

Topic 12 – Gymnosperms

- I. Characteristics of
 - A. Sporophytes
 - Dominant
 - Axillary branching
 - Eustele
 - Secondary Growth

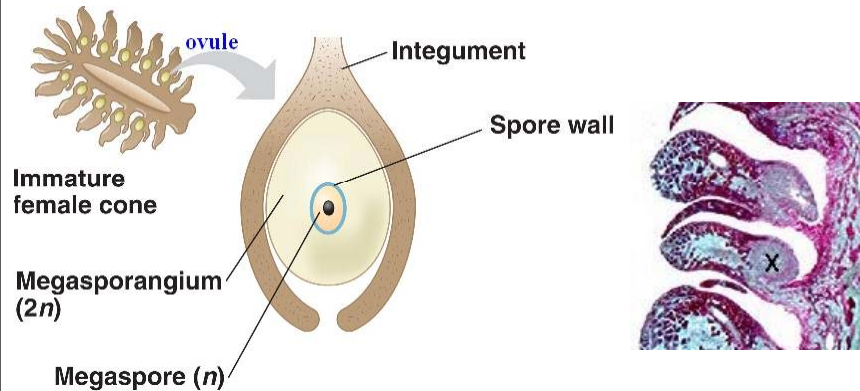
Topic 12 – Gymnosperms

- I. Characteristics of
 - A. Sporophytes
 - Heterosporous:
 - Microsporangia on sporophylls in simple strobilus, make microspores



Topic 12 – Gymnosperms

- 1 Megasporangium in 1 ovule
 - Ovules usu. in simple or complex strobilus (“cone”)
 - Each sporangium makes one functional megaspore.



Topic 12 – Gymnosperms

- I. Characteristics of
 - B. Gametophytes
 - Not-Dominant, not photosynthetic
 - Microgametophyte is pollen grain, develops largely in strobilus; has no antheridia.
 - Megagametophyte (also called embryo-sac) contained in ovule, has two minute archegonia.

Topic 12 – Gymnosperms

- I. Characteristics of
 - C. Life cycle (e.g., cycad)

Topic 12 – Gymnosperms

- I. Characteristics of
 - D. Naked seed plants
 - gymnos* = naked; *sperma* = seed
 - no fruits
 - ovule exposed in strobilus or cone at pollination.

Topic 12 – Gymnosperms

- I. Characteristics of
 - E. Three groups to know
 - 1. Cycads
 - 2. Conifers
 - 3. Ginkgo

Topic 12 – Gymnosperms

- I. Characteristics of
- II. Cycads**

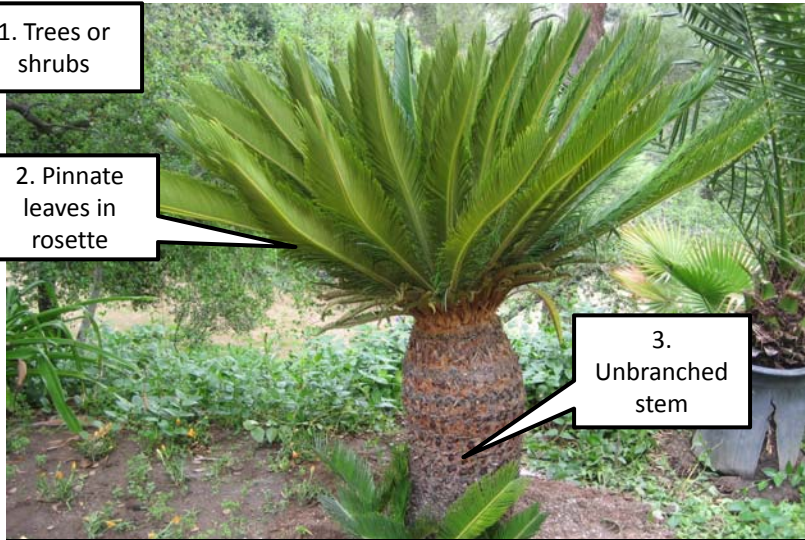
Cycads

A. Vegetative Morphology

1. Trees or shrubs

2. Pinnate leaves in rosette

3. Unbranched stem



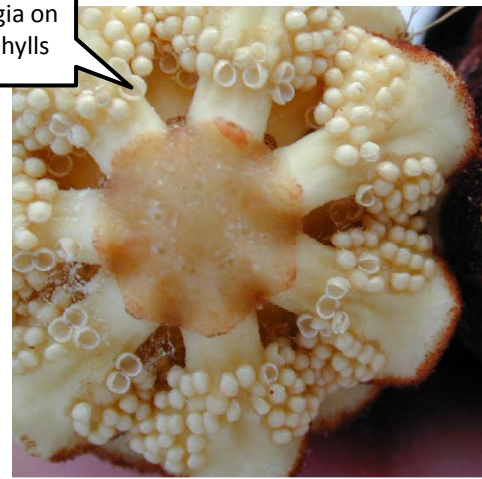
Cycas revoluta (sago-palm)

Cycads

B. Reproductive.....1. Dioecious a. Males w/ strobili.

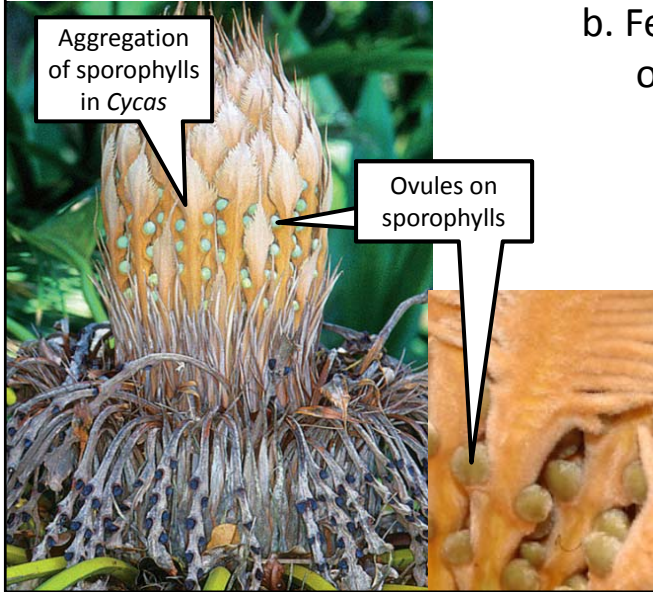
Male strobilus on male plant.

Sporangia on sporophylls



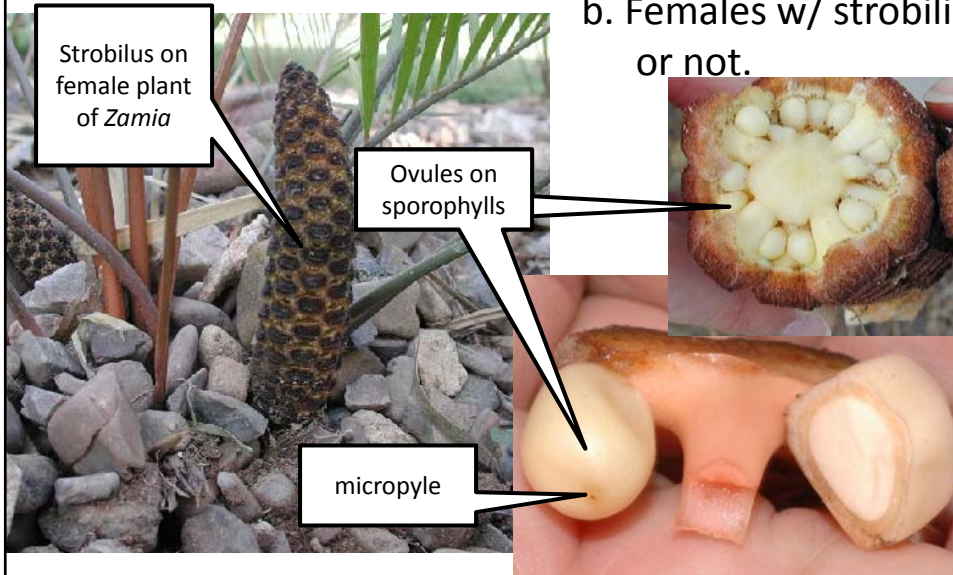
Cycads

B. Reproductive.....1. Dioecious
b. Females w/ strobili or not.



Cycads

B. Reproductive.....1. Dioecious
b. Females w/ strobili or not.



Cycads

B. Reproductive.....

Seeds on
sporophylls in
Cycas.



Seeds on
sporophylls in
Zamia



Cycads

C. Economic botany

-Ornamental horticulture



Cycads

Rare cycads fetch big money on black market

Cycad thieves strike at Van Stadens Reserve

2009/06/02
 Guy Rogers ENVIRONMENT & TOURISM EDITOR rogersg@avusa.co.za



POACHED ... A blue cycad like the ones that were stolen.

CONSERVATION authorities are hoping that sharp-eyed members of the public might be able to help with a weekend incident in which seven rare, protected cycads were seized from the Van Stadens Wildflower Reserve.

Reserve manager Wesley Berrington said yesterday that he was off the reserve on Sunday and returned to find the seven blue cycads (*Encephalartos horridus*), which are endemic to the Uitenhage area, gone.

"They were growing in our work area around our store rooms. They were just dug up. One was left behind, which seems to indicate that the thieves were disturbed."

Cycads

Rare cycads fetch big money on black market

Thieves target rare, valuable plants

Sunday, December 12, 2004 Posted: 6:12 PM EST (2312 GMT) Sunday, December 12, 2004 Posted: 2312 GMT (0712 HKT)

COSTA MESA, California (AP) --
The thieves struck at night and knew just what they were after.

In minutes, they ripped two plants from the lavish landscaping at a home in this Los Angeles suburb, then fled when the homeowner woke up and turned on a porch light.

Total haul: \$3,500.

The thieves were after cycads, palmlike plants so prized that a rare specimen can fetch \$20,000 or more on the international black market. Some species have been around since the time of the dinosaurs but are now close to extinction.

story.cycads.ap.jpg

Horticulturist Jason Kubrock says cycads are "the hot, trendy plant right now."

“ In the black market, some species of cycads are like a fine piece of art -- like a Picasso. ”

-- Nannette Zapata,
 Fairchild Tropical Botanic
 Garden spokeswoman

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Cycads
 Research on DNA technology to help prosecute.

news24
 Breaking News. First.

The Southern African Larger Telescope has brought more than astronomy to the depressed town of Sutherland. See it in pictures.

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Barcode bars cycad smugglers
 2010-01-11 16:07

Johannesburg - Scientists at the University of Johannesburg have started a DNA bar-coding project to stop the smuggling of endangered cycad species in the country.

Botany masters student Philip Rousseau started the project with the aim of creating a barcode library for the African Encephalartos species in an attempt to control collectors in America and the Far East who are prepared to pay up to R71 000 for a large specimen of a rare species, university spokesperson Herman Esterhuizen said in a statement.

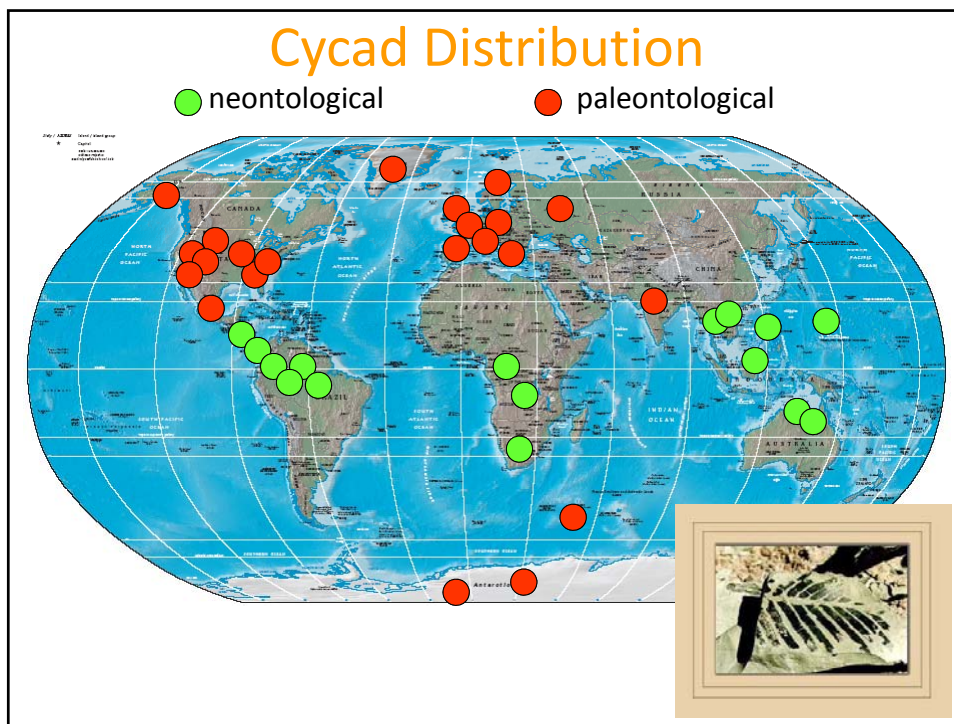
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Cycads

D. Biogeography & Conservation

- Pantropical (rainforest to deserts)
- Long fossil history (<200 my)
- ca. 240 extant (surviving) species
- threatened by poaching & black market



Fossil Cycads

Int. J. Plant Sci. 164(6):1007-1020. 2003.
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 1058-5893/2003/16406-0016\$15.00

GYMNOSPERMS FROM THE MIDDLE TRIASSIC OF ANTARCTICA: THE FIRST STRUCTURALLY PRESERVED CYCAD POLLEN CONE

Sharon D. Klavins,* Edith L. Taylor,* Michael Krings,† and Thomas N. Taylor*

*Department of Ecology and Evolutionary Biology and Natural History Museum and Biodiversity Institute, Lawrence, Kansas 66045-7534, U.S.A.; and †Bayerische Staatssammlung für Paläontologie, Richard-Wagner-Strasse 10, 80333 Munich, Germany

The first permineralized cycad pollen cone is described from the lower Middle Triassic of Antarctica. The cone is characterized by helically arranged, wedge-shaped microsporophyll projections extending from the rhomboid distal face. The vascular cylinder traces to each microsporophyll. Three vascular bundles enter the base of the microsporophyll. The sporophyll lamina produce at least five vascular strands in the sporophyll lamina. Pollen sacs are produced on the lateral margins on the abaxial surface of the microsporophyll. Each pollen sac is fused for approximately half their length and display lateral margins that are sessile and attached to a vascularized, receptacle-like pad of tissue that is fused to the microsporophyll. Pollen is ovoid, psilate, and monolocate. Although the characters of the fossil are consistent with those of extant Cycadales, the complement of characters in the fossil is unique to a new family. Features of the cone are evaluated against reproductive characters of extant Cycadales.

Keywords: Cycadales, *Delemaya*, gymnosperms, microsporophylls, pollen

Introduction

that this approach solving relationships

Fig. 4 Suggested reconstructions of *Delemaya spinulosa*. A, Cone morphology, showing helical arrangement of microsporophylls and organization of projections on microsporophyll faces. Scale bar = 1 mm. B, Morphology of a microsporophyll, showing the position of pollen sacs and extension of adaxial ridges into apical projections at the microsporophyll face. Scale bar = 2.5 mm. C, Abaxial view of a microsporophyll, showing the organization of the pollen sacs into two radial clusters. Scale bar = 2.5 mm.

Cycads

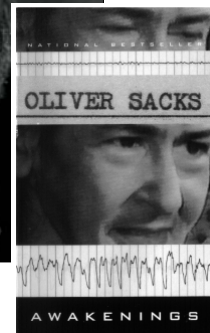
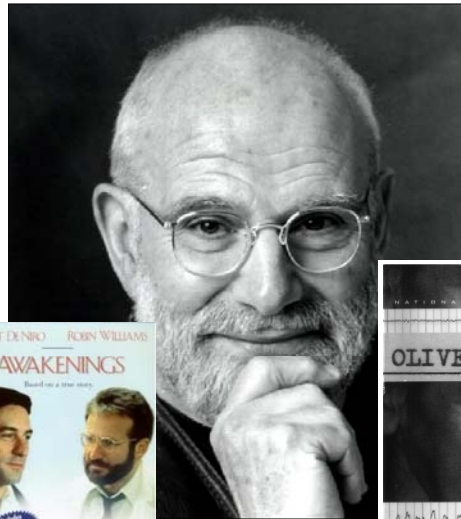
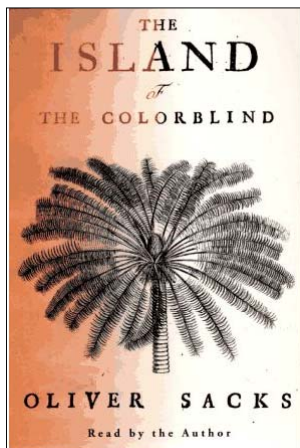
E. Cycads & Guam Dementia

US territory 1898-1941, 1944-present.
Japanese 1941-1944



Cycads

E. Cycads & Guam Dementia



Chamorro = indigenous people of Guam

- *Extremely healthy by historical accounts.
- *20th century brought lytico-bodig, leading cause of death in 40's, 50's, 60's.



Lytico-Bodig (sometimes called Guam dementia).

Demographics: Chamorro men; usu. strikes 25-40 yrs.

Symptoms:

Lytico = progressive paralysis that resembles ALS (amyotrophic lateral sclerosis);

Bodig = parkinsons-like shakes with Alzheimers-like dementia.

Prognosis: premature death.



NIH investigates from 1940-1990's:

They Explore:

1. Genetics (including sex-linked)



NIH investigates from 1940-1990's:

They Explore:

1. Genetics (including sex-linked)
2. Cycad pollen (BMAA discovered in 1950's)



NIH investigates from 1940-1990's:

They Explore:

1. Genetics (including sex-linked)
2. Cycad pollen (BMAA)
3. Cycads as food ("fadang" flat bread; BMAA)



NIH gives up in the 1990's.

Enter botanist Paul Cox, Oliver Sacks, flying foxes, & the return of the cycads.



Then, Institute of Ethnobotany, NTBG, Hawaii.

Now, Institute for Ethnomedicine in Jackson Hole, Wyoming.





- Bats eat the seeds.
- Hyperaccumulate BMAA 400x in fatty tissues (apparently unaffected).

But, what's the connectin to lydigo-bodig?



- Bats eat the seeds.
- Hyperaccumulate BMAA 400x in fatty tissues (apparently unaffected).

But, what's the connectin to lydigo-bodig?

1. Why primarily in men?
2. Why could it be passed to men from other tribes only through marriage?
3. Why did it arise during 20th century, then peak in 40-60's?



Neurology 2002;58:956-959
 © 2002 [American Academy of Neurology](#)

Medical Hypothesis

Cycad neurotoxins, consumption of flying foxes, and ALS-PDC disease in Guam

Paul Alan Cox, PhD and Oliver W. Sacks, MD

From the Institute for Ethnobotany (Dr. Cox), National Tropical Botanical Garden, Kalaheo, HI; and Department of Neurology (Dr. Sacks), Albert Einstein College of Medicine, Bronx, NY.

Address correspondence and reprint requests to Dr. Paul Alan Cox, Institute for Ethnobotany, National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo, Kauai, HI 96741.

The Chamorro people of Guam have been afflicted with a complex of neurodegenerative diseases (now known as ALS-PDC) with similarities to ALS, AD, and PD at a far higher rate than other populations throughout the world. Chamorro consumption of flying foxes may have generated sufficiently high cumulative doses of plant neurotoxins to result in ALS-PDC neuropathologies, since the flying foxes forage on neurotoxic cycad seeds.

Topic 12 – Gymnosperms

I. Characteristics of

II. Cycads

III. Conifers

Conifers

A. Vegetative Morphology

1. Branched trees or shrubs

2. Leaves needle-like



Pinus resinosa (red pine)

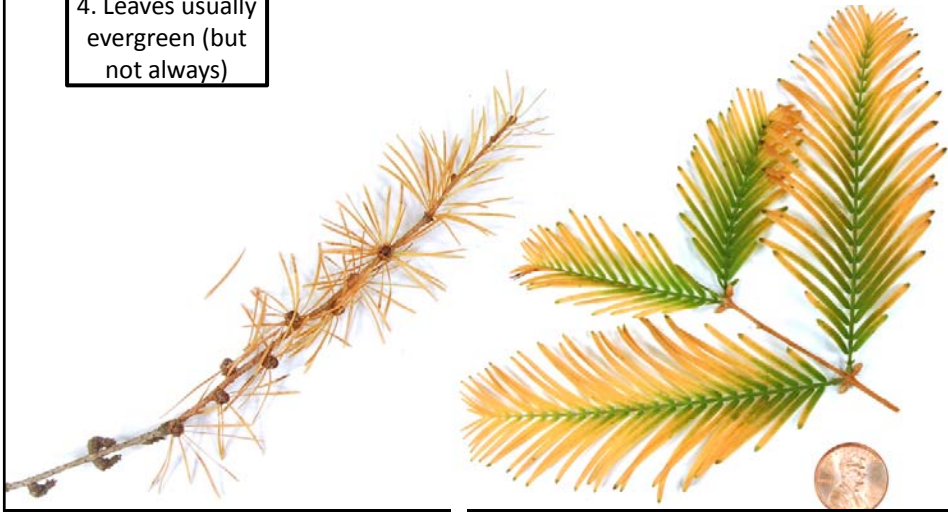


Taxus baccata (English yew)

Conifers

A. Vegetative Morphology

4. Leaves usually evergreen (but not always)



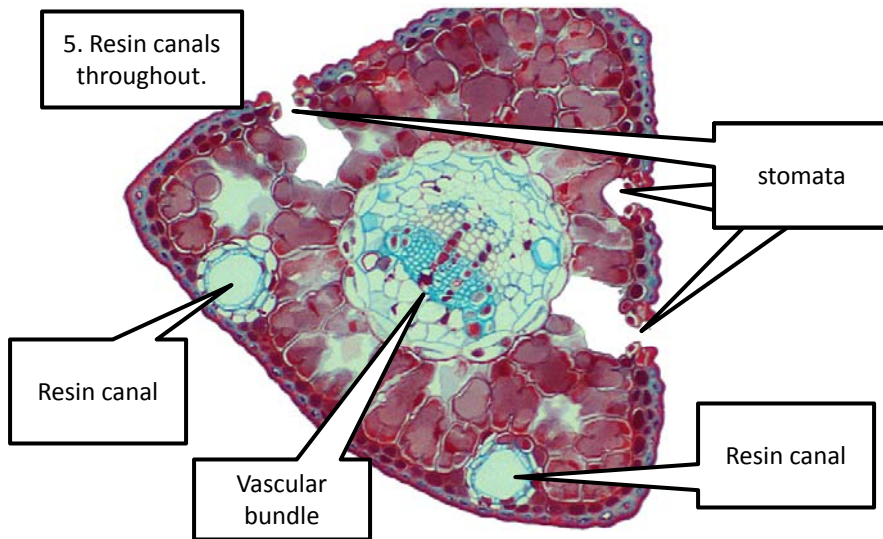
Larix laricina (American larch)

Metasequoia glyptostroboides (dawn-redwood)

Conifers

A. Vegetative Morphology

5. Resin canals throughout.



pine needle – transverse section

Conifers

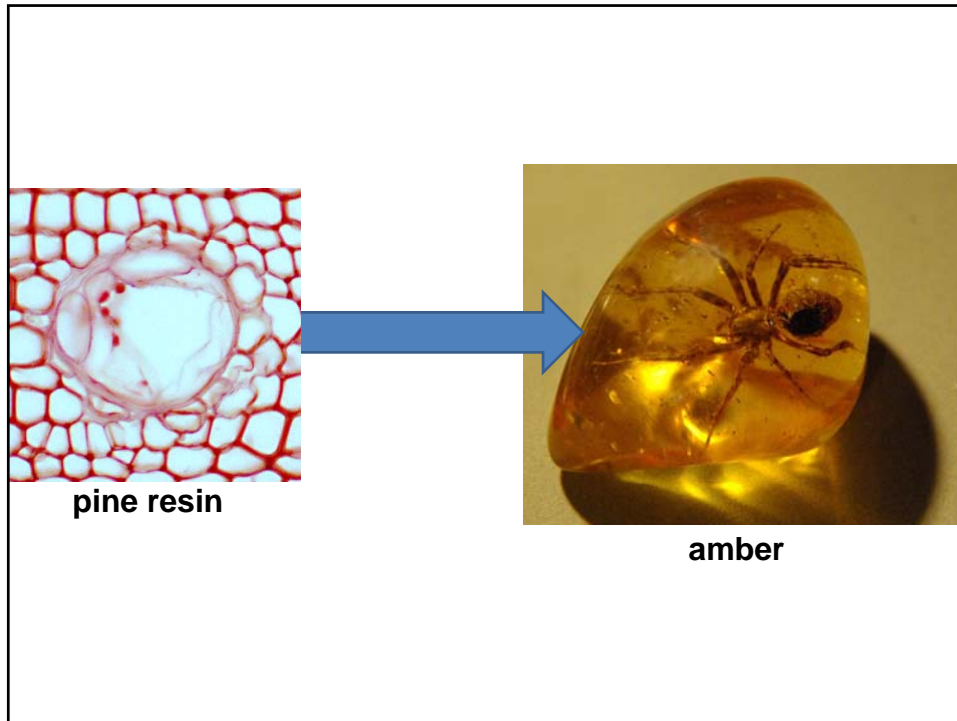
A. Vegetative Morphology

5. Resin canals throughout.



Resin makes conifers the quintessential symbol of fresh scents.





Conifers

B. Reproductive Morphology

1. Monoecious
or Dioecious



male strobilus ("pollen cones" of laypersons)



female cone (a compound strobilus)

Conifers

B. Reproductive Morphology

Male strobilus: sporophylls with sporangia.

Female cone: ovule/seed scales (modified branches) in axils of bracts.

archegonium
m
female gametophyte

Cone of balsam fir (with bracts exerted from scales)

Seeds visible here in broken cone.

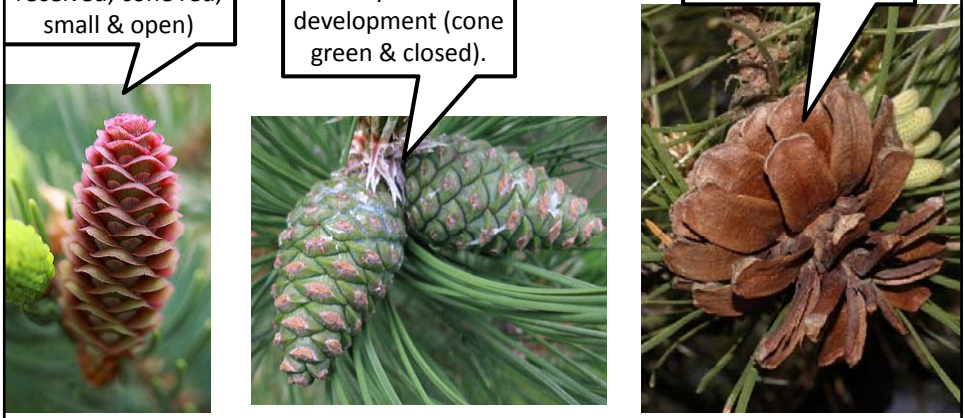
Conifers

B. Reproductive Morphology

1st Spring (pollen received; cone red, small & open)

2 seasons for fertilization, embryo & seed development (cone green & closed).





End of 2nd season, embryo, seed, & cone is mature (cone is larger, brown & woody; opens itself or via fire)



Conifers

B. Reproductive Morphology

2. Seed Cones typically woody, w/ winged seeds



Cypress & Redwood Family

Pine, Spruce, & Fir Family



Conifers

C. Economic botany

- 1. Lumber & paper pulp
- 2. Pine "nuts"

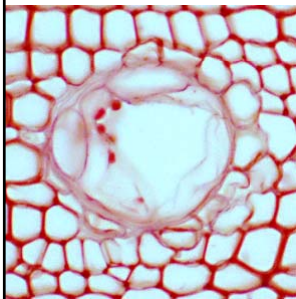


Conifers

C. Economic botany

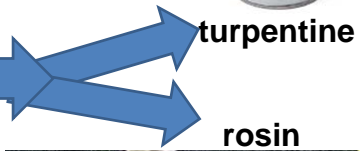
- 1. Lumber & paper pulp
- 2. Pine "nuts"

3. Turpentine & rosin



pine resin

distillation

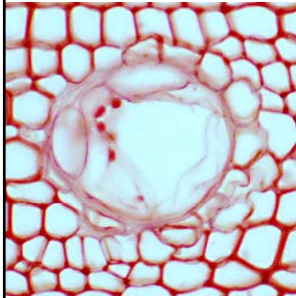


Conifers

C. Economic botany

- 1. Lumber & paper pulp
- 2. Pine "nuts"
- 3. Turpentine & rosin

4. Amber



pine resin



amber

Conifers

C. Economic botany

- 1. Lumber & paper pulp
- 2. Pine "nuts"
- 3. Turpentine & rosin
- 4. Amber

5. Sounding boards



Conifers

C. Economic botany

1. Lumber & paper pulp
2. Pine "nuts"
3. Turpentine & rosin
4. Amber
5. Sounding boards

6. Christmas trees



Other uses:

7. Boat sealer, caulk, patch (resin).
8. Survival food (inner bark – Amerindians – raw or candied, dried strips).
9. Scurvy Prevention (tea – needles or inner bark - Amerindians).

Conifers

C. Biogeography & Ecology

1. Pine (Pinaceae) and Cypress (Cupressaceae) families dominate north temperate zone.

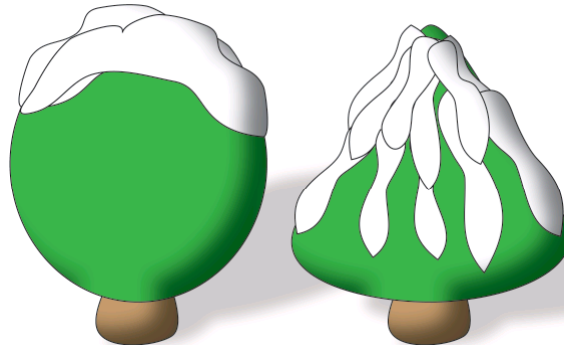
e.g., Taiga (Boreal Forest) Biome

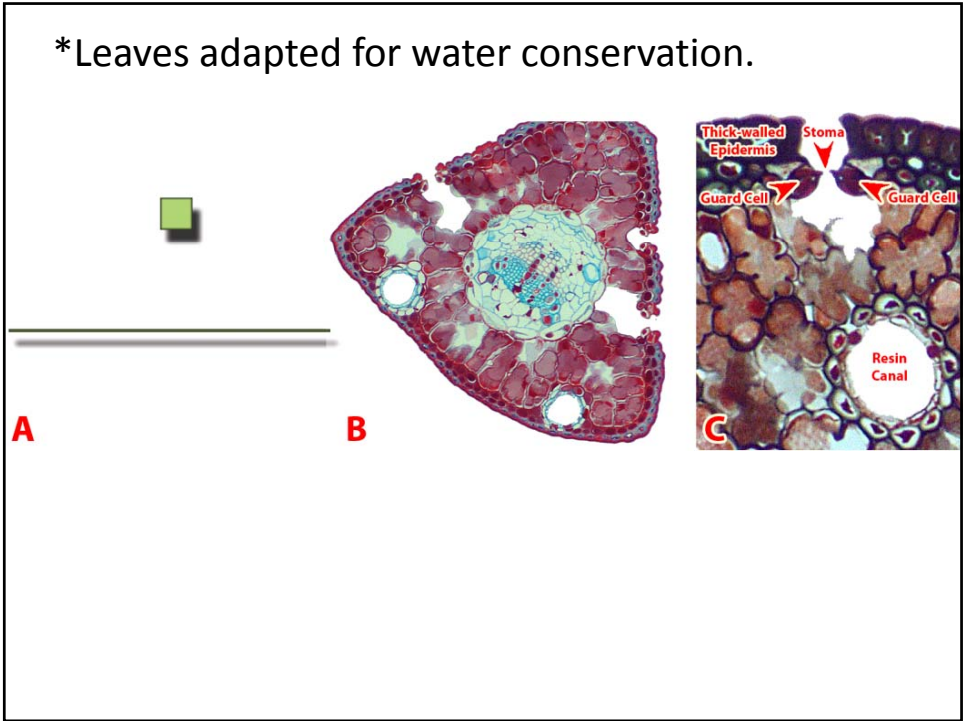
- *Long, cold winter with frozen groundwater;
- *Short summer;
- *Avg. Annual Temp of -5 to 5 degrees F;
- *Most precip as snow; threat year-round.



Short growing season favors evergreenness – but keeping leaves through winter requires some adaptations.

- *Conical form sheds snow, distributes weight.





C. Biogeography & Ecology

2. Podocarps (Podocarpaceae) & araucoids (Araucariaceae) dominate south temperate zone.



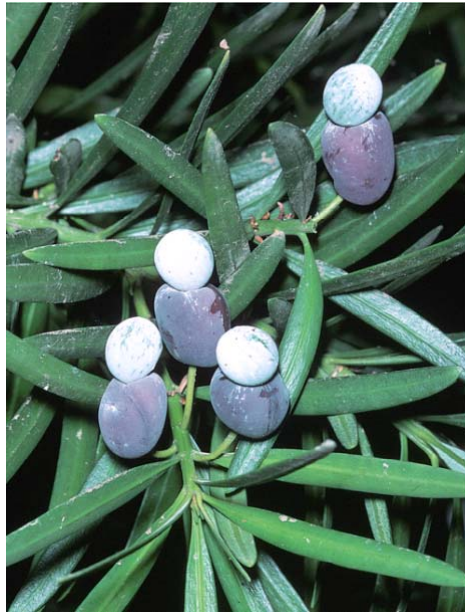
Norfolk Island "Pine" (*Araucaria heterophylla*); Norfolk Island – between New Zealand & New Caldeonia



Monkey puzzle tree (*Araucaria araucana*); central Chile



Wollemi "pine" (*Wollemia nobilis*); Australia (1994)



Podocarps (156 spp.) of southern hemisphere

Topic 12 – Gymnosperms

I. Characteristics of

II. Cycads

III. Conifers

IV. Ginkgos

Ginkgos

A. Vegetative Morphology



1. Ginkgo tree.



2. Leaves clustered on short shoots.



3. Dichotomous leaf venation.

Ginkgos

B. Reproductive Morphology

Dioecious



Ginkgos

B. Reproductive Morphology

Dioecious



Ginkgos

C. Economic botany

- Ornamental horticulture
- Seeds Asian delicacy
- Extract increases blood flow.

HB7652

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