Comments to the presentation "SAR_02" for Botany of Non-vascular Plants

01
- Xanthophyceae are a group of stramenopile algae (i.e. those with secondary rhodoplasts, which however possess plastids that look (almost) like chloroplasts of green algae
- it is because of the lack of *fucoxanthin*, which is a member of xanthophyll pigment group, typical by brown colour that is abundant in plastids of other stramenopile algae (like diatoms, chrysophytes, etc.)
- thus in xanthophytes, chlorophyll in their plastids predominates and gives them a typical green colour
- given the fact that many xanthophytes have similar morphology to green algae (Chlorophyta) it is no wonder that many members of this group were originally classified as chlorophytes (and vice versa)

02
- in asexual xanthophytes there is a typical huge morphological variability among individual life cycle stages
- in this case of *Myxochloris sphagnicola*, which lives in the leaf cells of *Sphagnum*, the life cycle consists of many stages, such as amoeboid cells, flagellates and coccoid cells

03
- many xanthophytes are typical members of *soil microflora*
- here, we see the example of the genus *Botrydiopsis*, which lives in the upper-most soil layes, often in Alpine habitats

04
- in the planktonic genus *Ophiocytium* we see the morphological adaptation to this life style
- the cells are extremely elongated and often pointed (defensive measure against the herbivores)
- *Ophiocytium* is typical for freshwater habitats with low nutrients and lower pH

05
- Tribonema is a filamentou organism with (once again) complicated asexual life cycle
- the filaments are constructed by H-shaped cell wall fragments

06
- Botrydium is another terrestrial member of Xanthophyceae
- it typically lives on the the surface of wet soil (river banks, dessicated pond bottoms)
- it is a single celled organism with many nuclei; the cell is differentiated to subterranean part (lacking plastids) and the photosynthetic spherical part above the ground

07
- Vaucheria is another xanthophycean algal with multiple nuclei per cell
- in this case, each filament is a single giant cell
- there are both benthic and terrestrial species
- this lineage is sexual and it is typical by oogamic sexual process

08
- Eustigmatophyceae is a small but important group of unicellular stramenopile microalgae
- again, fucoxanthin is missing
- the cells are always coccoid, many of them are typical by crystallic pyrenoid (a body containing RuBisCO in the plastids)
- they often live in soils but there also freshwater and marine lineages
- another typical feature of Eustigmatophyceae is intense production of lipidic compounds stored in oil vacuoles

09
- all Eustigmatophyceae are unicellular and coccoid
- however, planktonic taxa tend to have more complicated cellular shapes due to herbivore defense

10
- oil vacuoles, crystalline pyrenoids...

(11-)12
- due to their high lipidic content (incl. EPA - eicosapentaenoic acid) eustigmatophytes are one of the favourite microorganisms for biotechnology
- these omega-polyunsaturated fatty acids are used both in pharmaceutical industry and as food supplements

13
- Phaeophyceae is the lineage encompassing most multicellular stramenopile algae
- they constitute the only lineage of macroscopic phototrophic organisms that are not (either red or green) plants

14-15
- in the past, people thought that the morphologically most simple phaeophytes (order Ectocarpales) with filamentous morphology are also those that are most plesiomorphic (phylogenetically "primitive")
- however, it is not the case; several molecular phylogenetic studies showed that the most ancient lineages are those with *isomorphic life cycles*
- on the contrary, lineages with very different haploid and diploid stages are derived, evolutionarily younger
- Ectocarpales are secondarily simplified

16-18
- Dictyotales is one of these groups with isomorphic life cycles (sporophytes and gametophytes are morphologically identical)
- the genus Dictyota is distributed in warmer parts of the world ocean coastal regions
- the thalli are ephemeral, constituted by three layers of cells; a typical feature is the dichotomic branching of the thalli

19
- Dictyopteris is another dictyotalean genus, it is also distributed in warmer marine habitats

20-23
- Padina is an important dictyotalean genus typical by fan-shaped, calcified thalli
- it typically grows in ruderal, disturbed habitats in tropical and subtropical marine coastal habitats
- one of these ruderal habitats are the communities replacing destroyed coral reef habitats in the tropics

24
- another pantropical member of Dictyotales

25-26
- Sphacelariales is another of these plesiomorphic lineages with isomorphic life cycle
- most members live in tropical and subtropical regions but there are also cold-water species of the genus Sphacelaria
- a typical feature of this order are the multiaxial filaments
- similar to Ectocarpales, Sphacelariales also possess the typical stalked plurilocular sporangia

27
- Ectocarpales is a large group, most members are morphologically relatively simple algae with branched filamentous morphology
- in most cases, they have ephemerous thalli

28
- the genus Ectocarpus lives as an epiphyte of other macroalgae (or on stones and rocks), mostly in colder marine regions, such as the Northern Atlantic and Baltic Sea

29
- Colpomenia is the genus with most complex thalli
- originally from N Pacific, it has been spead all over the world by oyster business

30
- ther are also a number of ectocarpalean algae that ar edistributed on the southern hemisphere; the genus Adenocystis is such an example

31-32
- the *kelp algae or kelp seaweeds* are the key components of the cold-water marine vegetation
- they may form the so called kelp forests that are - sort of - the undewater analogy of boreal forests in the terrestrial habitats
- most kelp algae belong to Laminariales and most of the genera are limited to coastal regions of the boreal and subantarctic parts of the planet

- Laminariales originated in N Pacific, then distributed to N Atlantic and to S hemisphere; crossing across the equator took place probably only three times in three different genera; therefore, diversity of kelps on the southern hemisphere is much lower than in the N hemisphere

33
- Laminariales are a group with heteromorphic life cycle
- this means that they have two morphologically different stages - vegetative, diploid sporophyte and ephemereous, filamentous, haploid gametophytes
- sporophyte is typical by thalli differentiated to phylloids, cauloid and holdfast
- L. digitata and L. hyperborea are two most important European kelp species

34-35
- the genus Ecklonia is one of those that form kelp forests on S hemisphere
- for example, Ecklonia kelps dominate on the SW coast of Africa

36-37
- Alaria is the N hemisphere genus, both in N Atlantic and (mostly) in N Pacific, where kelp forests occur all along the Pacific coast of N America from Alaska to N Mexico

38-40
- Macrocystis is the genus with the largest thalli (up to 50 meters!)
- it is distributed in N Pacific and it crossed the equator along the W American coast; so, nowadays M. pyrifera it is one of the dominant species on the S hemisphere (Macrocystis belt)

41
- Nereocystis is a genus distributed on the American Pacific coast
- it is typical by large air vesicles (floating vesicles) positioned at the base of the phylloids

42
- Postelsia, another American Pacific genus, is typical by distribution in the upper intertidal; this means that they are periodically expesed to terrestrial conditions along the coasts

43-44
- the genus Chorda is classified into Laminariales (or as a sister order Chordales)
- contrary to other Laminariales, the thalli are not differentiated, they look like long, hollow (air-filled) tubes; they are ephemerous
- gametophyte stages are microscopic, similar to other Laminariales
- it is the only member of this group that tolerates lower salinities (brackish conditions) of the Baltic Sea

45
- Fucales are an order of Phaeophyceae were the tendency to heteromorphic life cycle went to the extremes
- in fact, they only live as diploids (sporophytes) and their haploid stages (gametophytes) live only as an ephemerous stage on the diploids (within sexual chambers called conceptacles)
- Fucales are also relatively very young evolutionary lineage
- contrary to Laminariales, they thrive not just in cold waters but there are families (genera) distributed in the tropics, as well (Sargassum, Turbinaria)

46
- here, we see the conceptacles as tiny chambers in the thallus surface with gametophyte stages, sexual organs and zygotes

47
- here, we see that distribution of main European Fucaceae follows typically northern Atlantic patterns
- note, that a few species penetrate far into the brackish Baltic Sea (contrary to Laminariales)
- in the Atlantic Ocean, the genus Fucus occurs mainly in the intertidal; i.e. above the kelp forest, which largely limited to the subtidal

48-53
- in the Baltic Sea there are three Fucus species
- they form, what is called "Fucus belt", and it is considered as one of the most important habitat type in this region
- ther eare practically no tides, so Fucus in the Baltic Sea lives in the sublittoral

- F. vesiculosus is typical in the upper-most sublittoral, close to the sea surface; it is typical by thalli with air vesicles
- F. serratus forms the layer beneath F. vesiculosus, it has serrated margins and no air vesicles
- F. radicans is an endemic species of the eastern and northern parts with very low salinity; it speciated from F. vesiculosus relatively recently (in the postglacial period of Holocene)

54
- Ascophyllum nodosum is an important Atlantic intertidal species
- the thalli are typical by air vesicles formed in a serial fashion as thickenings of the cauloid

55-58
- the genus Cystoseira is a large and important group of Mediterranean fucoids
- it evolved in the (geological ancestors) of current Mediterannean Sea and up to our times the centre of diversity of this lineage is in the Mediterranean basin and surrounding seas
- it is typical by bushy plants, up to 70 cm, with no phylloids but sometimes with air vesicles
- Cystoseira plants are perrenial (long-living) and form the so called canopy layer of Mediterranean marine vegetation
- their high proportion in the communities indicates ecologically stable conditions; since 1970s they have been retreating from many different Mediterranean locations

59
- Sargassum is primarily a tropical genus of fucoids
- it has phylloids which can sometimes be transformed to air vesicles
- a few Sargassum species can even form free-floating populations on the sea surface, especially in the tropical Atlantic ocean
- these free-floating populations only reproduce asexually (by thallus fragmentations); this is because the zygotes rapidly sink to deeper parts of theocean and cannot successfully germinate
- in the Mediterranean Sea there are a few native Sargassum species; ecologically, they are similar to Cystoseira (S. vulgare, S. hornschuchii)
- S. muticum, native to Japan, is an invasive species along European Atlantic coast

60
- due to composition of their cell walls, the so callod alginate gels can be produced from phaeophyte algae (both Fucales and Laminariales)
- they are used in a vast number of biotechnological applications