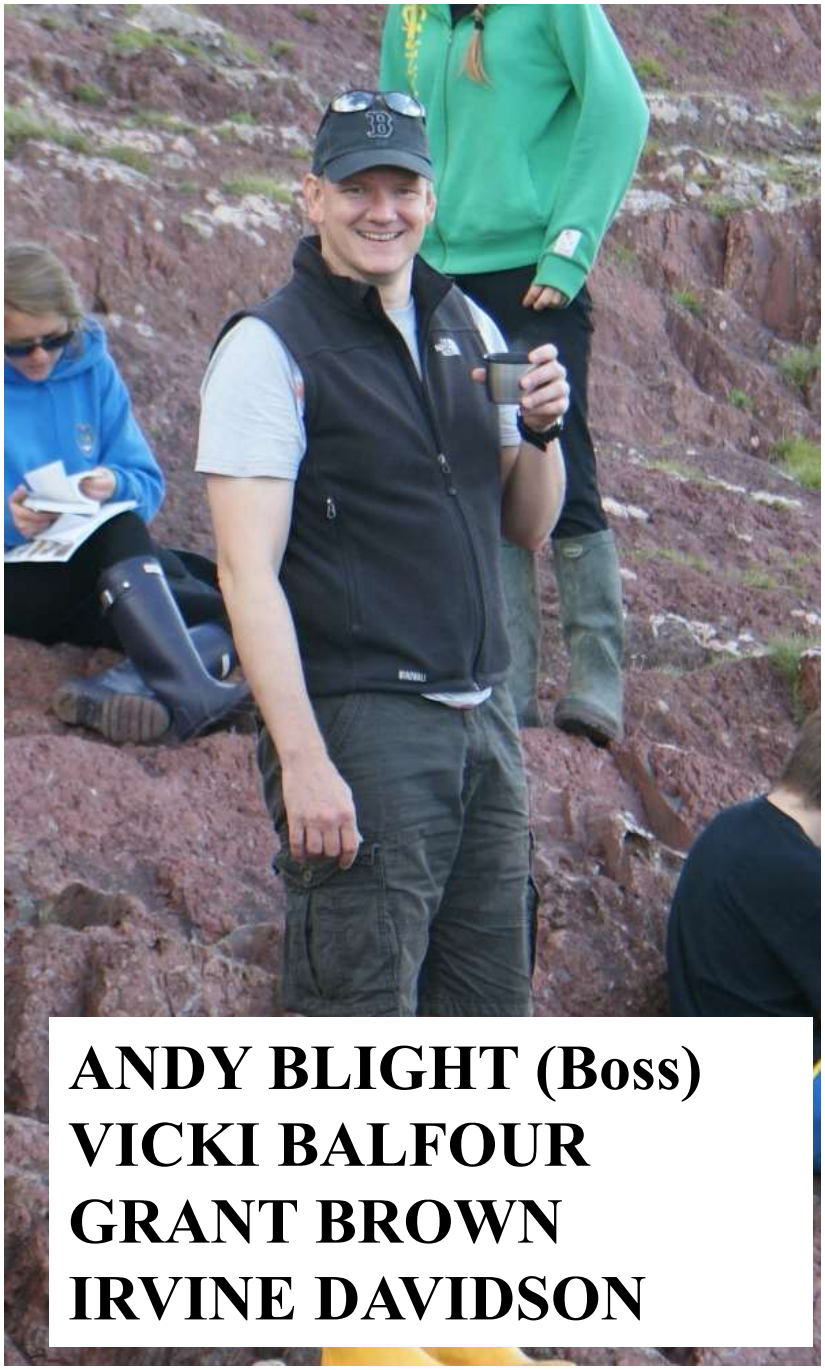
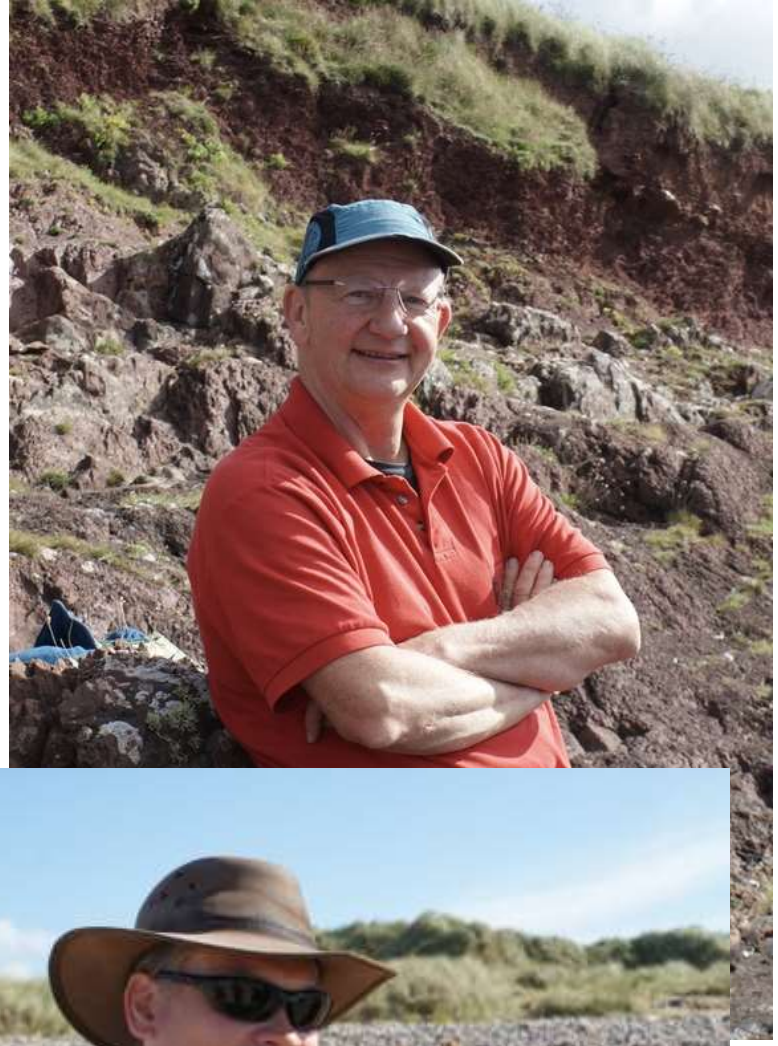
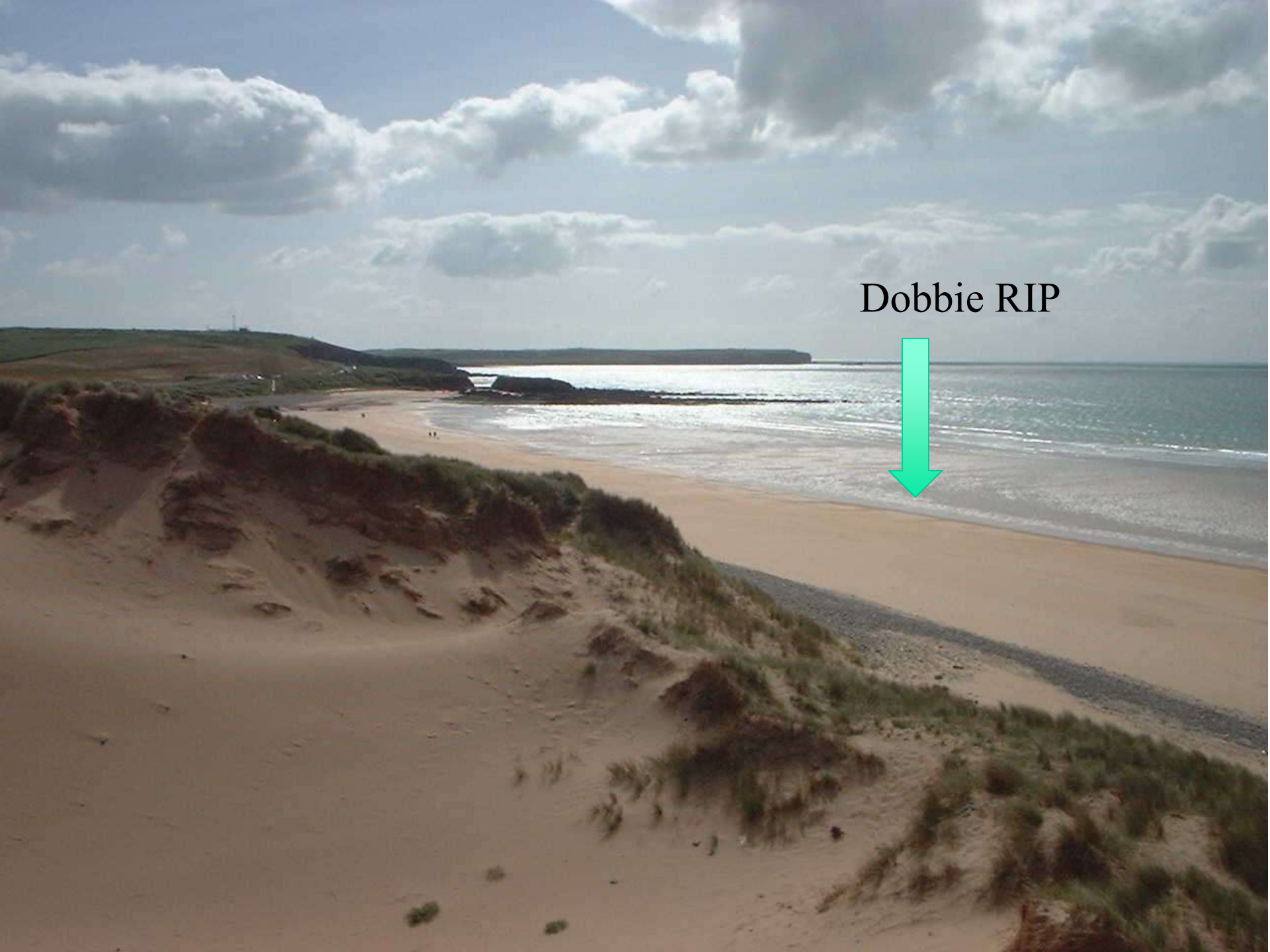
WELCOME TO ST ANDREWS ON TOUR: ORIELTON 2019



ANDY BLIGHT (Boss)
VICKI BALFOUR
GRANT BROWN
IRVINE DAVIDSON



FAITH JONES
SUE HEALY
DAVID PATERSON
DAVID SHUKER


Dobbie RIP

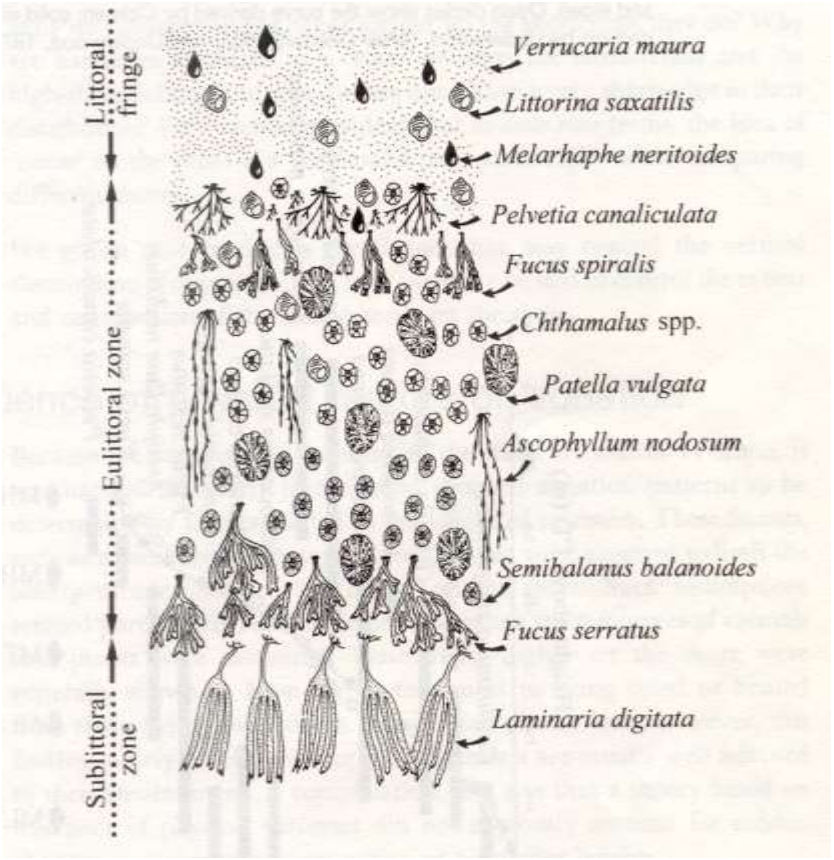
The classical ecological laboratory of the rocky coastline

Joseph Connell, Rocky Shore Biologist

Algae and animals are found in distinct bands (or zones) at particular vertical heights along the area between low and high tide.

The intertidal is the fringe of the sea bed between the highest and lowest extent of the tides

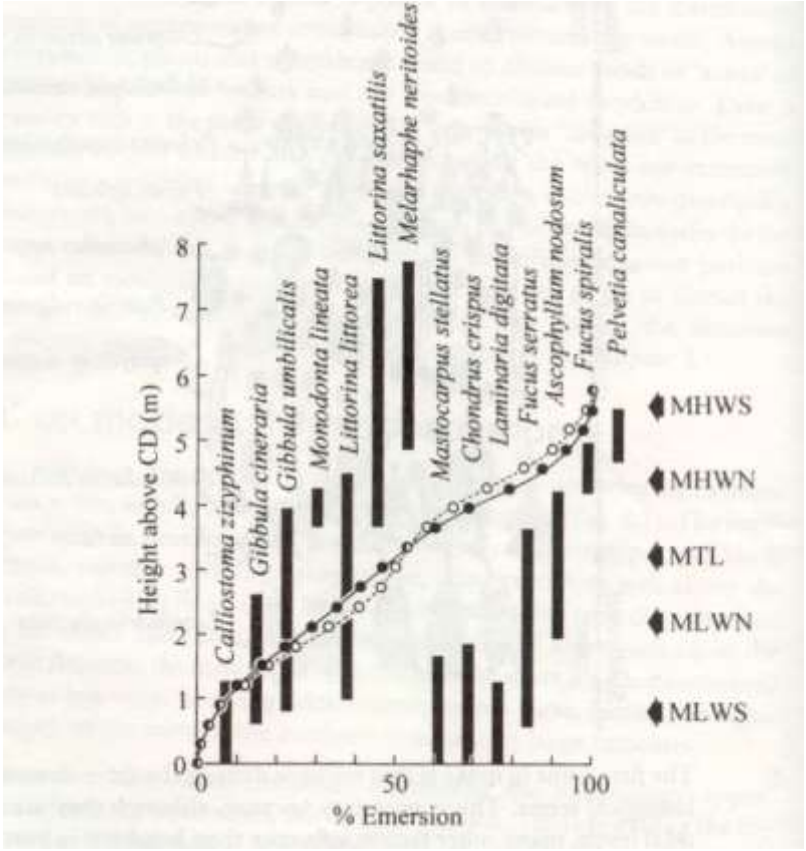
In 1949 Stephenson & Stephenson proposed a universal scheme of zonation for rocky shores



Littoral fringe

Eulittoral zone

Sublittoral zone

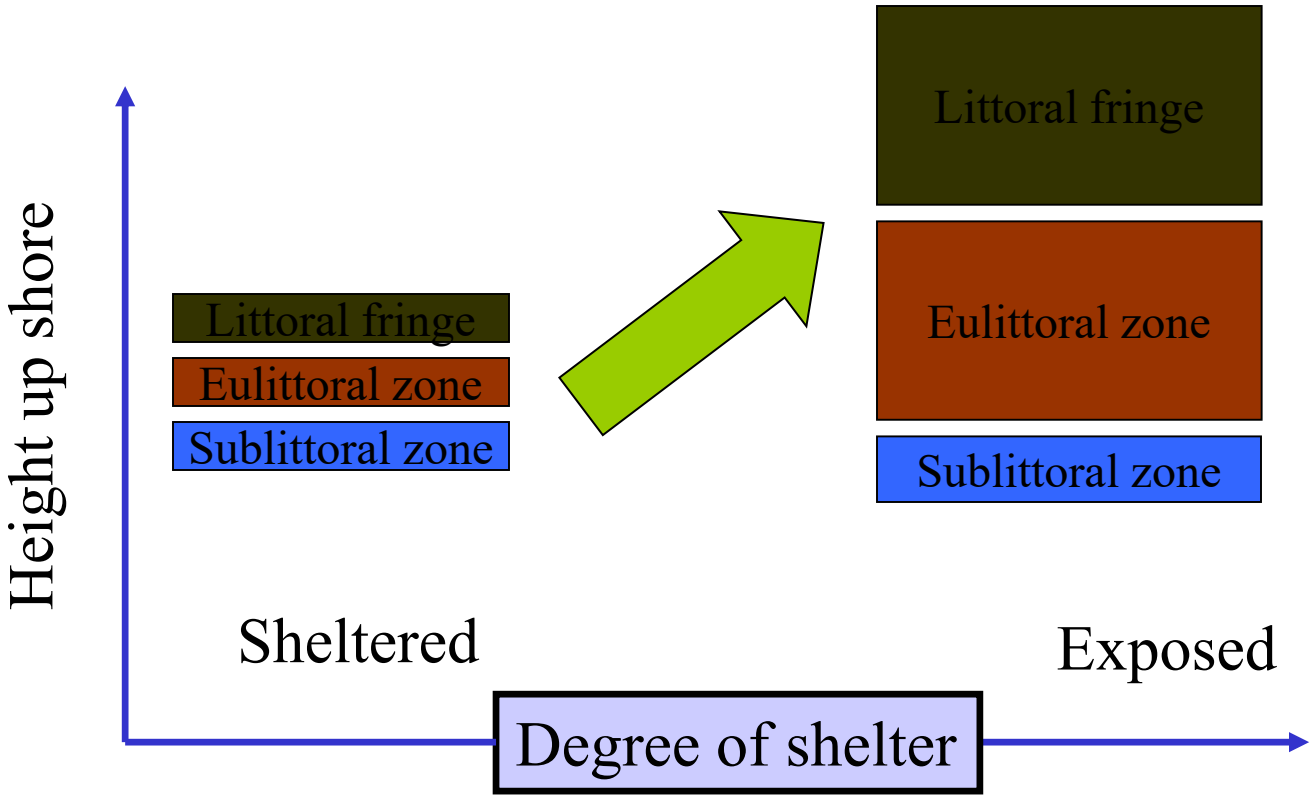


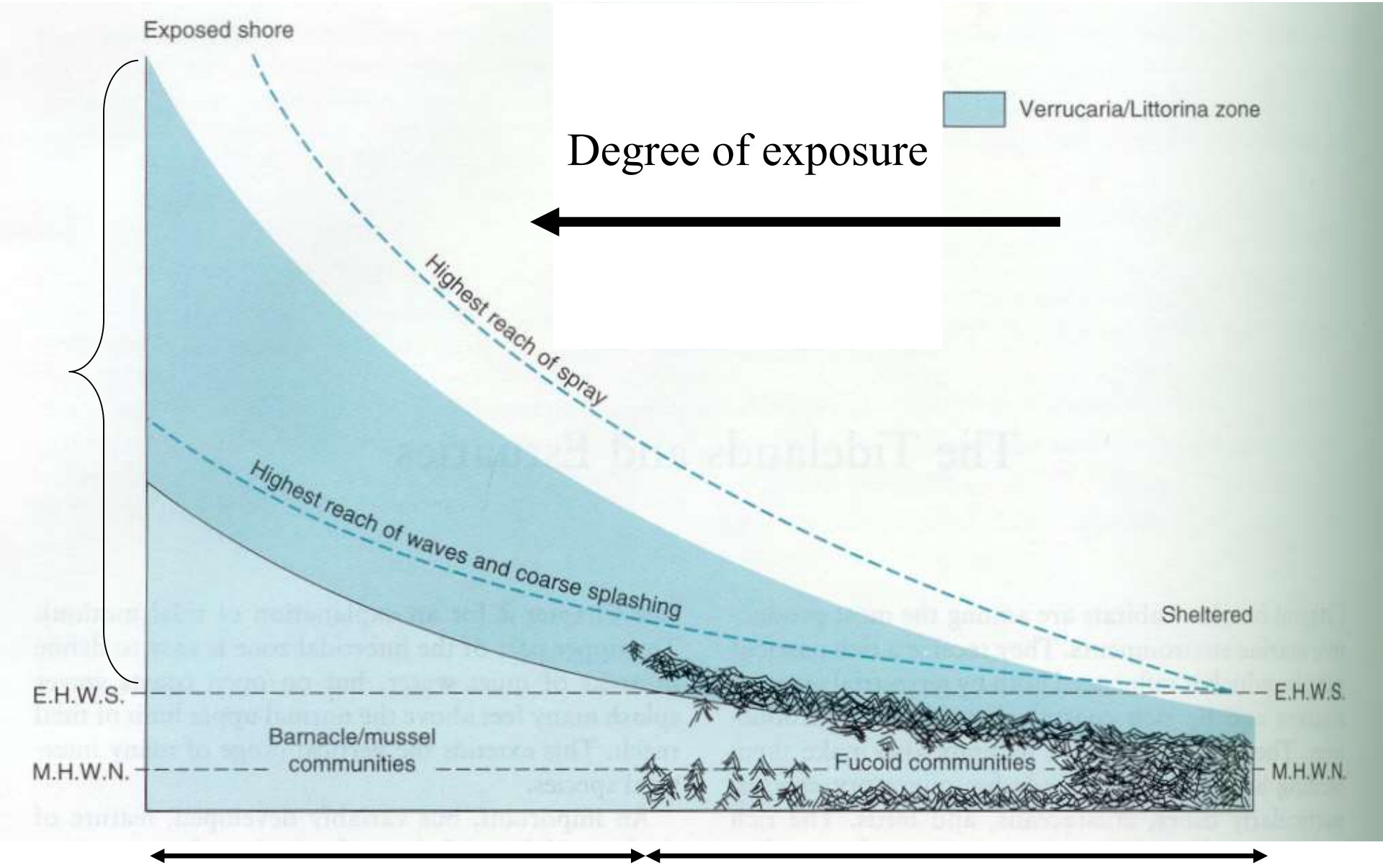
Colman (1933)
Underwood (1978)

- **Animals and plants have overlapping distributions**
- **Clearly 3 zones is over simplified**
- **Biological definitions often used but many other influencing factors**
- **Therefore the Zonation concept is useful but we must be aware of its limitations**

Beware of "Context dependency"

Exposure
Fetch

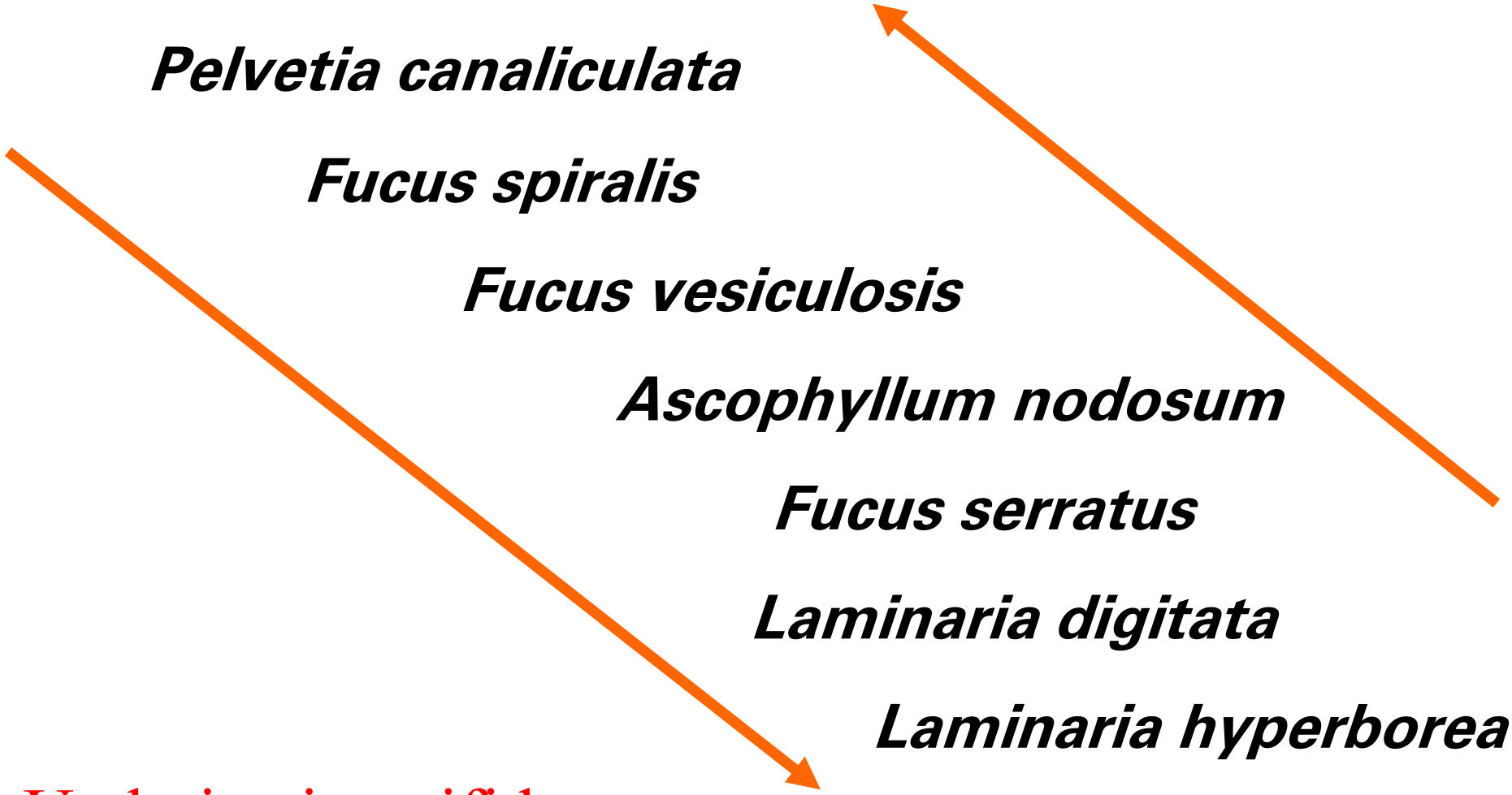

Height up shore
Littoral fringe
Eulittoral zone
Sublittoral zone
Littoral fringe
Eulittoral zone
Sublittoral zone
Sheltered
Exposed
Degree of shelter

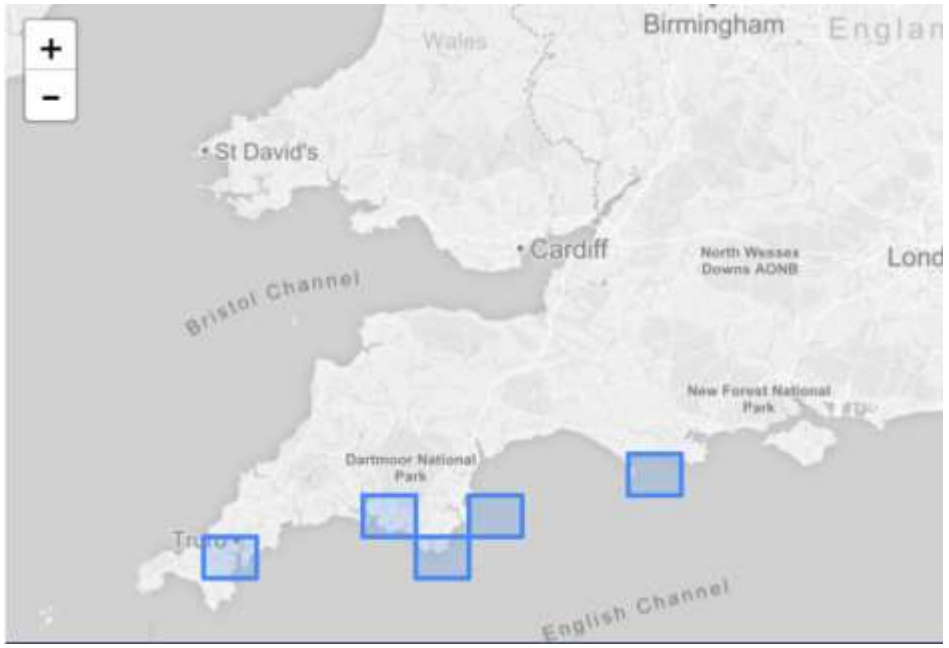

Exposed shore
Verrucaria/Littorina zone
Degree of exposure
Highest reach of spray
Highest reach of waves and coarse splashing
Sheltered
E.H.W.S.
E.H.W.S.
Barnacle/mussel communities
Fucoid communities
M.H.W.N.
M.H.W.N.

The effects of exposure on algal form

Durvillaea antarctica (New Zealand): the strongest kelp in the world?

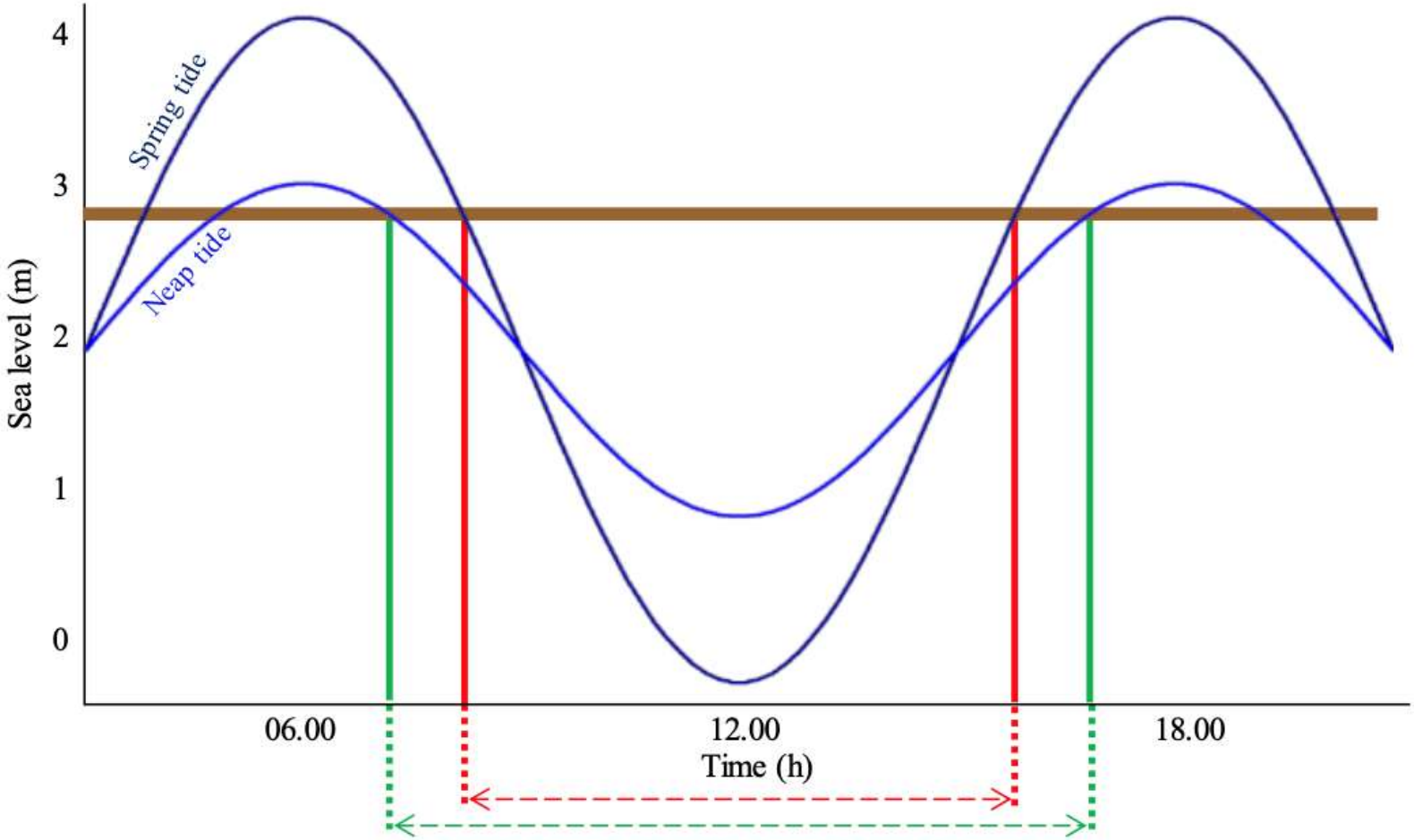
TYPICAL ZONATION PATTERN: SHELTERED SHORE





Undaria pinnatifida

Wakame


4
3
2
1
0
Sea level (m)
Spring tide
Neap tide
06.00
12.00
18.00
Time (h)

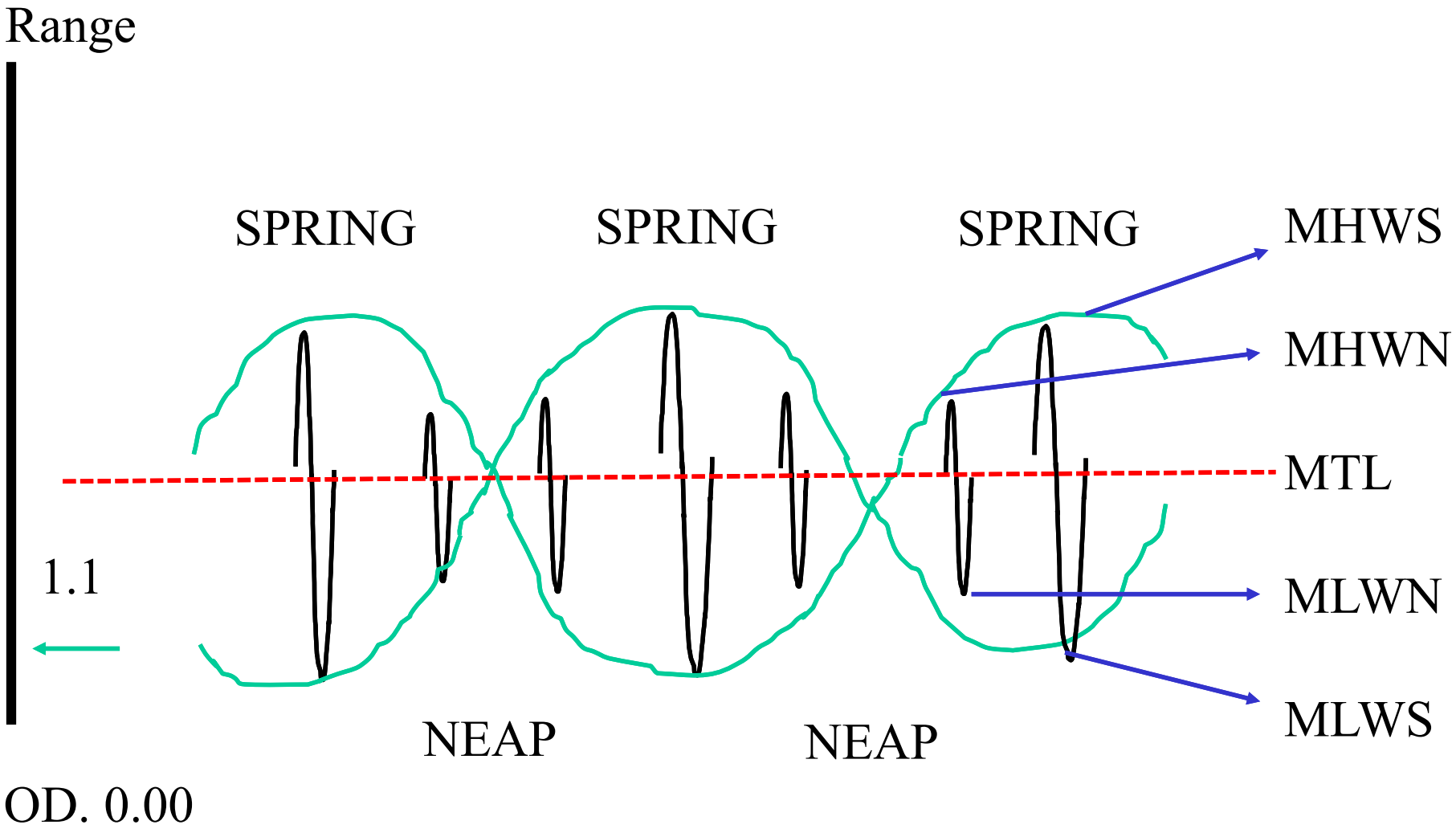


Chart datum:
Lowest level

Control of algal vertical zonation?

- **Hypothesis 1**: Zonation controlled by dispersal and settlement of propagules
- **Hypothesis 2**: Exposure: Physically controlled and directly related to tidal level, linked to physiological capabilities
- **Hypothesis 3**: Competition for space
- **Hypothesis 4**: Grazing

Hypothesis 1: Zonation controlled by dispersal and set

- Most intertidal organisms produce propagules that enter the plankton and each new generation must recolonise the shore.

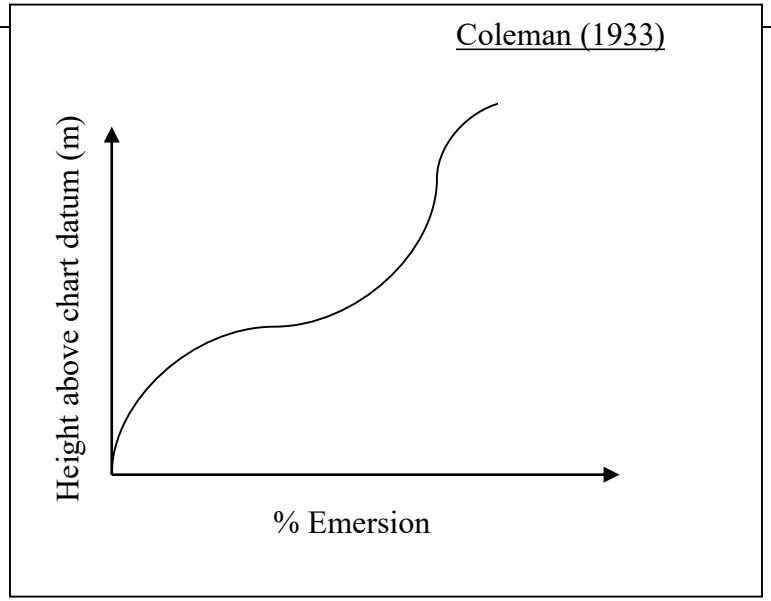
Limited supply of propagules might influence dispersion?

Laminaria	20 x 10^9 spores produced 9.8 x 10^5 colonise rocks 2 grow into adults
Fucus	1 x 10^6 per plant per year

Hypothesis 2: Physically controlled and related to tidal level

- Critical tidal levels (Doty 1946)

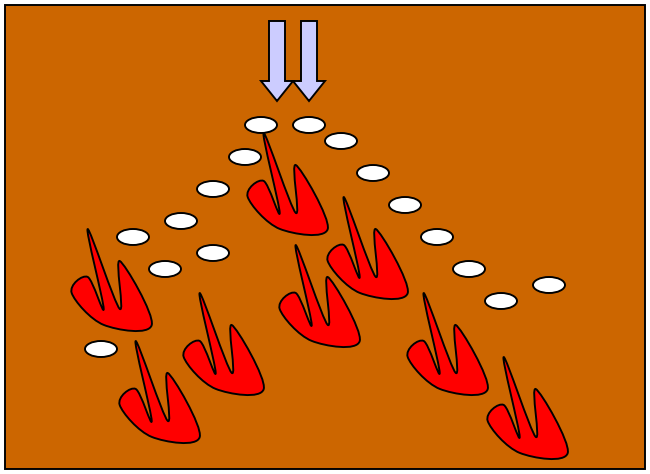
There is no good evidence for this in the UK (Underwood 1978)



- Different emersion periods (Water cover/Weather) (Baker 1909/Schonbeck & Norton 1978)

Light regime (Dring 1982)

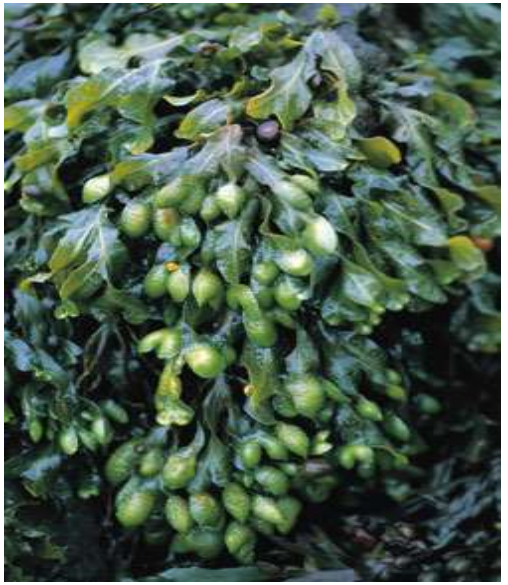
Thermal conditions (Newell 1979)



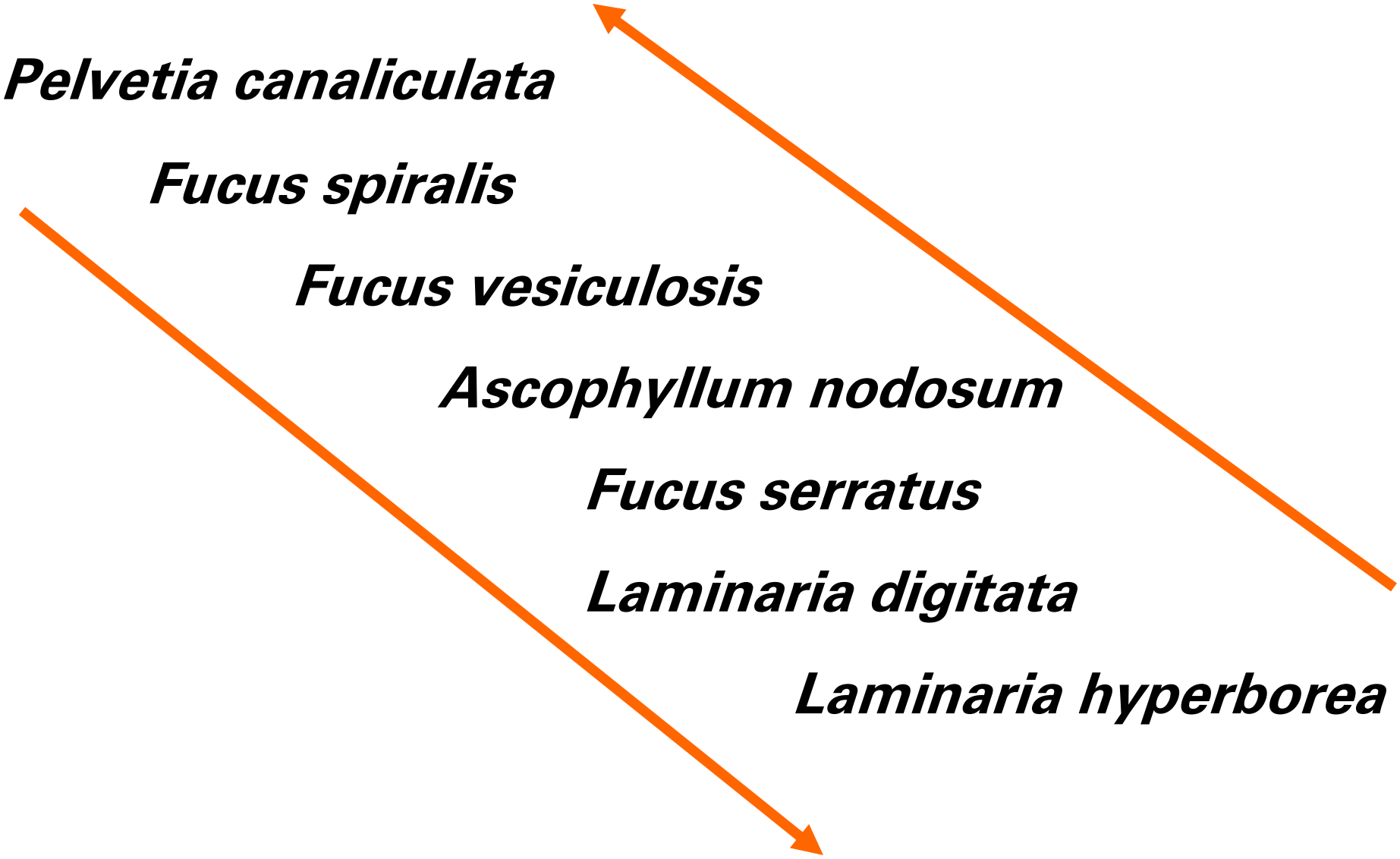
Hypothesis 3: Inter-specific competition

- Dayton (1975) Kelps dominate lower regions, but when removed smaller **opportunistic** or **fugitive** species were able to move in

- Schonbeck and Norton (1980)/Norton's weeding experiments (1985)



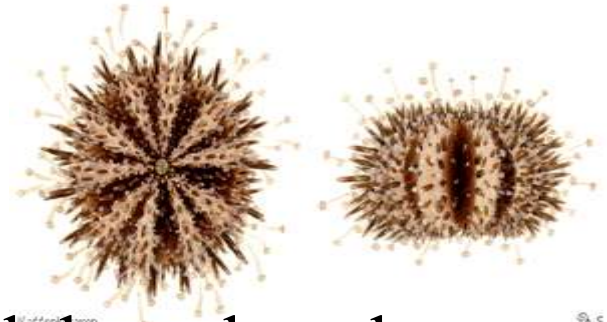
TYPICAL ZONATION PATTERN: SHELTERED SHORE



Hypothesis 4: Grazing

Increasing evidence that grazing prevents algae from extending their lower limits.

The dominant grazers on the rocky intertidal are gastropod molluscs, crustaceans, sea urchins and fish.



Himmelman & Steele (1971) demonstrated that when the urchin *Strongylocentrotus droebachiensis* was removed the alga *Alaria esculenta* was able to spread its range.

Take home messages

1. Zonation controlled by events after settlement
2. Physiological tolerance is greater in littoral fringe spp
3. Limits of littoral fringe controlled by aerial exposure
4. Upper limits within eulittoral by physiology, competition and grazing
5. Lower limits of eulittoral by competition and grazing

Overall the upper limits of macroalgal distribution on the rocky intertidal is regulated by physical factors and the lower limits by biological factors

AND NOW…

Group A

Dave Paterson

Faith Jones

Madingley	Abbs
Heather	Borland
Aarika	Dhir
Aisling	Geraghty
Leah	Gray
Sarah	Ildevert
Chloe	Lamb
Henry	Memmot
Ying	Ng
Paige	Roepers
Daisy	Sankey
Jessica	Undy-Jamison
Caitlin	Woombs

Group B

Andy Blight

Vicki Balfour

Ella	Ackroyd-Weldon
Kyela	Brennan
Rebekah	Douglas
Stephanie	Glendinning
Jemma	Guthrie
Hope	Irvine
Mary	McArthur
Morgan	Morris
David	Nicholson
Anna	Rouviere
George	Sato
Raqib	Valli
Melissa	Wright

Group C

Dave Shuker

Grant Brown

Claire	Baker
Carolyn	Coonan
Megan	Fletcher
Rebecca	Gorgon
Jamie	Hogarth
Aaron	Jessop
Julie	McDonald
Martha	Morrison
Ella	Papenfus
Freya	Sanders
Mikayla	Schmidt
Sophie	Wilson
Jessica	Wright

Group D

Sue Healy

Irvine Davidson

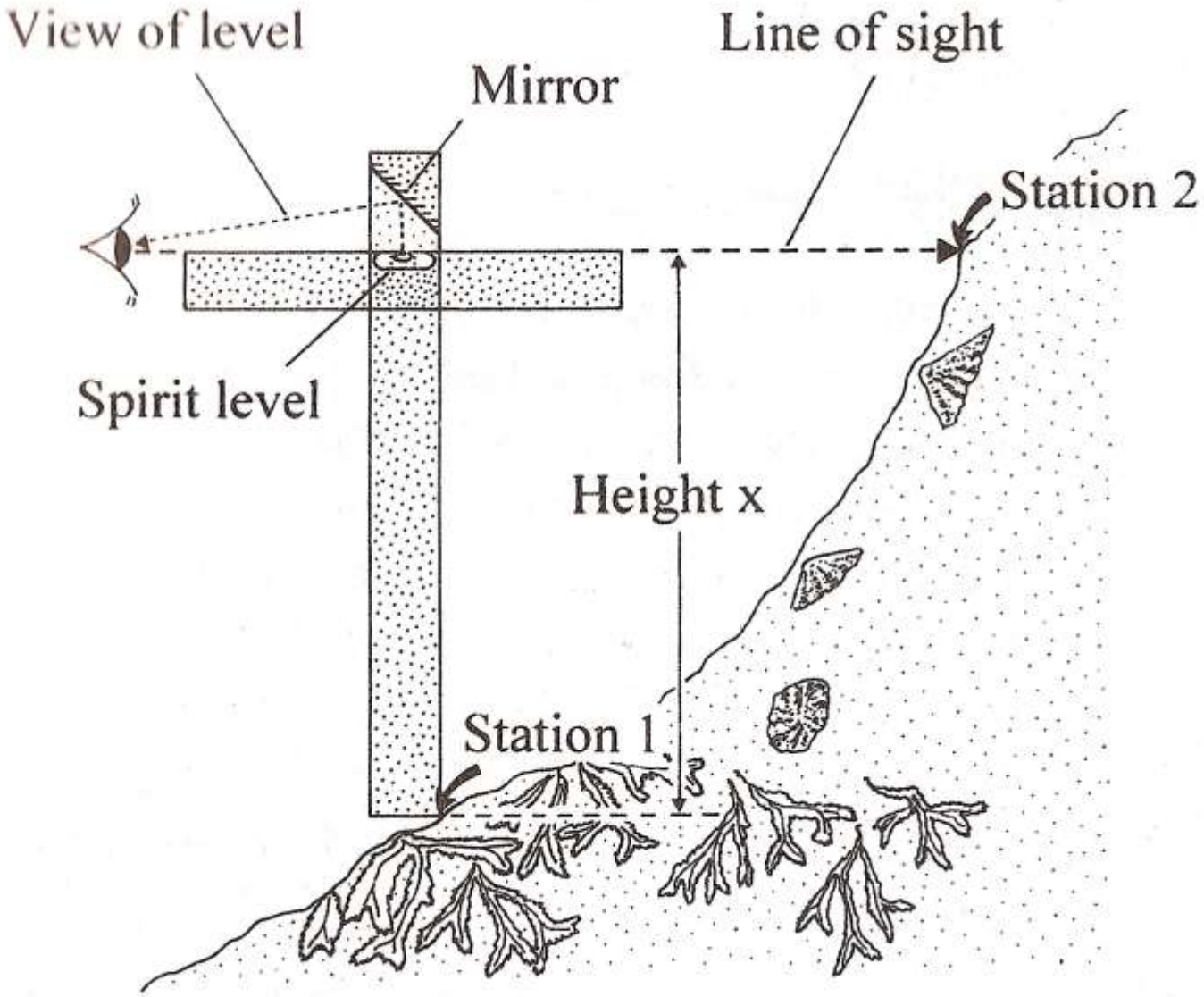
Dylan	Baldridge
Maisie	Dawson
Gabriella	Frank
Wayne	Gourlay
Phoebe	Hyde
Emily	Jones
Alex	McMaster
Sophie	Nettesheim
Mia	Richmond
Angus	Sandison
Vida	Svahnstrom
Josh	Witzmann

Rocky Shore Survey

- A good "model system" for studying how and why species distributions vary
- We will compare within and between different rocky shores
  - (1) Describe rocky shore communities
  - (2) Ask how those communities differ within and among different shores
  - (3) Consider why these communities differ

Rocky Shore Survey

- Survey from the littoral fringe (lichens) to the low tide mark
  - Day 1 – 12:21, 1.0m
  - Day 2 – 13:09, 0.6m
- One pair from each group will measure out a transect
  - Start at the littoral fringe (lichens)
  - Cross staff (60cm)
  - Tape measure
  - Coloured stones (numbered ~ 25)


View of level
Line of sight
Mirror
Station 2
Spirit level
Height x
Station 1

- At each shore level haphazardly place six quadrats
  - Avoid rock pools
  - Each pair to collect data for two quadrats (3 grps/level)
  - ID/abundance for all species
    - Counts for organisms with sensible 'individuals'
    - Percentage cover for algae, lichens, barnacles, sponges
    - Sub-analysis of barnacle species, diagonal of small square
- Equipment
  - Per group: Cross staff, tape measure, coloured stones (>20)
  - Per pair
    - Field guides – Lichen and shore species
    - Hand lens
    - Quadrat

Timetable

Day	Tide	Group A	Group B	Group C	Group D
Thursday 29th	12:21 (1.0m)	West Angle	Sawdern	Sawdern	West Angle
Friday 30th	13:09 (0.6m)	Sawdern	Manorbier	West Angle	Sawdern
Saturday 31st	13:54 (0.3m)	Dunes	Dunes	Dunes	Dunes

Manorbier (exposed rocky shore)

Sawdern Point (shletered rocky shore)

West Angle Bay (moderately exposed rocky shore)

Limpets

- Potentially 3 species
  - *Patella vulgata*
  - *P. depressa*
  - *P. ulyssiponensis*
- Can only be identified by removing from the rock
- DO NOT DO THIS!!!
- ID everything as *P. vulgata*

Barnacles

- *Semibalanus balanoides*
  - Diamond-shaped operculum
  - Broad rostral plate
  - Terga/scuta joint – acute angle
- *Chthamalus montagui*
  - Kite-shaped operculum
  - Terga/scuta joint – less than one third down centre line
- *Chthamalus stellatus*
  - Oval operculum
  - Terga/scuta joint – one third or more down centre line
  - Aperture margins electric blue

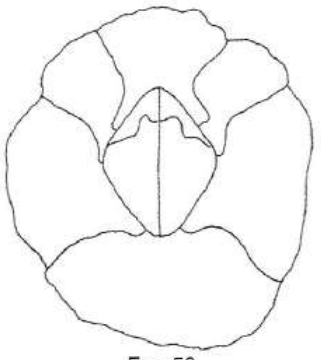


FIG. 50

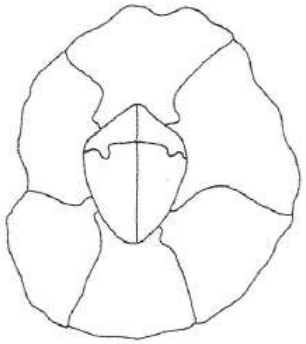


FIG. 51

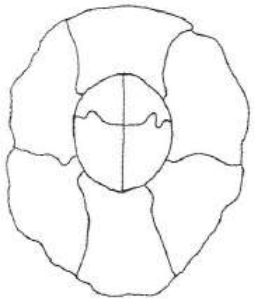
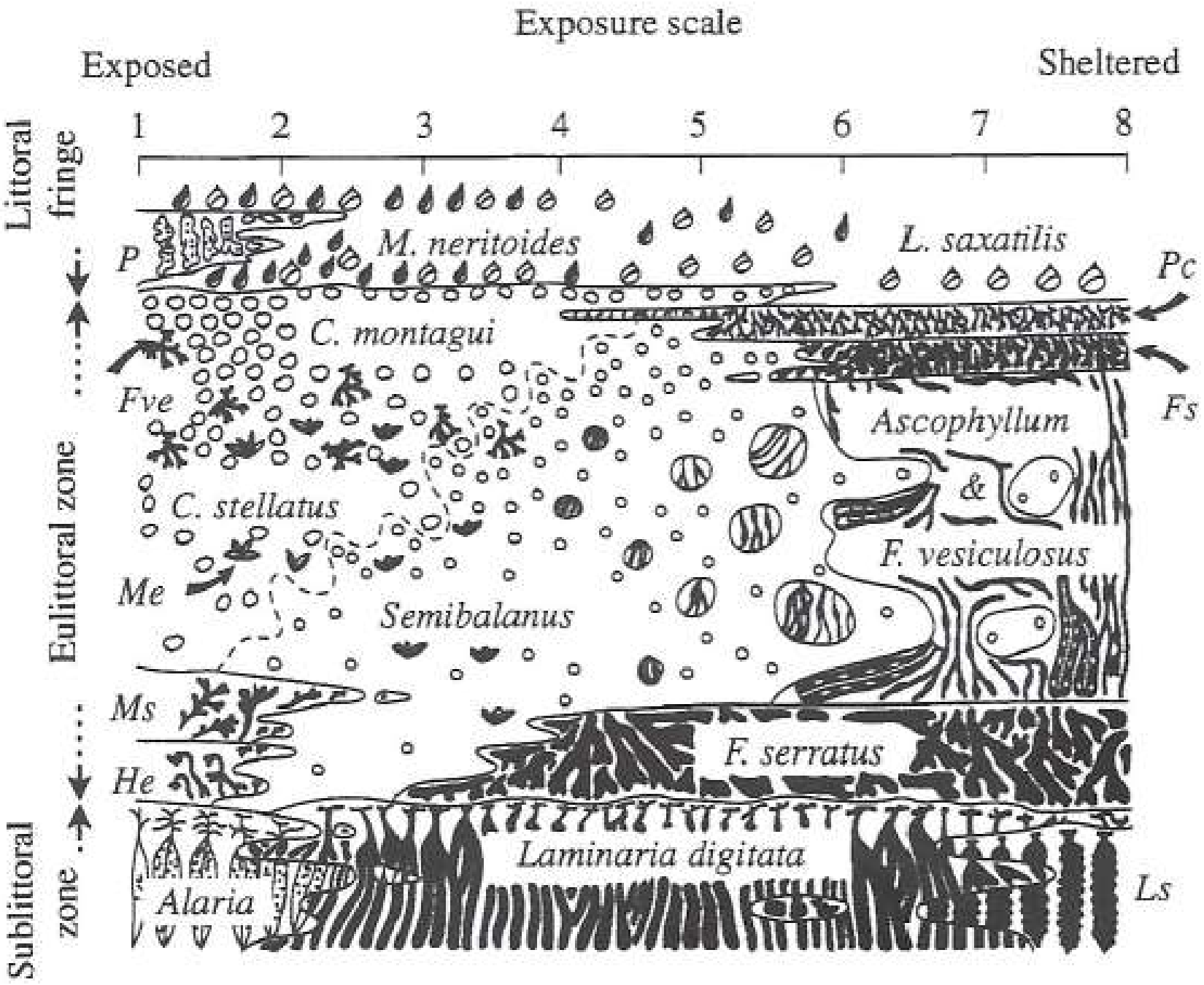
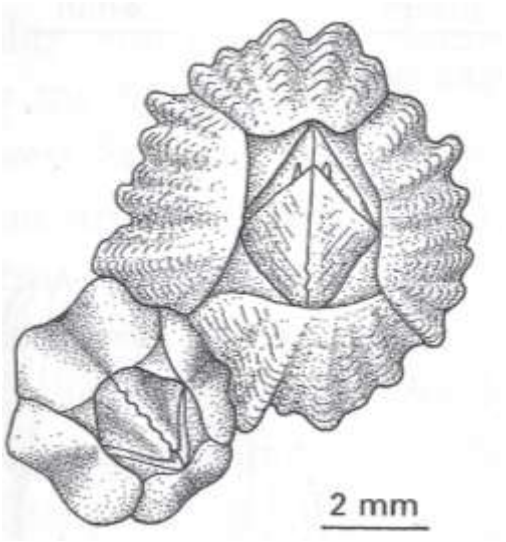


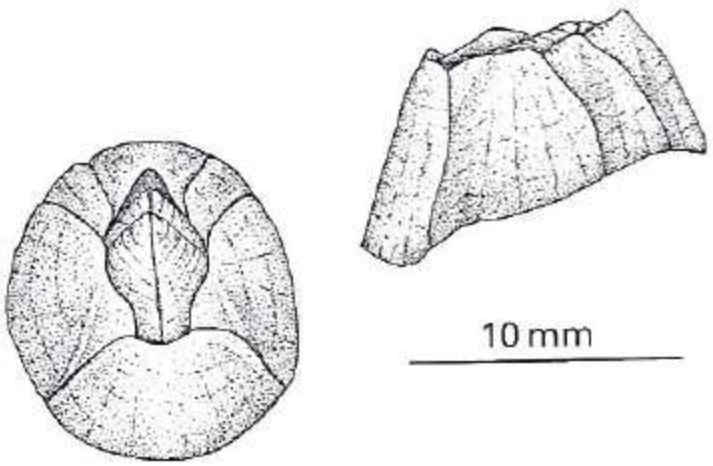
FIG. 52


Exposure scale
Exposed
Sheltered
1
2
3
4
5
6
7
8
Littoral fringe
Eulittoral zone
Sublittoral zone
P
M. neritoides
L. saxatilis
Pc
C. montagui
Fve
Fs
Ascophyllum
&
F. vesiculosus
C. stellatus
Me
Semibalanus
Ms
F. serratus
He
Laminaria digitata
Alaria
Ls

Barnacles

- *Austrominius modestus*
  - Large diamond-shaped aperture
  - Grey-white in colour
  - Four symmetrical wall plates
  - Terga/scuta joint pointed
- *Amphibalanus improvisus*
  - Narrow diamond-shaped operculum
  - White in colour
  - Six wall plates
  - Terga/scuta joint pointed





Amphibalanus improvisus

Assessment

- **Shore surveys online multiple choice quiz (10% assessment weighting)**
- **Presentation of project results (to take place during the trip) (20% assessment weighting)**
- **Project report (hand-in date 21st September) (50% assessment weighting)**
- **Oral examination (which takes place back in St Andrews) (20% assessment weighting)**

Project Report

Section	Maximum number of pages	Other Notes
Introduction	1	
Materials and methods	1	
Results	1	1 page of text, plus 5 figures **maximum**
Discussion	1	
References		**Maximum** of 5 references
Formatting		Double spaced, minimum 11 pt font