

Overview of Algae and Algal Blooms: Who are these guys?



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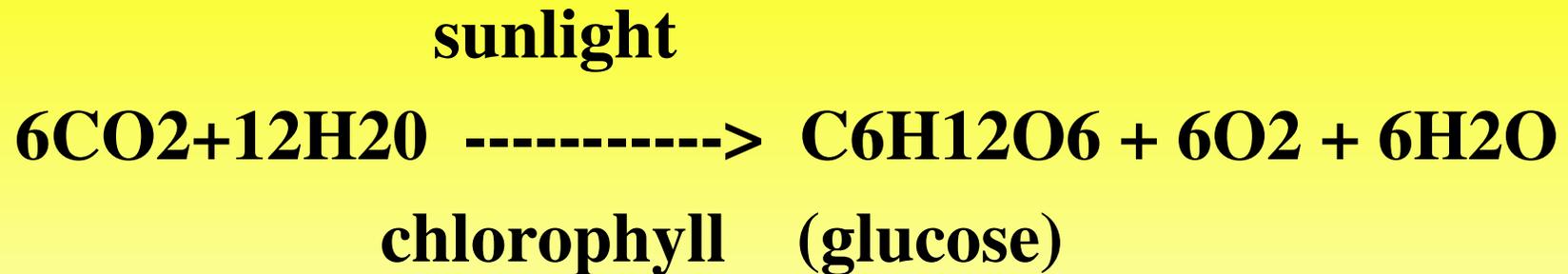
Some Terminology

- autotrophs
- heterotrophs
- microalgae
- phytoplankton
- macroalgae
- benthic
- red tides
- harmful algal blooms (HABs)

Common characteristics

- Algae is a term describing any non-vascular primary producer
- All take in nutrients (N, P, etc.) and perform photosynthesis
- Bloom forming algae are opportunistic and reproduce rapidly

PHOTOSYNTHESIS



- **ALGAE ARE NATURAL, NOT “BAD”!**
- **NO ALGAE = NO LIFE ON EARTH!**



GOOD!

Whaler's Cove, Point Lobos
giant kelp forest

Photo: D. Gregorio, SWRCB

GOOD? OR BAD?

Surfrider Beach, west, algae

Photo: D. Gregorio, SWRCB

Nutrients

- **Plentiful nutrients**
 - water
 - carbon dioxide
- **Limiting macronutrients**
 - nitrogen (nitrate, nitrite, ammonia, urea)
 - phosphate
 - silicate (mostly for diatoms)
- **Limiting micronutrients (e.g., iron, others)**
- **Natural Sources**
 - upwelling
 - stream runoff
 - lightning
 - bacteria and cyanobacteria

Cultural Eutrophication = Pollution

- e.g., Los Angeles River is effluent dominated
- excessive nutrients
- algae take advantage and bloom



Photo: D. Gregorio, SWRCB



Red Tide, San Pedro Bay. *Heterosigma* bloom on May 15, 1998.

What happens at night?

- Respiration continues, using up oxygen
- This can be a problem during bloom conditions!

What happens when oxygen or a limiting nutrient is exhausted?

- Population crashes
- Bacterial decomposition, more O₂ depletion

Different groups

- **Microalgae**
 - blue green algae (usually benthic)
 - diatoms (major phytoplankton group, can be benthic)
 - dinoflagellates (major phytoplankton group)
 - others, including raphidophytes
- **Macroalgae - benthic seaweed**
 - green algae
 - brown algae (kelp)
 - red algae



Photo credit: Santa Monica BayKeeper

Cyanobacteria



Photo Credit: Wikipedia, Dr. Ralf Wagner

- a.k.a. blue-green algae, but not always blue-green!
- one of the first life forms?
- prokaryotes - simple cells
- often forms chains
- organic cell walls - peptodiglycan
- nitrogen fixers - N_2 into organic N - heterocysts
- some are toxic (microcystins, anatoxins, saxitoxins)

Dinoflagellates

- single cell eukaryotes
- phytoplankton - red tides
- dormant benthic stage
- can be heterotrophic
- active swimmers
- asexual and sexual reproduction
- bioluminescent
- organic cell walls (cellulose)
- some are toxic (saxitoxins), e.g. Paralytic Shellfish Poisoning (PSP)



Photo: D. Gregorio SWRCB



Photo courtesy Dr. Rick Pieper, SCMI



© 2001 Photo courtesy of Brian Bill Northwest Fisheries Science Center

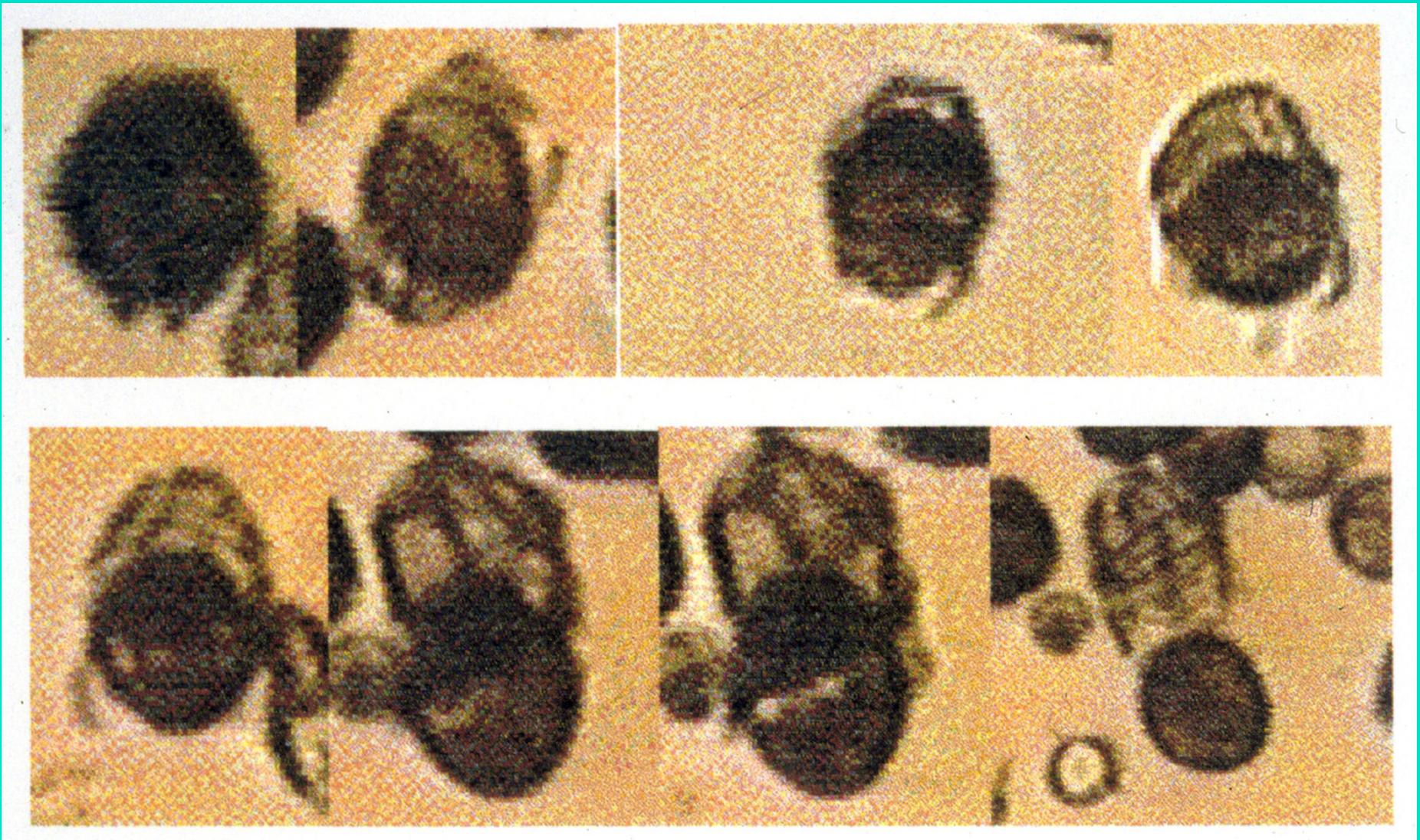


Photo: D. Gregorio, SWRCB

Lingulodinium polyedra bloom crashes, naked cells erupt

Red tides

- naturally occurring - recorded as early as 1746
- usually dinoflagellates
- but not always!
- raphidophytes can also cause red tides

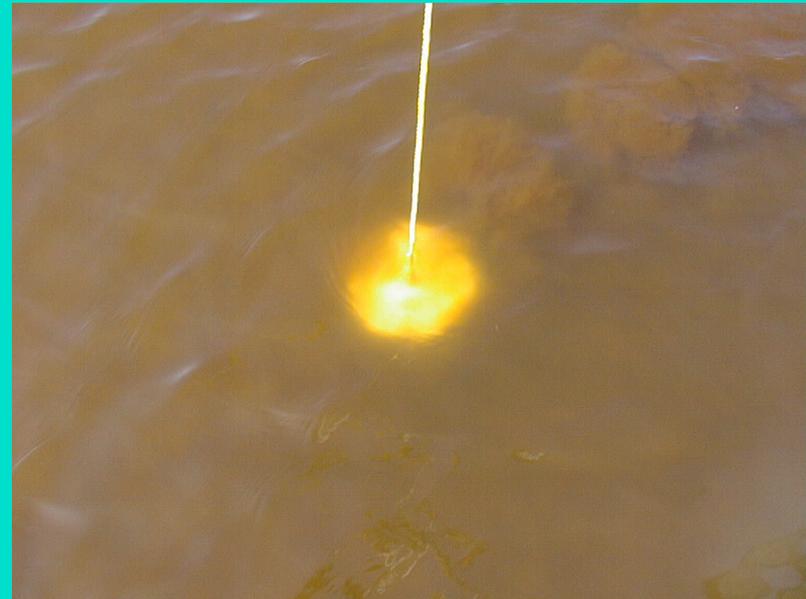


Photo: D. Gregorio, SWRCB

Raphidophytes

- single cell eukaryotes
- no rigid cell wall
- swimmers
- *Heterosigma akashiwo*
- an exotic species, introduction probably from ballast water
- toxic to fish



Photos: D. Gregorio, SWRCB

Diatoms

- single cell eukaryotes
- asexual and sexual reproduction
- silicate cell walls
- pennate and centric forms, also colonial chains
- phytoplankton and benthic forms
- only some are toxic, e.g.
Pseudo-nitzschia - domoic acid -
amnesic shellfish poisoning



Photo: Oregon DFW

Green Algae

- multicellular eukaryotes
- alternating haploid and diploid life stages
- sporophytes and gametophytes are benthic
- spores and gametes swim
- usually nontoxic but can deplete O₂
- Bloom formers are often filamentous (e.g. *Chaetomorpha*, *Cladophora*)
- An invasive marine form: *Caulerpa* – pretty yet noxious



Photo: D. Gregorio SWRCB



Photo: NOAA NOS

QUESTIONS???

- **Are harmful algal blooms increasing in frequency?**
- **Are we just paying more attention?**
- **Where are they natural, and where are they caused by man?**
- **Which actions cause blooms?**
 - **Waste discharges: agricultural runoff, storm runoff and sewage discharges?**
 - **Habitat modification (e.g., harbors and marinas)?**
 - **Species introduction (aquariums, ship ballasts and hulls, etc.)?**
 - **Other causes?**