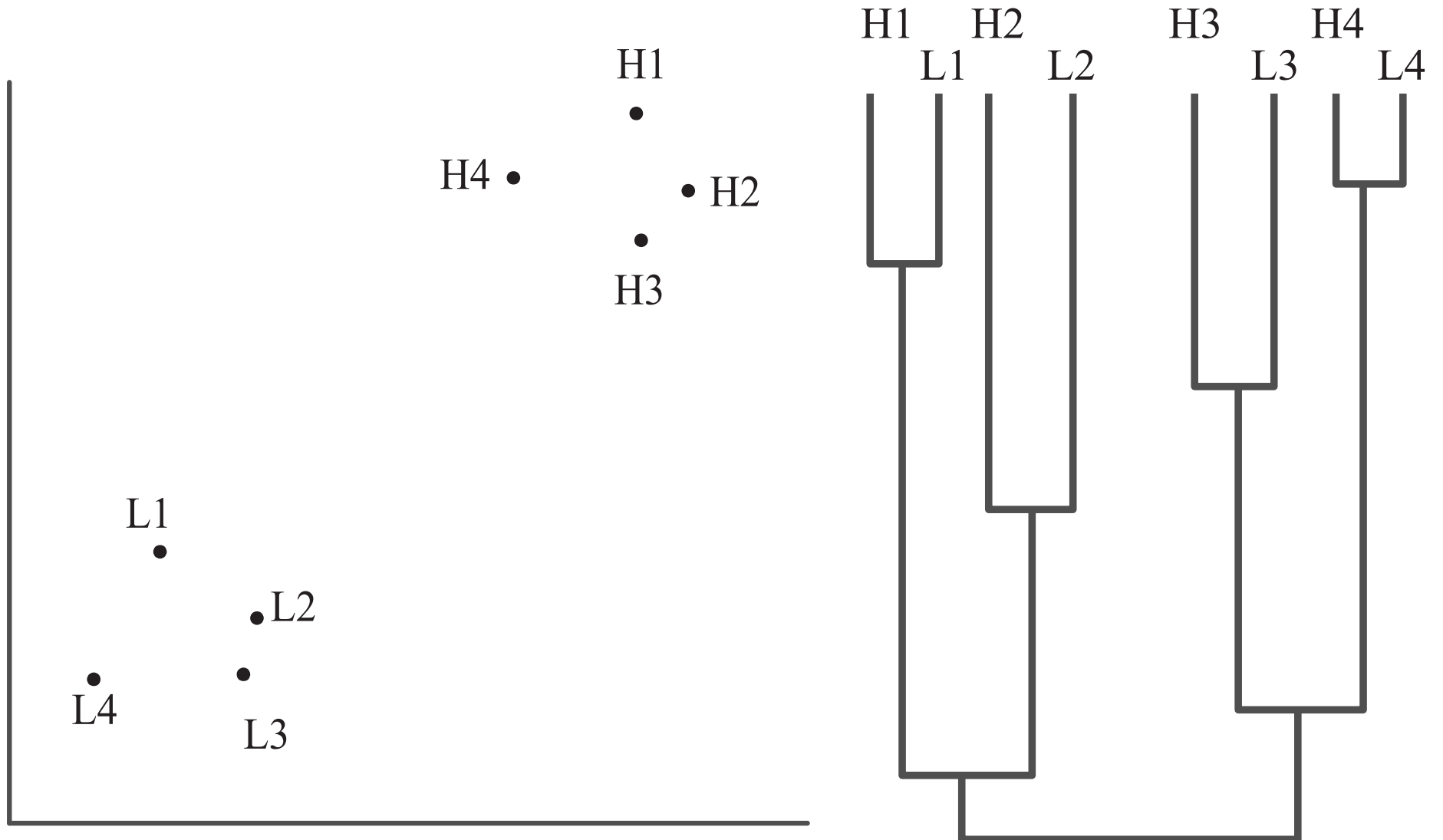


contrast	lat. offset	mass
H1 vs. H4	2.7	1.5
H2 vs. H3	1.0	1.1
H1,H4 vs. H2, H3	-3.9	3.0
L1 vs. L3	-2.0	2.8
L4 vs. L1, L3	-2.3	-0.9
L2 vs. L4, L1, L3	3.43	1.6
H vs. L	8.95	9.375

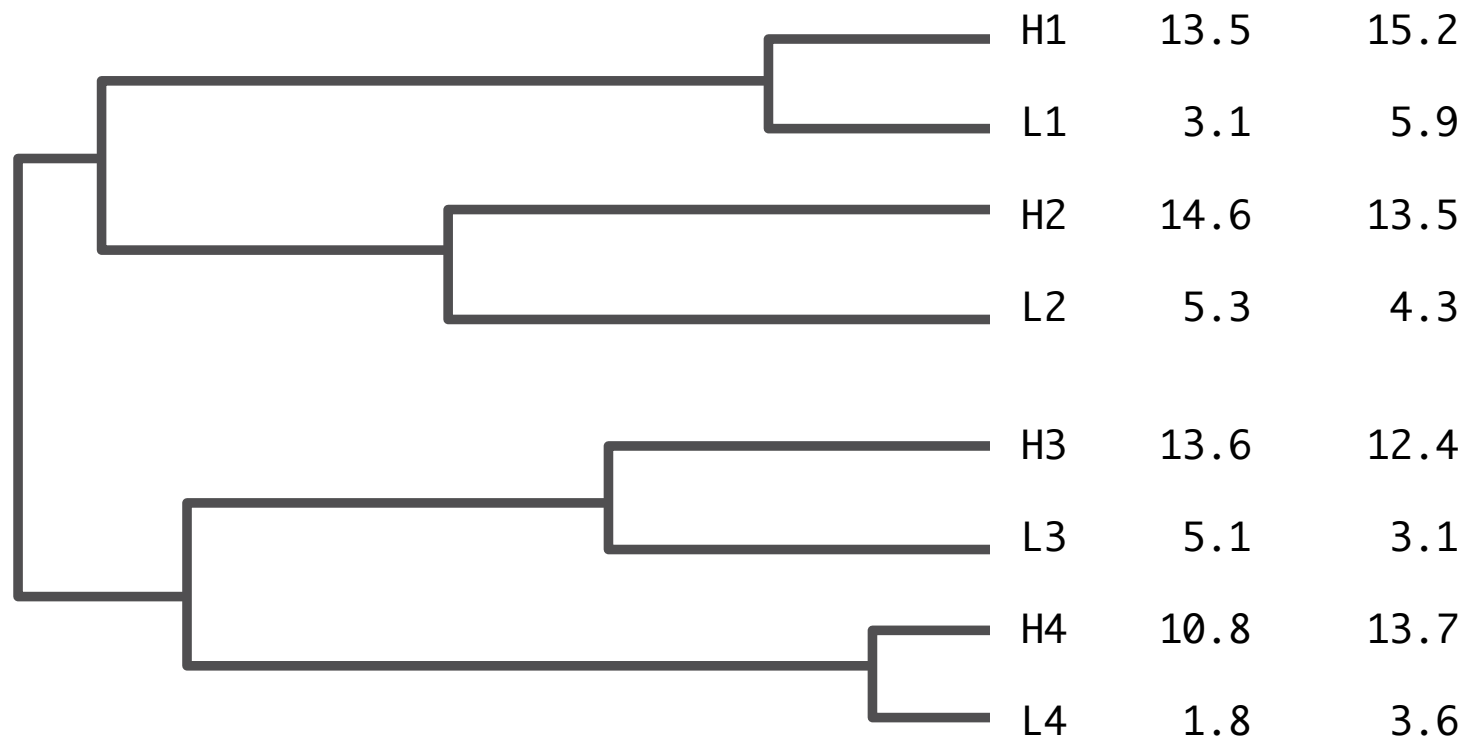
Contrasts do not shows strong evidence of correlation



Good evidence for correlation

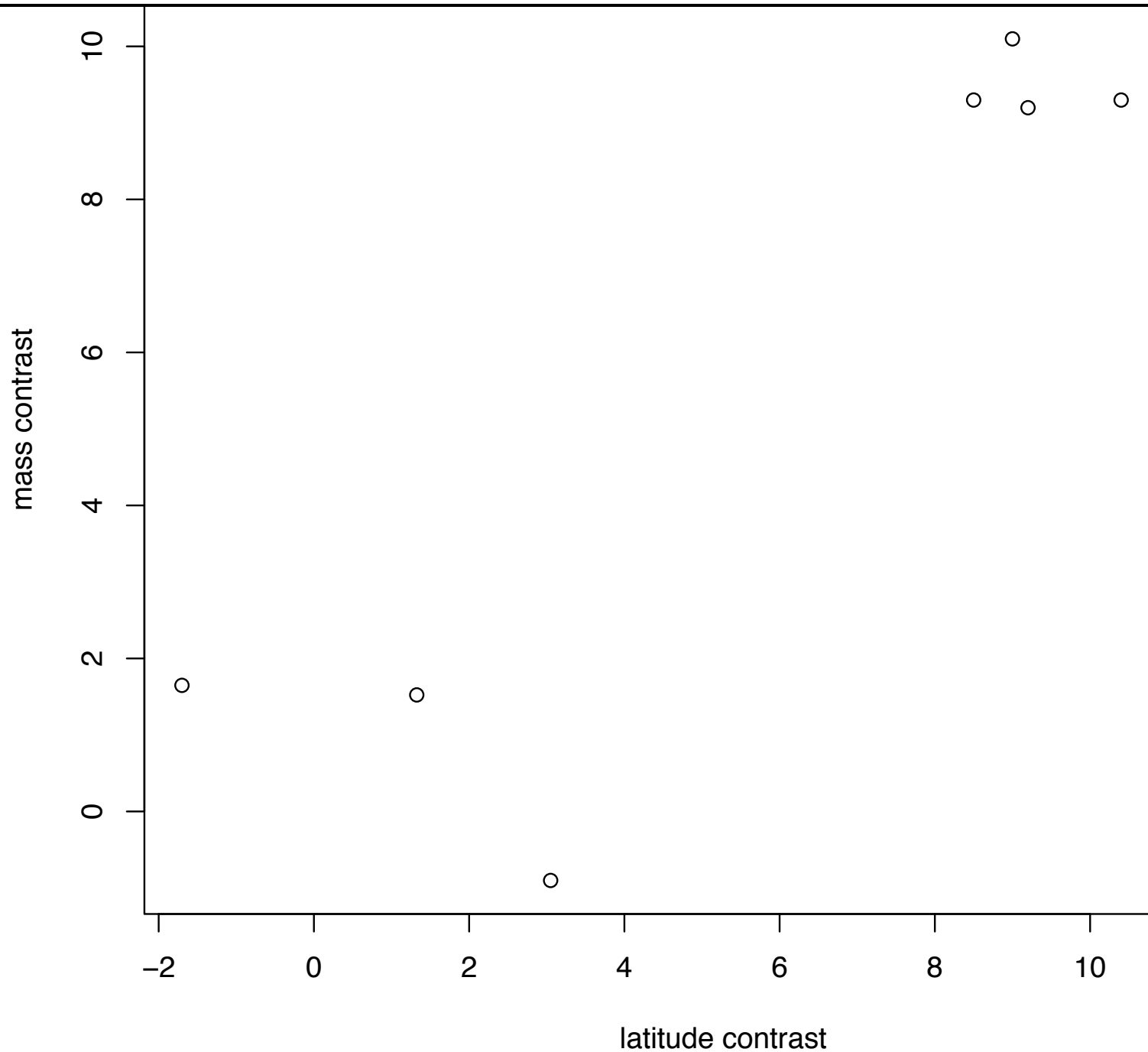


Good evidence for correlation



contrast	lat. offset	mass
L1 vs. H1	10.4	9.3
L2 vs. H2	9.2	9.2
L3 vs. H3	8.5	9.3
L4 vs. H4	9.0	10.1
L1, H1 vs. L2, H2	-1.7	1.65
L3, H3 vs. L4, H4	3.05	-.9
1, 2 vs. 3, 4	1.325	1.525

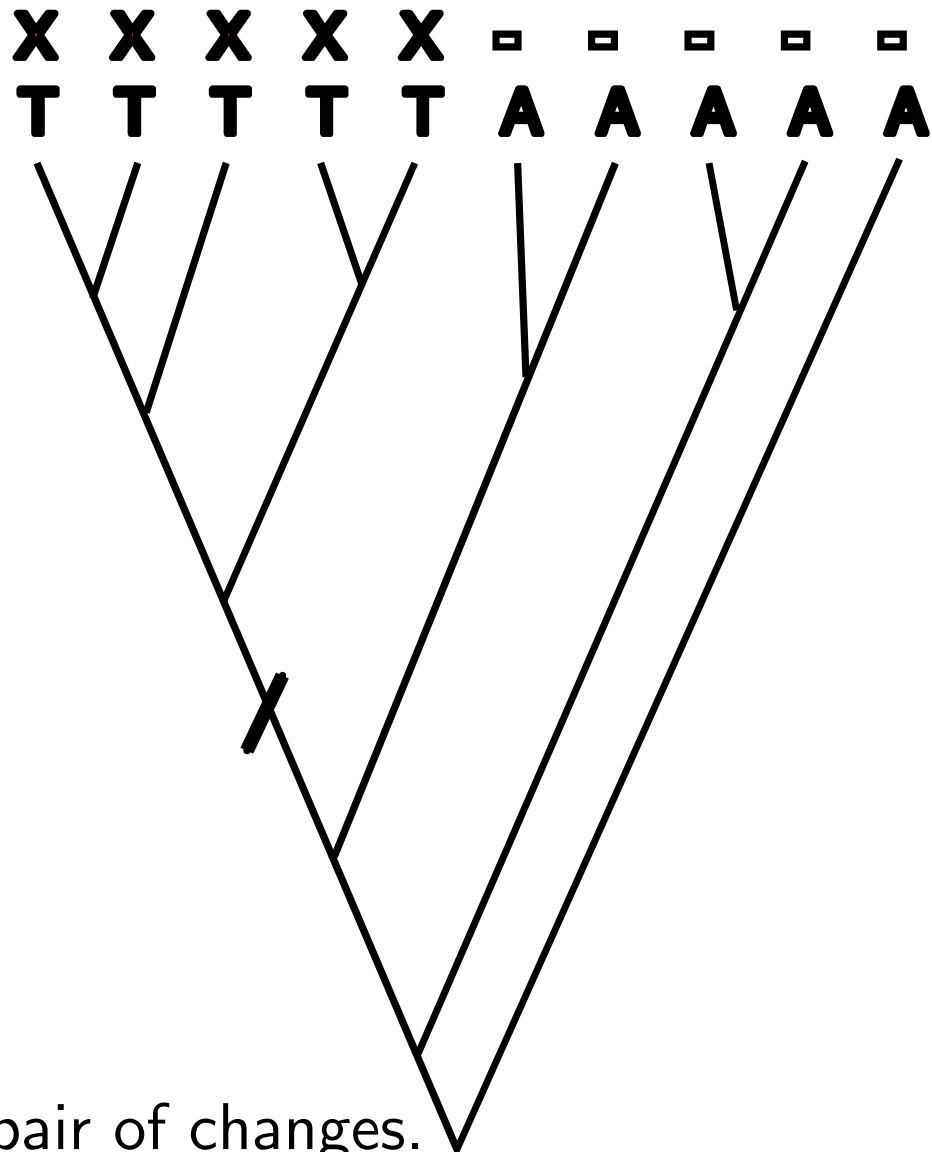
Now the contrasts do show strong evidence of correlation



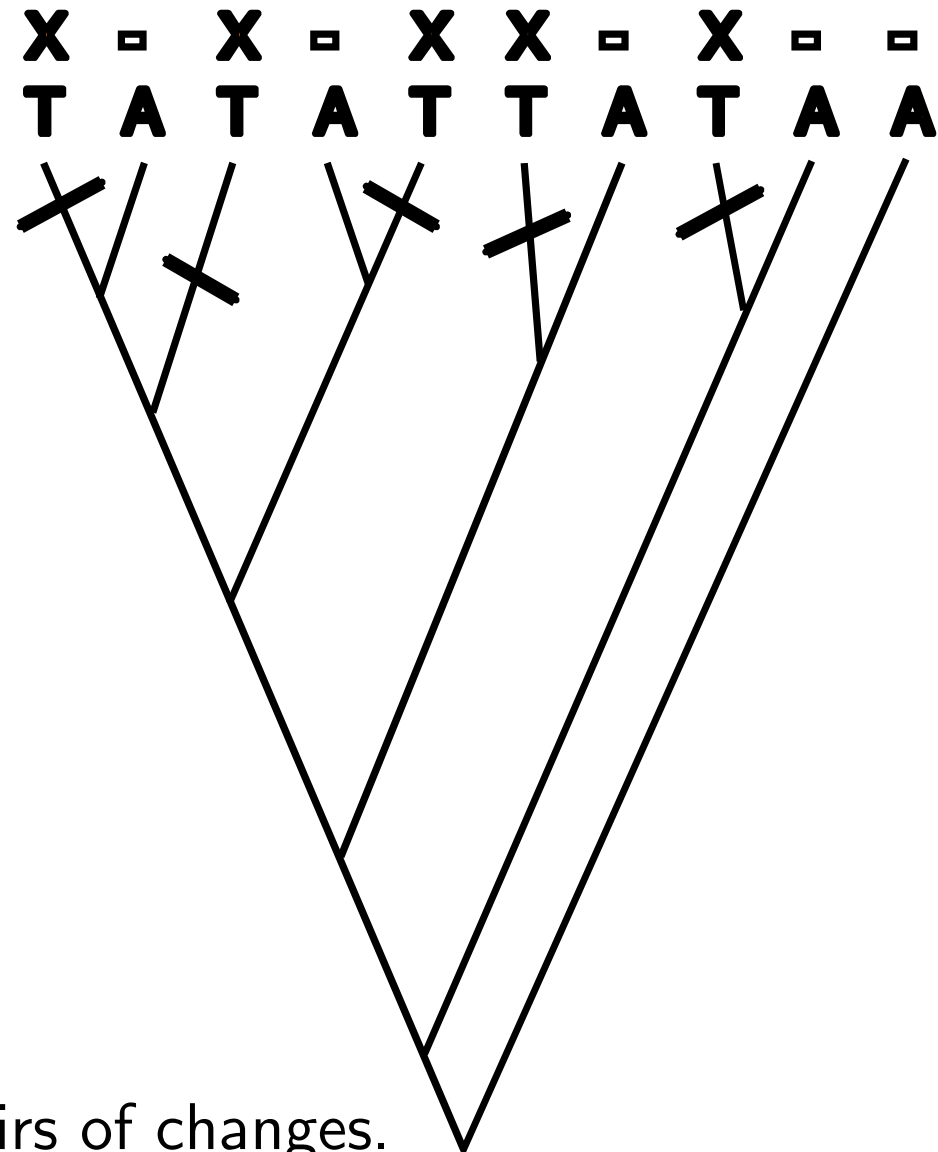
Are desert green algae adapted to high light intensities?

Species	Habitat	Photoprotection
1	terrestrial	xanthophyll
2	terrestrial	xanthophyll
3	terrestrial	xanthophyll
4	terrestrial	xanthophyll
5	terrestrial	xanthophyll
6	aquatic	none
7	aquatic	none
8	aquatic	none
9	aquatic	none
10	aquatic	none

Phylogeny reveals the events that generate the pattern



1 pair of changes.
Coincidence?



5 pairs of changes.
Much more convincing

Summary of Intro. to the course

Systematics:

1. Only science giving a vivid picture of the diversity of life.
2. Provides us with the data and methods to infer the phylogeny (or history) of life.
3. Reveals numerous interesting evolutionary phenomena (mimicry...)
4. Encompasses entire other branches of biology (e.g., biogeography, paleontology, macroevolutionary studies).
5. Prerequisite for application of comparative method.
6. Supplies classifications – great information storage and retrieval systems.

Failings of folk taxonomies for scientific purposes

1. “lump” species together too much
2. strongly under-represent some groups
3. Multiple names used for the same species vary over the range (according to cultural breaks)
4. Names are reused for different species (e.g. “robin”)
5. Groupings based on utility can obscure the most relevant biological relationships. (e.g. “fruit” and “vegetable”)
6. Lack of regulation means that names do not keep up with latest research.
7. Using native languages of different researchers would be cumbersome.



The basic needs of a biological taxonomic system

1. one specific name for each species
2. applicable to all organisms
3. standardized rules for constructing reasonable names and determining the correct name.
4. recognizable as a specific type of name – a scientific name.
5. international
6. having names that capture a crucial aspect of the organism biology would be helpful (this will turn out to be names that reflect the phylogeny)



Hull (1965) quoting Popper:

I use the name methodological essentialism to characterize the view, held by Plato and many of his followers, that it is the task of pure knowledge or 'science' to discover and to describe the true nature of things; i.e. their hidden reality or essence. It was Plato's peculiar belief that the essence of sensible things can be found in other and more real things – in their primogenitors or Forms. Many of the later methodological essentialists, for instance Aristotle, did not altogether follow him in determining this; but they all agreed with him in determining the task of pure knowledge as the discovery of the hidden nature or Form or essence of things. All these methodological essentialists also agreed with Plato in holding that these essences may be discovered and discerned with the help of intellectual intuition; that every essence has a name proper to it, the name after which the sensible things are called; and that it may be described in words. And a description of the essence of a thing they called a 'definition'

According to Aristotle you can know 3 things about any entity:

1. its essence
2. its name. The name applies to the essence.
3. its definition: a complete and exhaustive description of the essence

In such a definition: every property is *necessary*, and taken as a whole they are *sufficient* to fully describe the essence.

The “dark side” of Aristotle’s legacy

Aristotle’s emphasis on essences gave systematics:

1. the wrong way to approach species:
 - (a) Species in nature were to be defined.
 - (b) List the essential properties (each necessary, and jointly sufficient).
2. an unhelpful way to approach polymorphism

Both of these attitudes dominated through the 1800’s and had an impact in the 1900’s

	Essentialistic Class					Cluster Class					
Individuals:	1	2	3	4	5	1	2	3	4	5	
	A	A	A	A		A	A	A		A	
	B	B	B	B	B		B	B	B		
Class	C	C	C		C			C	C	C	
Characteristics:	D	D	D	D			D		D	D	
	E	E	E	E	E	E		E		E	
Class	Y	Y	Y	N	N	2/5	3/5	4/5	3/5	4/5	(fuzzy set)
Membership:						N	Y	Y	Y	Y	(min. quorum three)
						N	N	Y	N	Y	(min. quorum four)

From Stamos (2005)

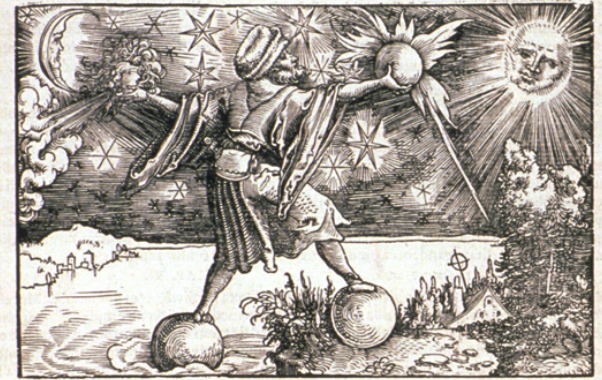
Gaius Plinius Secundus
(Pliny the Elder)
 (23 - 79)



"...[mandragora is] given for injuries inflicted by serpents and before incisions or punctures are made in the body, in order to insure insensibility to pain. Indeed for this last purpose, for some persons the odour is quite sufficient to induce sleep."

Thus aristocratic Roman author Pliny in *Historia Naturalis* (c.77 AD) describes what would later be known as inhalation anaesthesia. Pliny also relates how smelling the burning skin of a pregnant crocodile could render a patient oblivious of the surgeon's knife; but this notion has not been tested in the modern era.

C. PLINII
SECUNDI NATURALIS
HISTORIAE LIBER
SECUNDVS.



An sit mundus, & an vnus.

CAP. I.

MVNDVM † & hoc, quod nomine alio caelum appellare libuit, cuius circumflexu teguntur cuncta, numen esse credi par est, æternum, immensum, neq; genitum, neq; interitum vnquam. Huius extræ indagare, nec interest hominum, nec capit humanæ coniectura mentis. Sacer est, æternus, immensus, totus in toto, imò verò ipse totum: finitus, & infinito similis: omnium rerum certus, & similis incerto: extrâ, intrâ, cuncta complexus in se, idemq; rerum naturæ opus, & rerû ipsa natura. Furor est, mensuram eius animo quosdam agitalle, atq; prodere aulos: alios rursus occasione hinc sumpta, aut his data, innumerabiles tradidisse mûdos, vt totidem rerû naturas credi oporteret: aut, si vna omnes incubaret, totidem tamen Soles, totidemq; Lunas, & cætera etiam in vno & immensa, & innumerabilia sidera: quasi non eadem quæstione semper in termino cogitationis occurrere, desiderio finis alicuius: aut, si hæc infinitas naturæ omnium artificii possit assignari, non illud idem in vno facilius sit intelligi, tanto præsertim opere. Furor est, profecto furor, egressi ex eo: & tanquam interna eius cuncta planè iam sint nota, ita scrutari extræ: quasi verò mensuram vilius rei possit agere, qui sui nesciat: aut mens hominis videre, quæ mundus ipse non capiat.

De forma eius.

CAP. II.

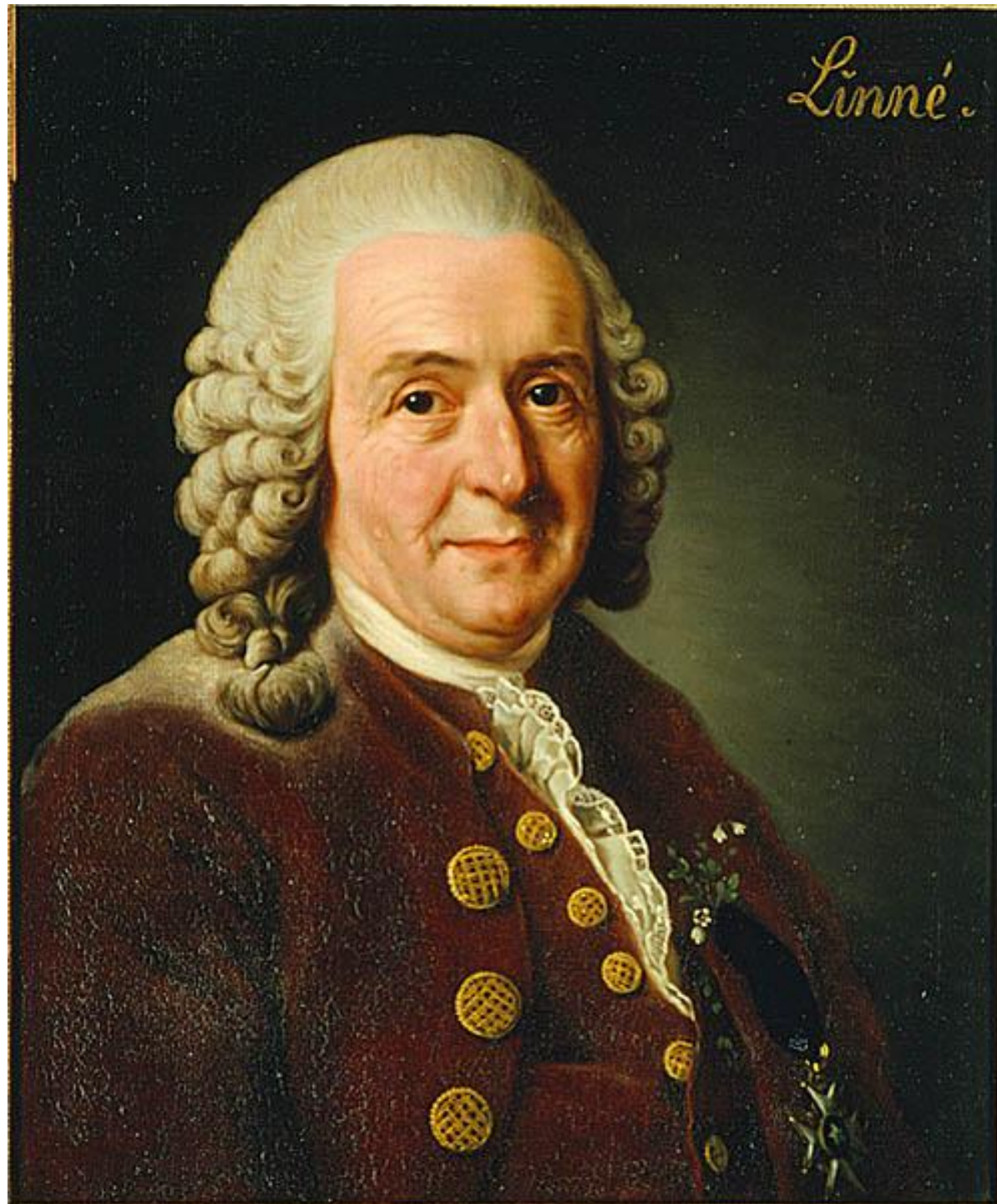
Forma eius in speciem orbis absoluti globatam esse, nomen in primis & consensus in eo mortalium, orbem appellantium, sed & argumenta rerum docent: non solum quia talis figura omnibus sui partibus vergit in se, ac sibi ipsa toleranda est, seque includit & continet, nullarû gens compaginum, nec finem aut initium vllis sui partibus sentiens, nec quia ad motum, † quo subinde verti debeat (vt mox apparebit) talis aptissima est: sed oculorum quoque probatione, quod conuexus mediusque quacunque cernatur, quum id accidere in alia non possit figura.

De motu eius.

CAP. III.

Hanc ergo formam eius, æterno & irrequieto ambitu inenarrabili celeritate, viginti quatuor horarum spatio circumagi, Solis exortus & occasus haud dubiû reliquere. An sit immensus, & ideo sensum aurium facillè excedens, tantæ molis rotatæ vertigine assidua sonitus, non equidem facillè dixerim, non hercle magis, quàm circumactorum simul tinnitus siderum, suosque voluentium orbis: an dulci quidem & incredibili suauitate concentus, nobis qui intus agimus, iuxta diebus noctibusq; tacitus labitur mundus. Esse innumeras ei effigies animalium rerumq; cunctarum impressas, nec (vt in volucrum notamus ouis) læuitate continua lubricum corpus, quod clarissimi

A. auctores



Carl Linnaeus

Contributions of Linnaeus

Mainly the impact of *Systema Natura*. By the 10th edition it was an exhaustive list of species known to science with:

1. binominal nomenclature
2. telegram-style diagnoses
3. standardization of synonymies
4. classification by hierarchy

He also contributed many other systematic procedures (particularly in botanical systematics – terminology for plant morphology including standardization of sexual characters)

References