Papers as Stories

Every paper tells a story

- In fiction, a “story” sets up and then resolves an interesting question in the reader’s mind.
- How? By exposing *characters* to a *plot.*
- **A paper does the same thing.**
- **Question:** what did you set out to learn?
- **Characters:** field site, equipment, equations, etc.
- **Plot:** experiments, data analysis, model results, etc.

- There’s no story without the reader. Your paper isn’t written for you.

What your paper **is not**

- Your paper is not a diary.
- Your paper is not a recipe.
- Your paper is not an encyclopedia.

What your paper **is**

- Your paper is **designed** to tell the reader the thing(s) you've **decided they need to know**.

The Minisummary

- The minisummary is a 2-3 sentence distillation of your paper.
- It includes the central question and its major answer.
- But no reader will ever see it – it’s a device for you.

The Minisummary

Stars form as clouds of interstellar dust and gas collapse under their own gravity. As a dense core (protostar) forms, gravitational potential energy is converted to heat. The heated material emits radiation, supplying an outward force (radiation pressure) that increasingly opposes the gravitational pull on the remaining matter in the cloud. Matter accretes to the protostar until it has become large enough and hot enough for radiation pressure to balance gravitational pull.

This process is well understood for small stars, but not for larger ones. The simplest models suggest that radiation pressure should become too strong for further accretion before the protostar can reach such masses. One possibility is that radiation doesn't escape equally in all directions, but rather in concentrated jets that clear away material in one direction but allow accretion from others (Banerjee and Pudritz, 2007). Another is that massive stars form at the center of star clusters, where accretion can be driven by the combined gravity of many proostars (Bonnell and Bate, 2006).

The rival models of massive-star formation make different predictions about the appearance of massive protostars and their distribution in space. This is testable with sufficient data. Regions of massive-star formation include Orion, Eagle, and Carina Nebulae.

The Minisummary

You have used the new ALMA (telescope array) to image the Eagle, Orion, and Carina Nebulae, where new massive stars are being formed. What story will you tell?

Minisummary #1: ALMA provided the most detailed images ever made of the Orion, Eagle, and Carina Nebulae. I explain how ALMA works, and show some of the images.

Minisummary #2: I present images of star forming regions in the Orion, Eagle, and Carina Nebulae, taken at 8 wavelengths from 0.4 to 10mm. They show many protostars, some in groups.

Minisummary #3: I outline what we know about star formation and stellar evolution. I present ALMA images of massive protostars at various stages of stellar evolution.

Minisummary #4: If massive stars form with gravitational assists from their neighbors, then massive protostars should always appear among other protostars. However, solitary massive protostars are common in ALMA images of the Orion, Eagle, and Carina Nebulae.

The wordstack

Figure 7.1. My wordstack for this chapter.

cohesive story. . . . "thesis"
?titles - shortest summary of story
outline
story about how I thought I didn't do outlines
when to outline – when story is ready; vs. to find the story
head and subheads as coarse outline
topic sentences as detailed outline
what goes in and doesn't, and what order

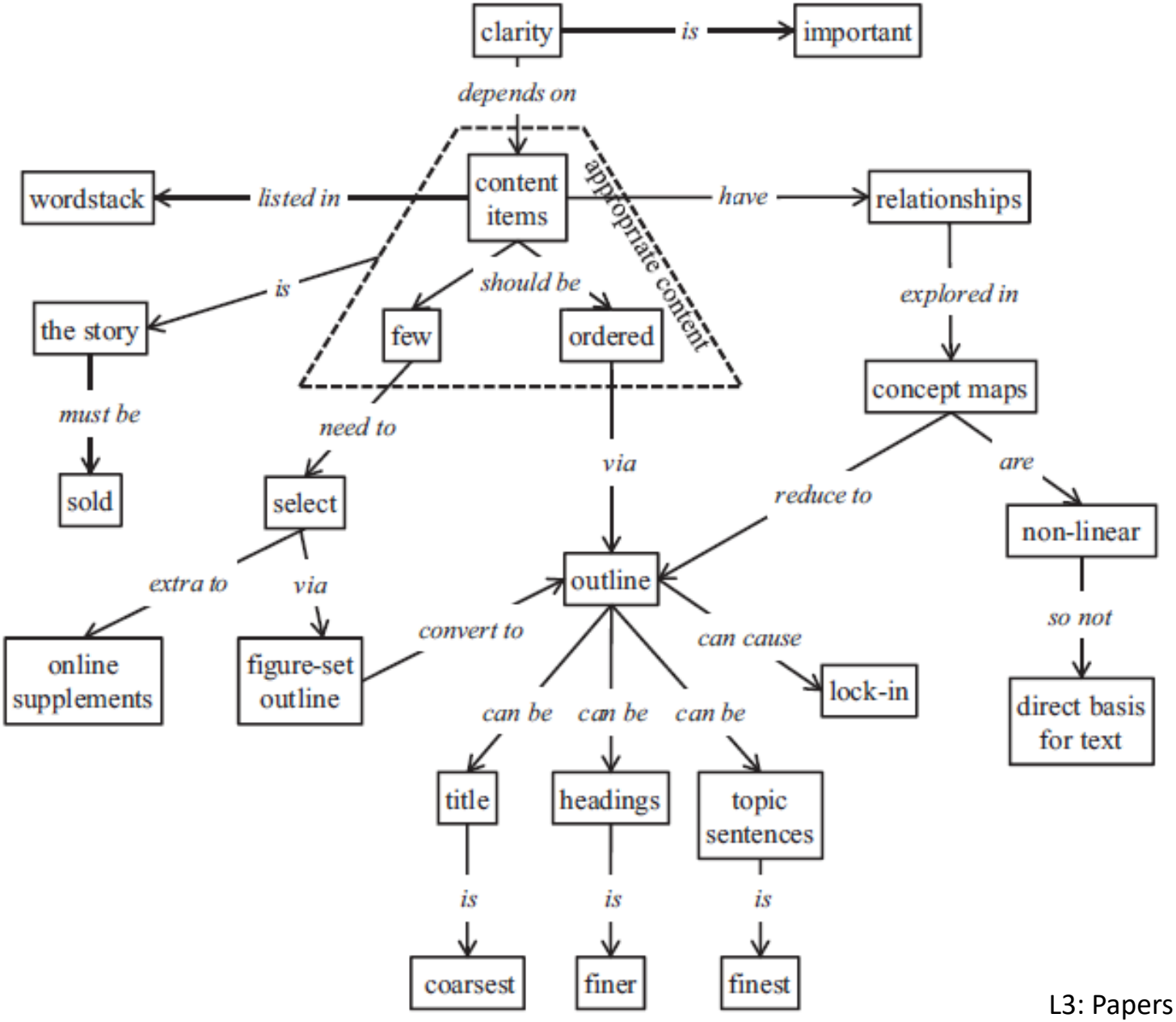
not everything you did
not in the order you did it

concept map: non-linear
intermediate step to outline
despite HTML, basic form still linear
wordstack/idea pile

first step
accumulate pre-writing

?Cahill – "pitch"
fail to consider story: leads to overlong, poorly organized MS
IMRaD structure

Concept mapping



Outlining

Figure 7.3. My outline for this chapter.

1. The concept and importance of your "story"
    - 1.1 what's a "story" (simple, clear direction)
    - 1.2 importance of story
2. Planning the story
    - 2.1.1 wordstack
    - 2.1.2 concept map
    - 2.1.2.1 use in learning
    - 2.1.2.2 use in writing
    - 2.1.3 outlines
    - 2.1.4 story summary
    - 2.1.5 subhead outline
    - 2.1.6 topic-sentence outline
    - 2.1.7 figure-set outline
    - 2.1.8 title
3. Hindsight storytelling
4. Revising the outline
5. Online supplements
6. Selling the story

The story summary

The story summary consists of the answers to 9 questions:

1. What is the central question?
2. Why is this question important?
3. What data are needed to answer the question?
4. What methods are used to get those data?
5. What analysis must be applied for the data to answer the question?
6. What data were obtained?
7. What were the results of the analysis?
8. How did those results answer the central question?
9. What does this answer tell us about the broader field?

The subhead outline

The subhead outline is based on IMRaD structure

1. Introduction
    - 1.1 Context in the field
    - 1.2 Our central question
    - 1.3 Our approach to the question
2. Methods
    - 2.1 Study species and field site
    - 2.2 Experimental methods
    - 2.3 Statistical analysis
3. Results
    - 3.1 The first experiment
    - 3.2 The second experiment
4. Discussion
    - 4.1 How results answer the question
    - 4.2 Possible weaknesses, loose ends
    - 4.3 Broader implication for the field

The topic-sentence outline

- Each paragraph in your paper will have a topic sentence.
- All your (intended) topic sentences can be a detailed outline
- Differs from subhead outline: each point is a statement, not a topic

- For example:

  not “3.1 The first experiment”,

  but “B-amaridine treatment of cell cultures led to dramatically increased differentiation of apparent vascular tissue”.

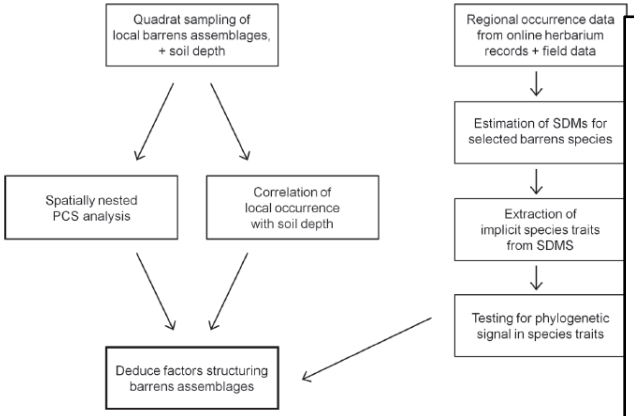
Figure shuffling

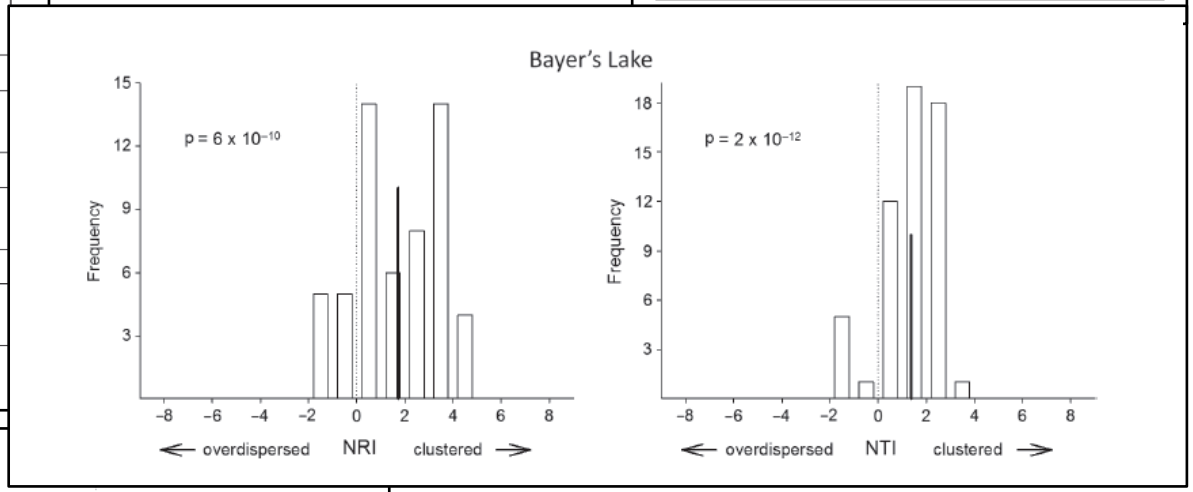
Table 1. NRI, NTI and p-values for each site and region. Bold: significant ($p < 0.05$) phylogenetic structure versus random null; italic, suggestive ($p < 0.10$) phylogenetic structure.

Sites and regions	NRI	p	NTI	p
Clarendon North	**2.48**	**0.02**	1.31	0.10
Clarendon South	**−1.64**	**0.03**	**−1.69**	**0.03**
Bayers Lake	1.15	0.14	*−1.52*	*0.06*
Spryfield	0.84	0.20	−0.47	0.33
Clarendon	0.15	0.41	0.61	0.27
Halifax	0.53	0.98	**−1.81**	**0.02**

Table 3. *K*-statistics (phylogenetic signal) for environmental-response traits (linear and quadradic coefficents from Maxent SDMs). Bold: significant phylogenetic conservatism ($p < 0.05$); italic: suggestive phylogenetic conservatism ($p < 0.10$).

Variables	K_{linear}	p	$K_{quadratic}$	p
PDQ	**1.02**	**0.01**	*1.39*	*0.07*
TWI	**1.11**	**0.03**	0.28	0.88
Altitude	0.38	0.69	0.55	0.31
TAR	0.49	0.49	1.11	0.39
MTWQ	0.34	0.80	0.97	0.37
Easting	0.81	0.15	0.43	0.52
Northing	0.30	0.88	0.36	0.74
Slope	0.32	0.79	0.36	0.76
TPI	0.33	0.77	0.31	0.76





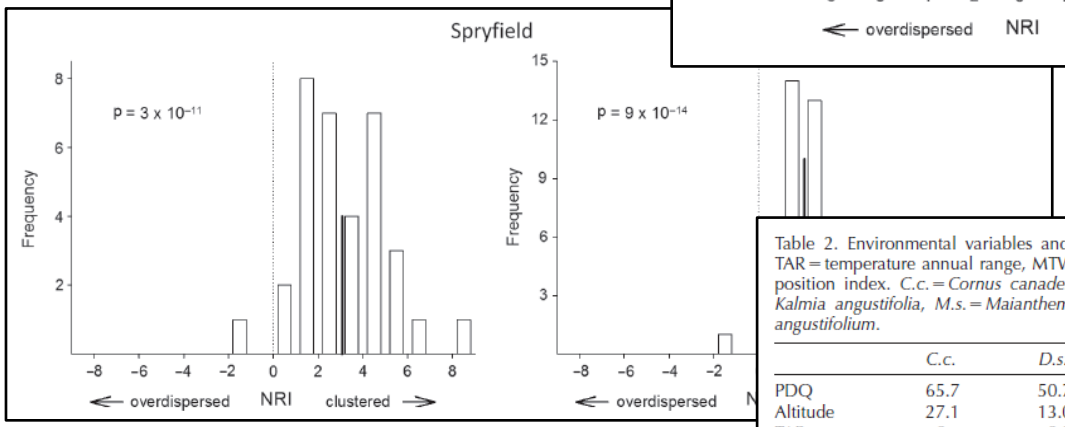


Table 2. Environmental variables and their respective contributions to the species distribution. PDQ = precipitation of driest quarter, TAR = temperature annual range, MTWQ = mean temperature of wettest quarter, TWI = topographic wetness index and TPI = topographic position index. *C.c.* = *Cornus canadensis*, *D.s.* = *Danthonia spicata*, *G.p.* = *Gaultheria procumbens*, *G.b.* = *Gaylussacia baccata*, *K.a.* = *Kalmia angustifolia*, *M.s.* = *Maianthemum canadense*, *R.c.* = *Rhododendron canadense*, *S.t.* = *Sibbaldiopsis tridentata*, *V.a.* = *Vaccinium angustifolium*.

	C.c.	*D.s.*	*G.p.*	*G.b.*	*K.a.*	*M.c.*	*R.c.*	*S.t*	*V.a.*
PDQ	65.7	50.7	40.9	42.1	86.4	62.3	55.0	63.4	64.9
Altitude	27.1	13.0	21.4	0.6	2.1	4.3	20.0	20.8	16.3
TAR	0	0.2	0.3	0.1	0	0	0	0.1	0.5
MTWQ	0.4	9.7	23.6	42.5	4.9	0.1	0	3.0	10.7
Easting	0.1	7.7	0.9	0.5	2.1	7.5	0	5.1	0
Northing	1.7	9.1	6.4	7.5	1.2	17.9	20.0	0.8	1.8
Slope	4.7	0.2	6.5	0.2	0.2	4.0	1.9	1.6	2.0
TPI	0	1	0	0	2.0	0	3.3	0.1	3.2
TWI	0.4	8.4	0	6.6	1.0	3.8	0.1	5.2	0.6

Don’t be a slave to your outline

- An outline is a guide; but your story can change as you write it.
- An outline ignored is useless; but an outline as handcuffs blocks improvement.
- Use an outline like a cruise control: have it force you to ask yourself, “will this change make my paper better?”

Today's workshop

Outlining three ways

- Choose (as a group) a paper (can be the one from last time).
- Write a 2-sentence mini-summary.

*Note: the summaries won't be comprehensive, and you aren't trying to recreate the **actual** paper – you will likely make different choices than the authors did. If you don't understand every detail of the paper, that's OK – make up something plausible.*