Marine Ecosystem Analyses

Dr. A C Anil
CSIR-National Institute of Oceanography
acanil@nio.org

Ecosystem

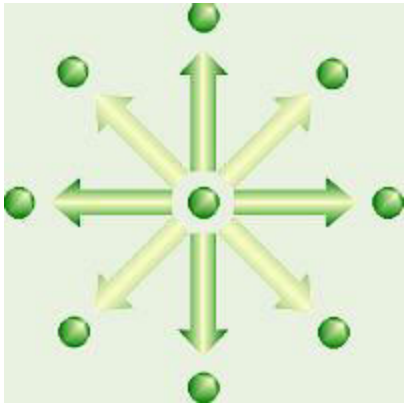
A system formed by the interaction of a community of organisms with their physical environment

Ecology

The branch of biology concerned with the relations between organisms and their environment .

Autecology

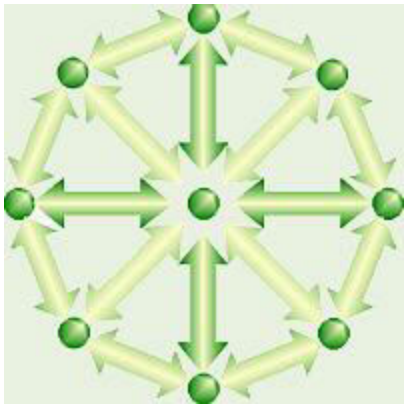
Also called **Species Ecology,** the study of the interactions of an individual organism or a single species with the living and nonliving factors of its environment. **Autecology** is primarily experimental and deals with easily measured variables such as light, humidity, and available nutrients in an effort to understand the needs, life history, and behaviour of the organism or species.



So: Encyclopedia brittanica

Synecology

Also called **Biocenology, Biosociology, or Community Ecology,** study of a group or community of organisms and their relationships to each other and to their common environment. Synecological concepts, such as those dealing with nutrient cycling and energy budgets, are based on descriptive analysis of the community. This subdivision of ecology can be further separated according to environmental types, such as terrestrial…



So: Encyclopedia brittanica

Indian Coastline

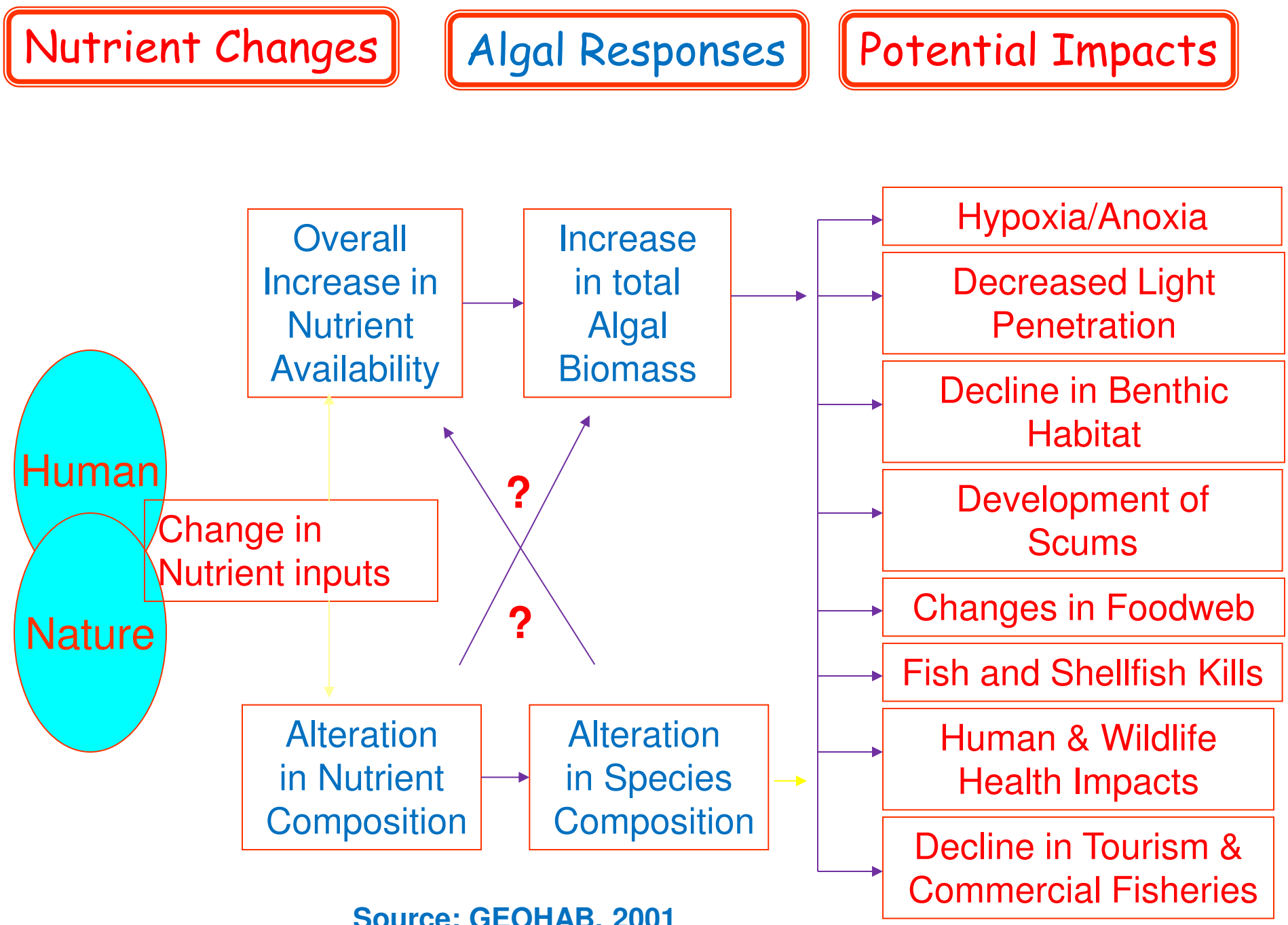
- ✓ India is bounded by water on 3 sides
- ✓ Arabian Sea in the west, Bay of Bengal in the East, Indian Ocean in the South
- ✓ The Indian coastline runs over a distance of 7500 km
- ✓ The coastal belt comprises of a wide range of ecosystems - sandy beaches, mangroves, coral reefs and rocky shores

India has a variety of natural coastal ecosystems

- ✓ The Western coastline has a wide continental shelf and is marked by backwaters and mud flats
- ✓ The east coast is low-lying with lagoons, marshes, beaches and deltas rich in mangrove forests
- ✓ Coral reefs are predominant on small islands in the Gulf of Kutch in Gujarat, Gulf of Mannar in Tamil Nadu and on Lakshadweeep and Andaman and Nicobar groups of islands

Eutrophication

A process of increased organic enrichment of an ecosystem, generally through increased nutrient inputs (Nixon, 1995)



Source: GEOHAB, 2001

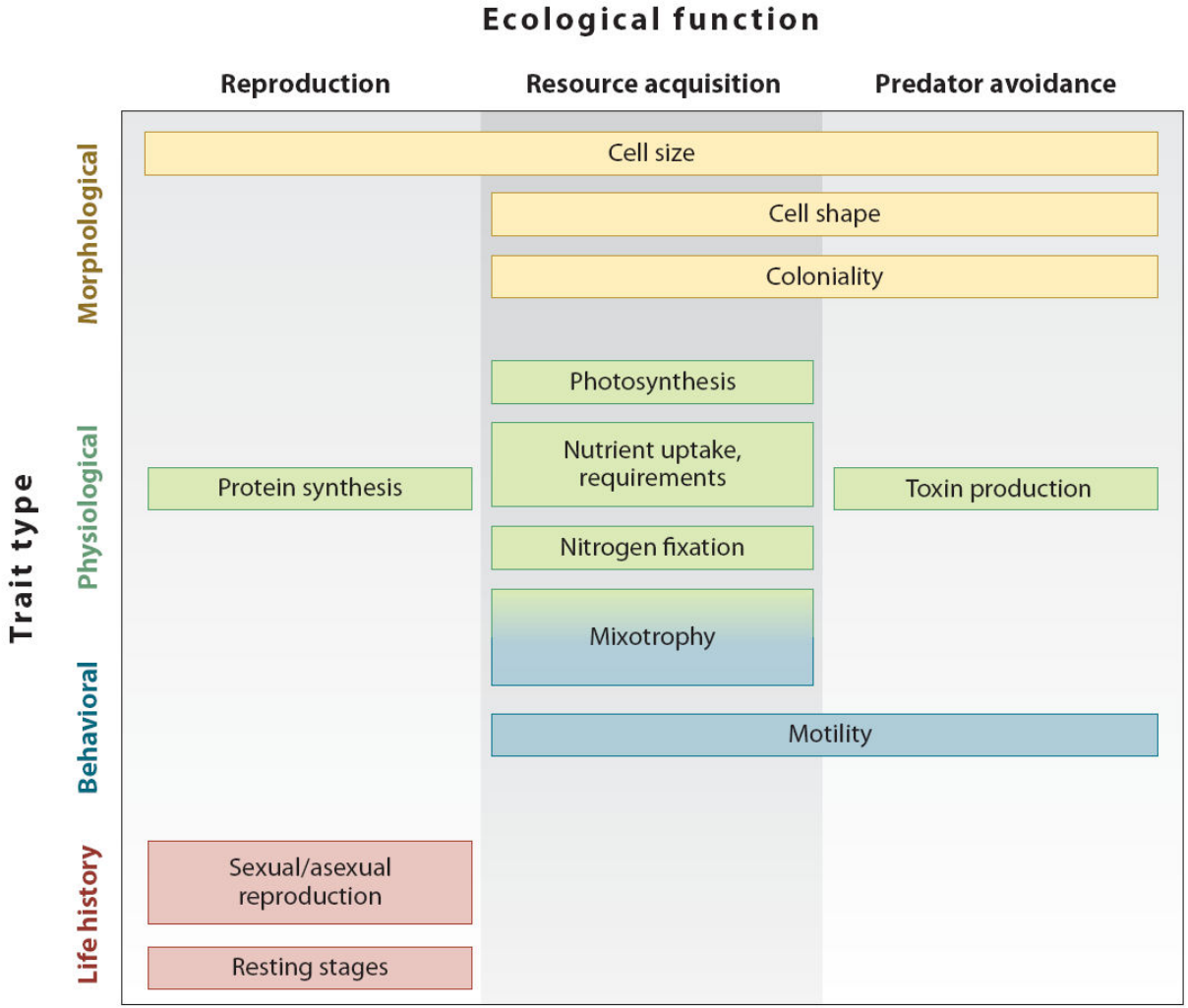
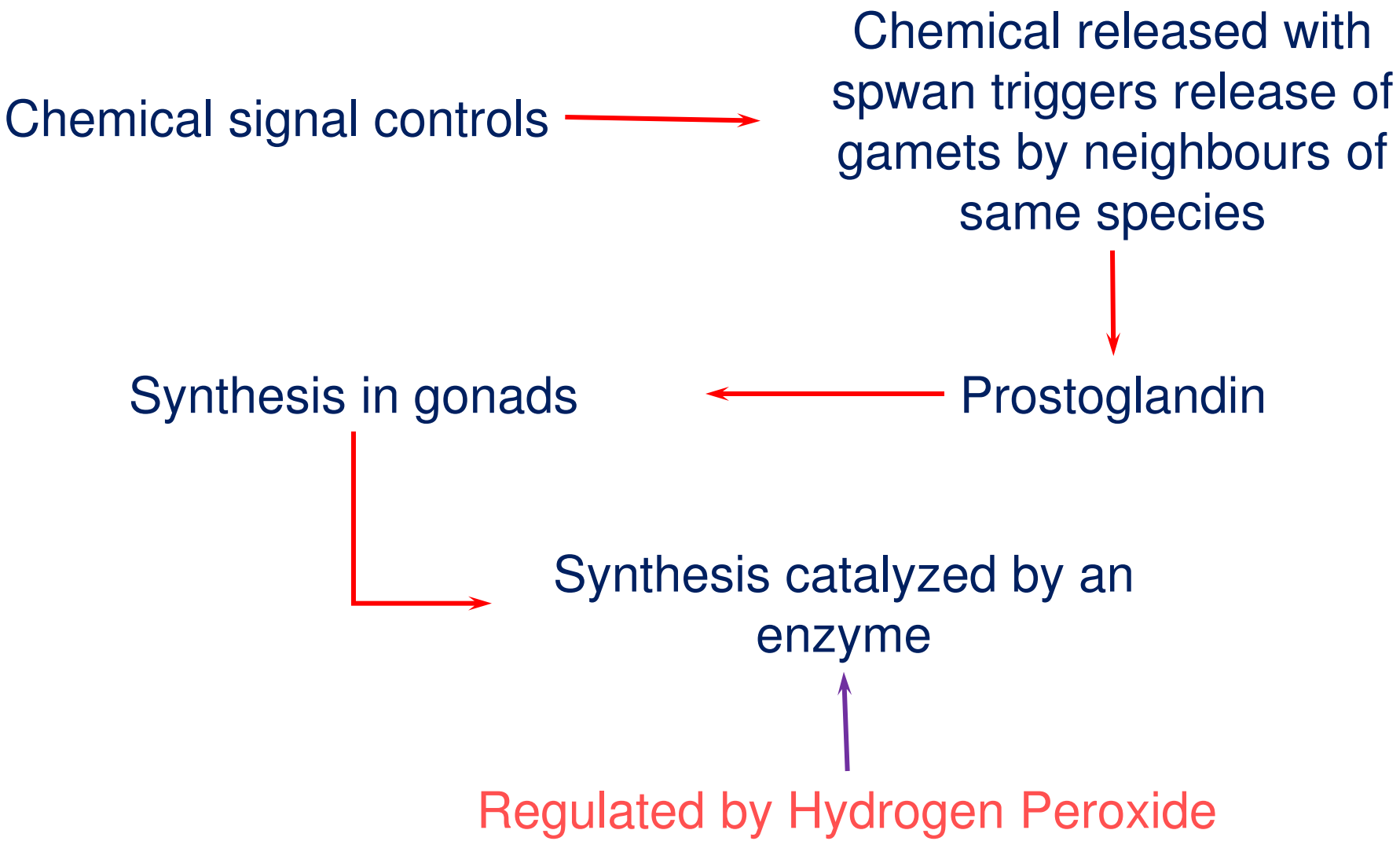


Figure 1

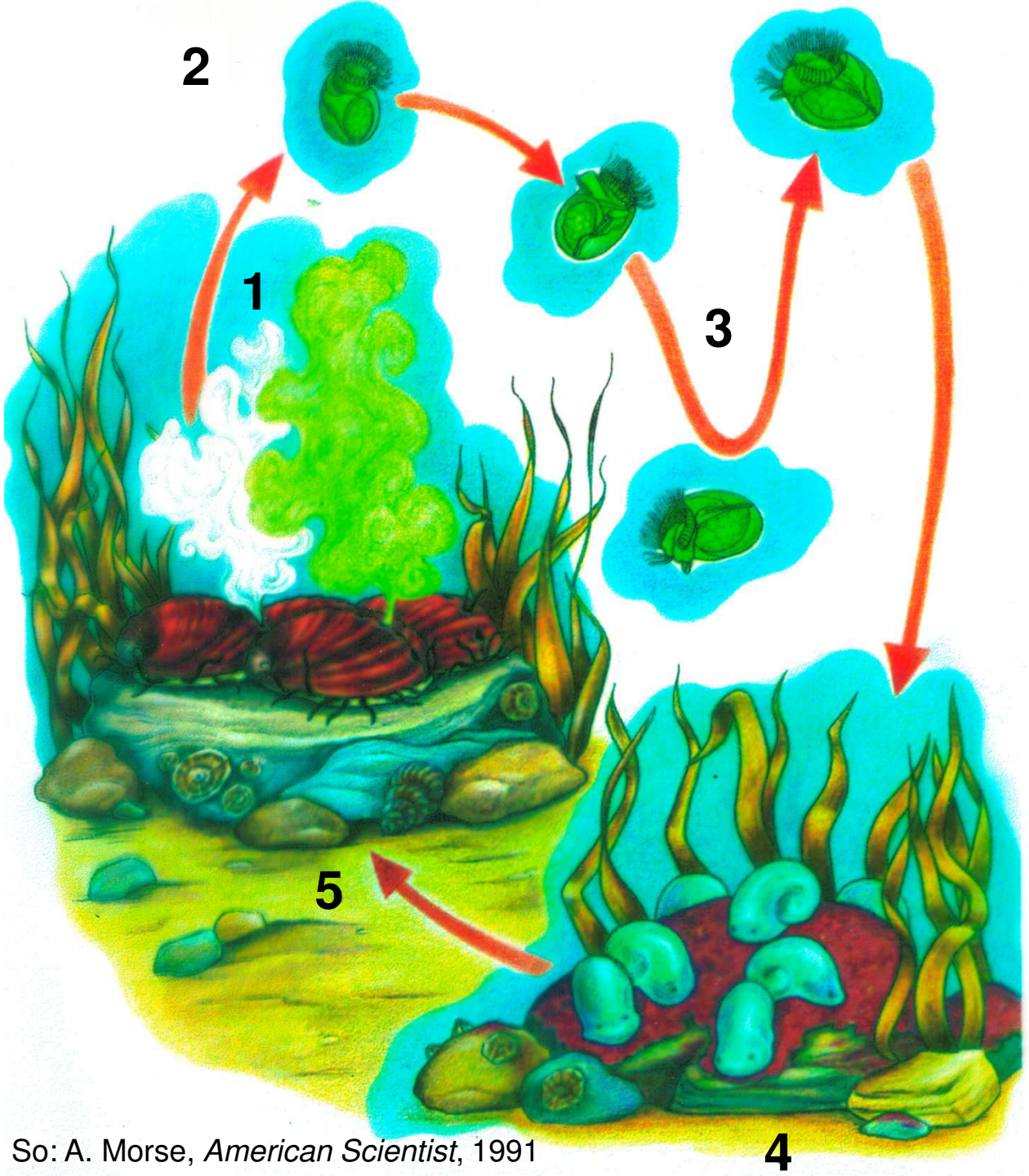
A typology of phytoplankton functional traits.

Elena Litchman[1] and Christopher A. Klausmeier[2]

How do planktonic larvae know where to settle



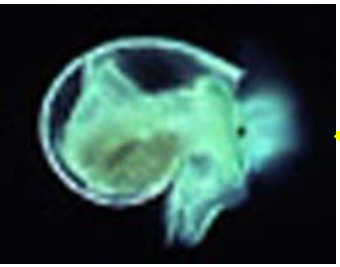
Life cycle of red abalone



So: A. Morse, *American Scientist*, 1991

Signals required for metamorphosis

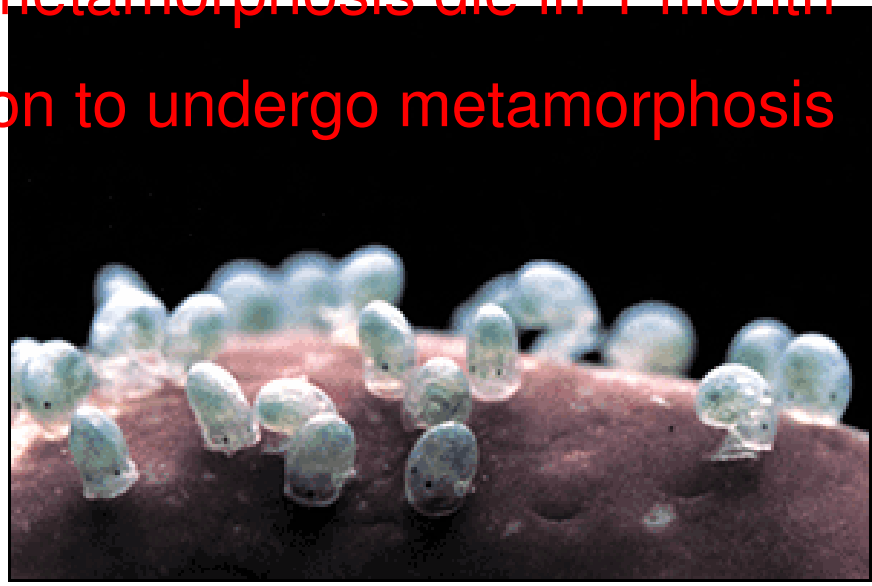
Abalone larva



Metamorphosis in 1 week

No metamorphosis die in 1 month

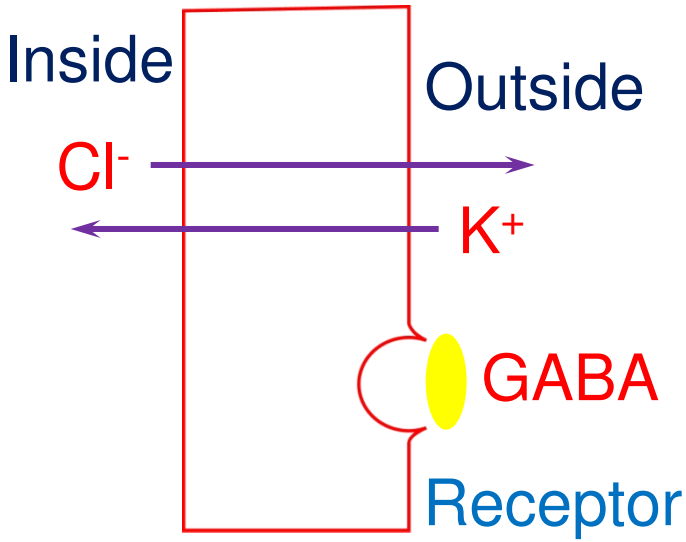
Require stimulation to undergo metamorphosis



Juvenile abalone – exclusively on crustose corraline red algae

Chemical recognition on red algae induce metamorphosis

GABA – Mimetic peptide



Inducer

↓

Enzymatic reaction

↓

Opens tiny channels in membrane of receptor cell

↓

Ion exchange

↓

Depolarizes cell

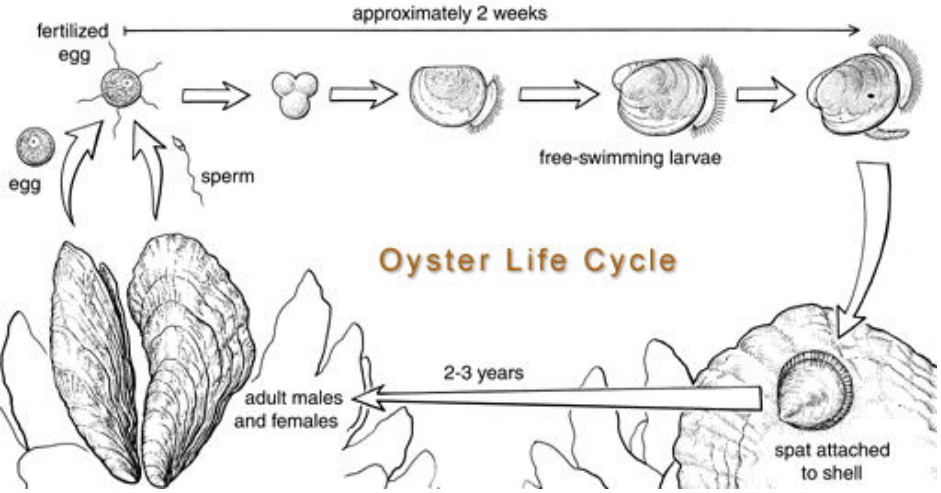
↓

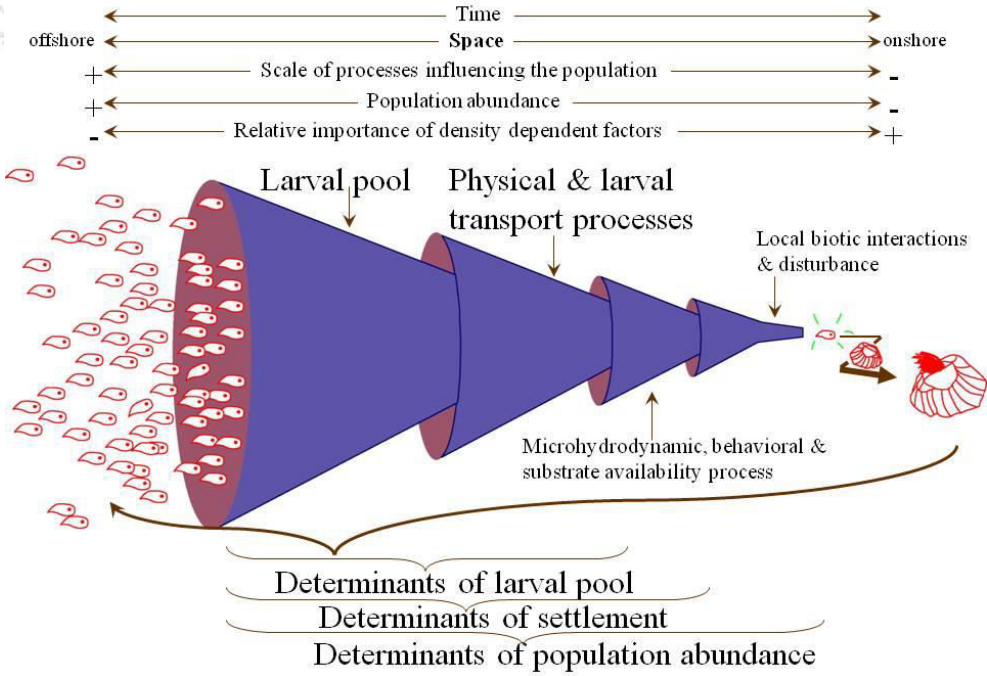
Electrochemical signal to the nervous system

↓

Coordinates metamorphosis

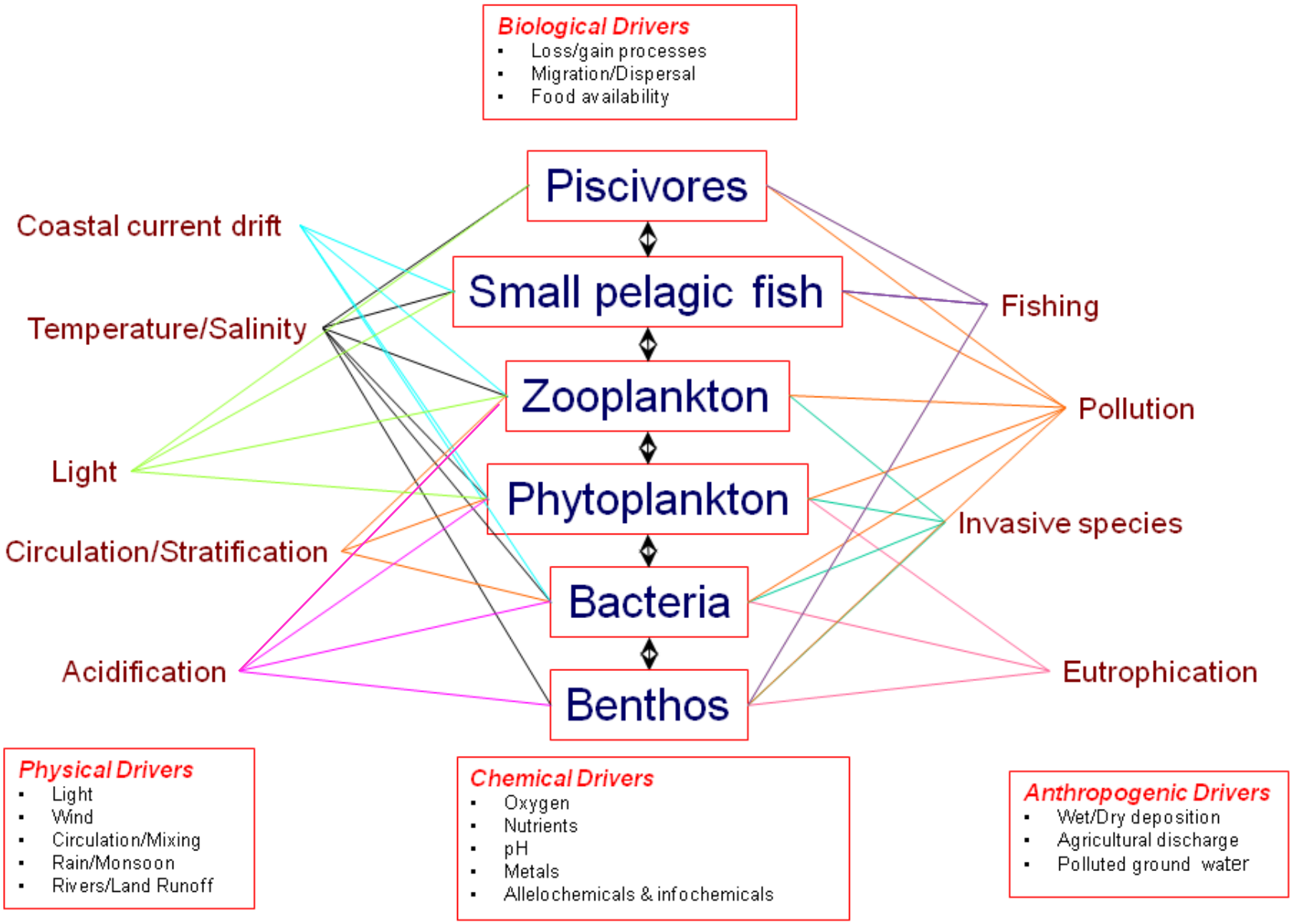
Inter-tidal and estuarine ecosystems



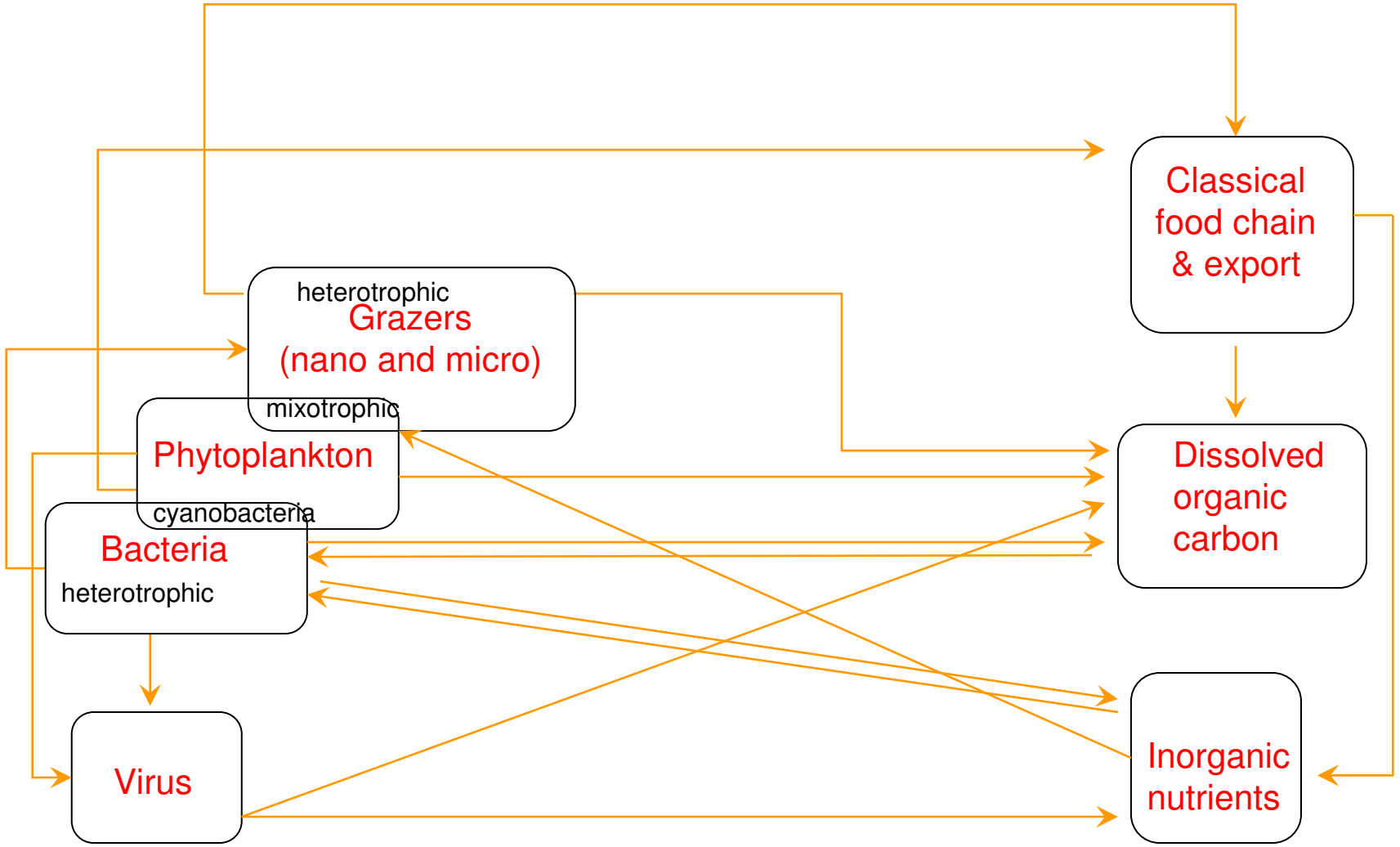


So: Jesús Pineda, Oceanography of the Eastern Pacific, 1 (2000) 84-105

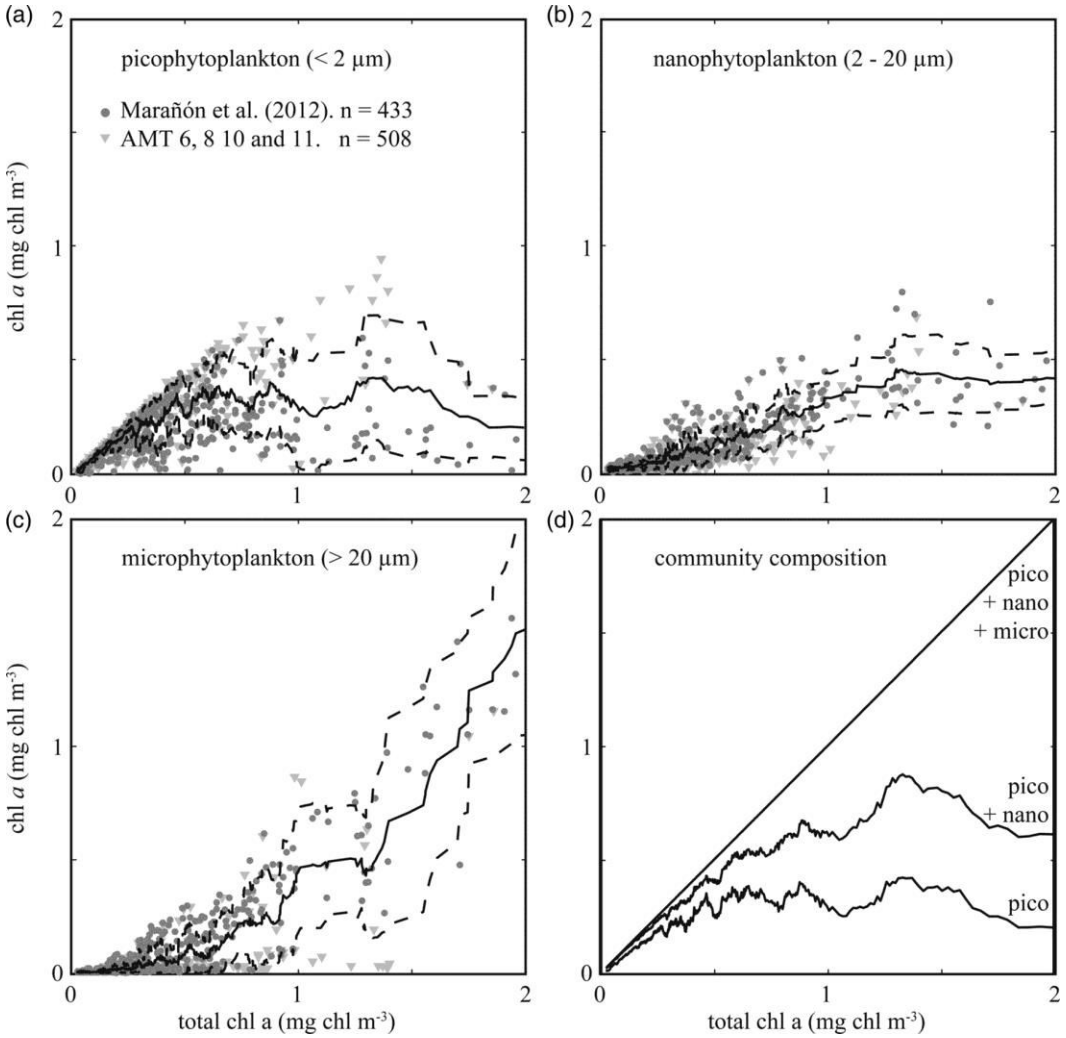
Schematic of an ecosystem model



Major components of the marine microbial food web and their interactions



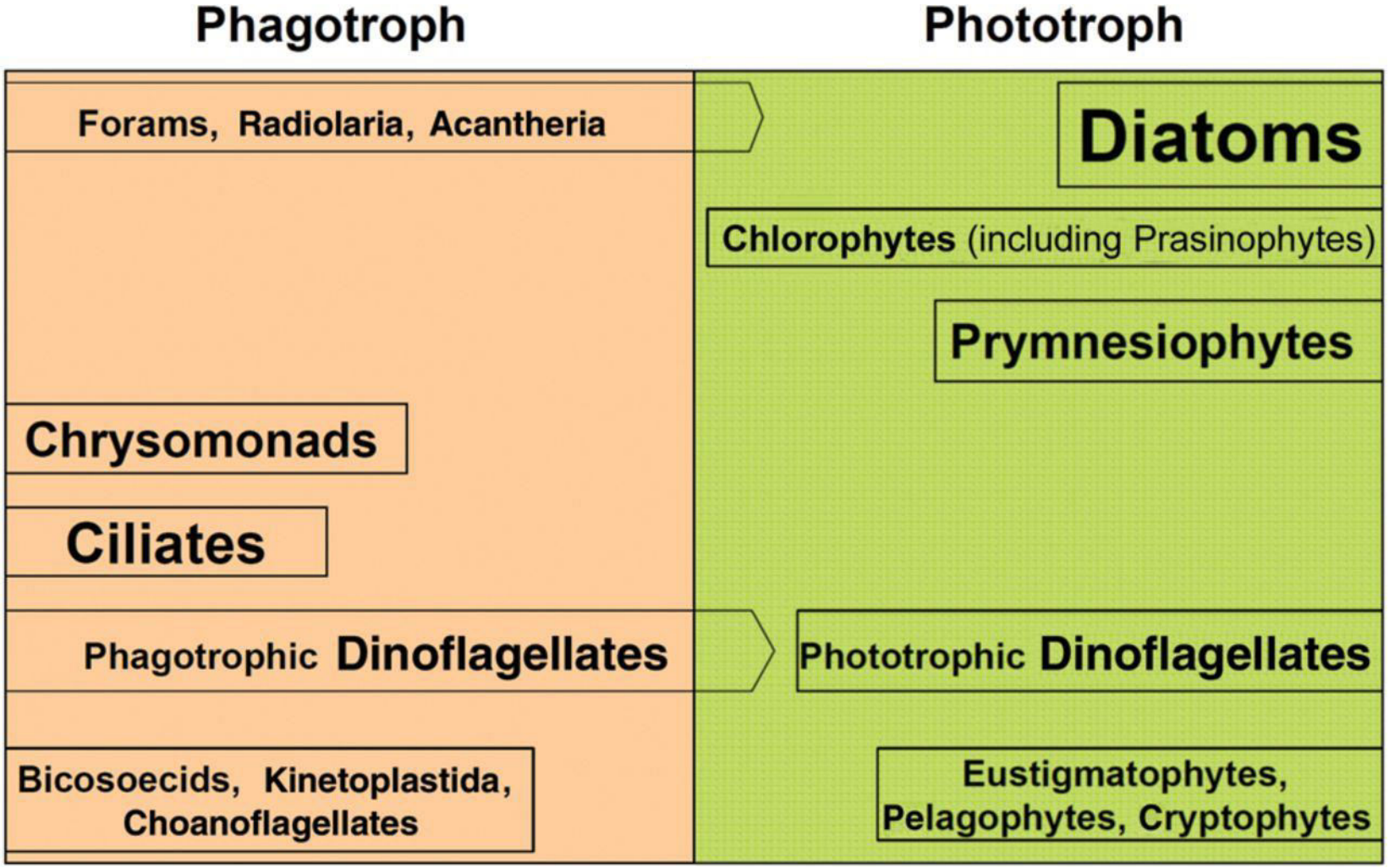
Chlorophyll a size fractionation.



Ben A. Ward et al. J. Plankton Res. 2013;plankt.fbt097

Journal of Plankton Research

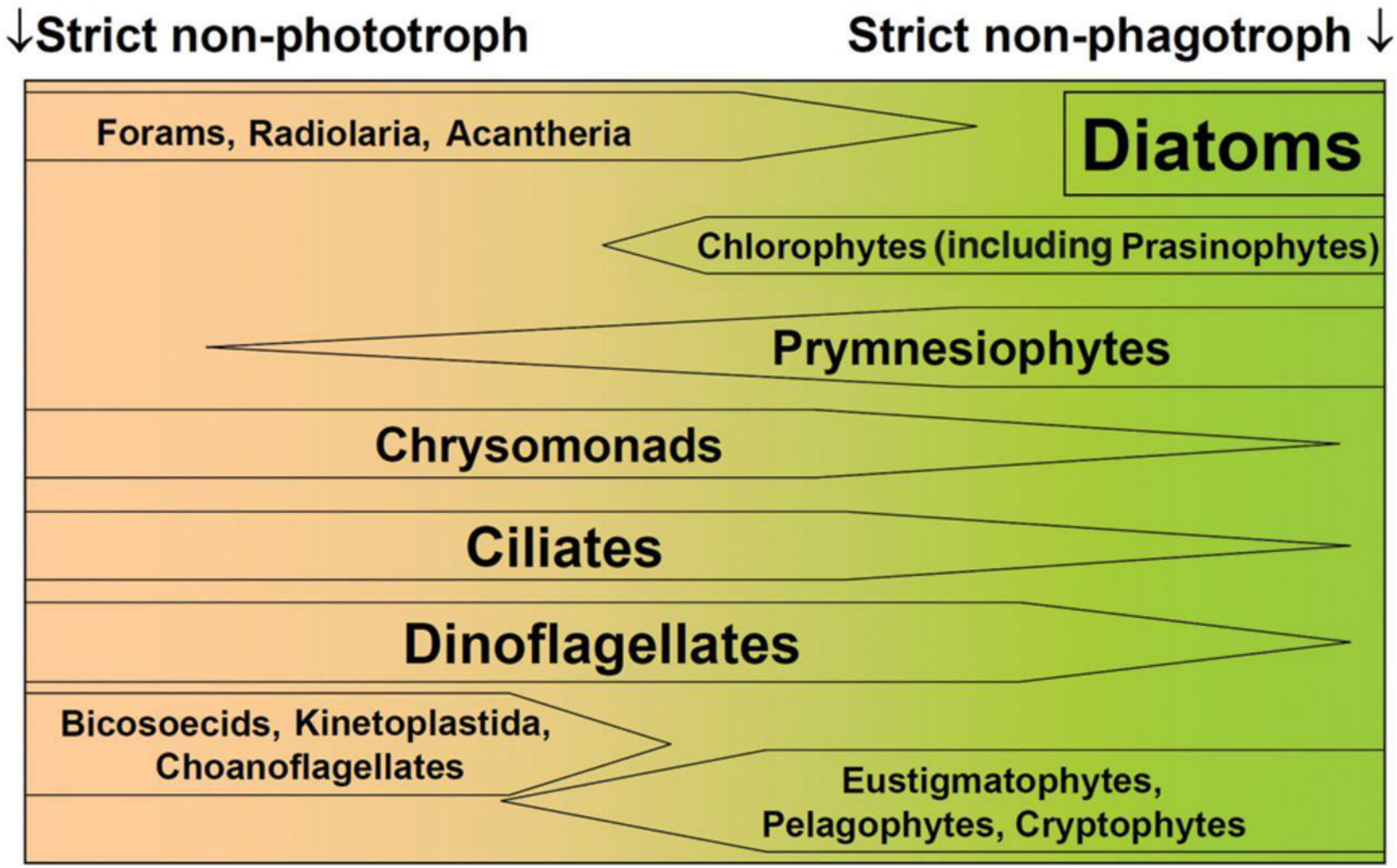
Schematic showing the classic misrepresentation of the functional classification of planktonic protists as contributors to primary production (on the right) or to secondary production (on the left).



Flynn K J et al. J. Plankton Res. 2013;35:3-11

Journal of Plankton Research

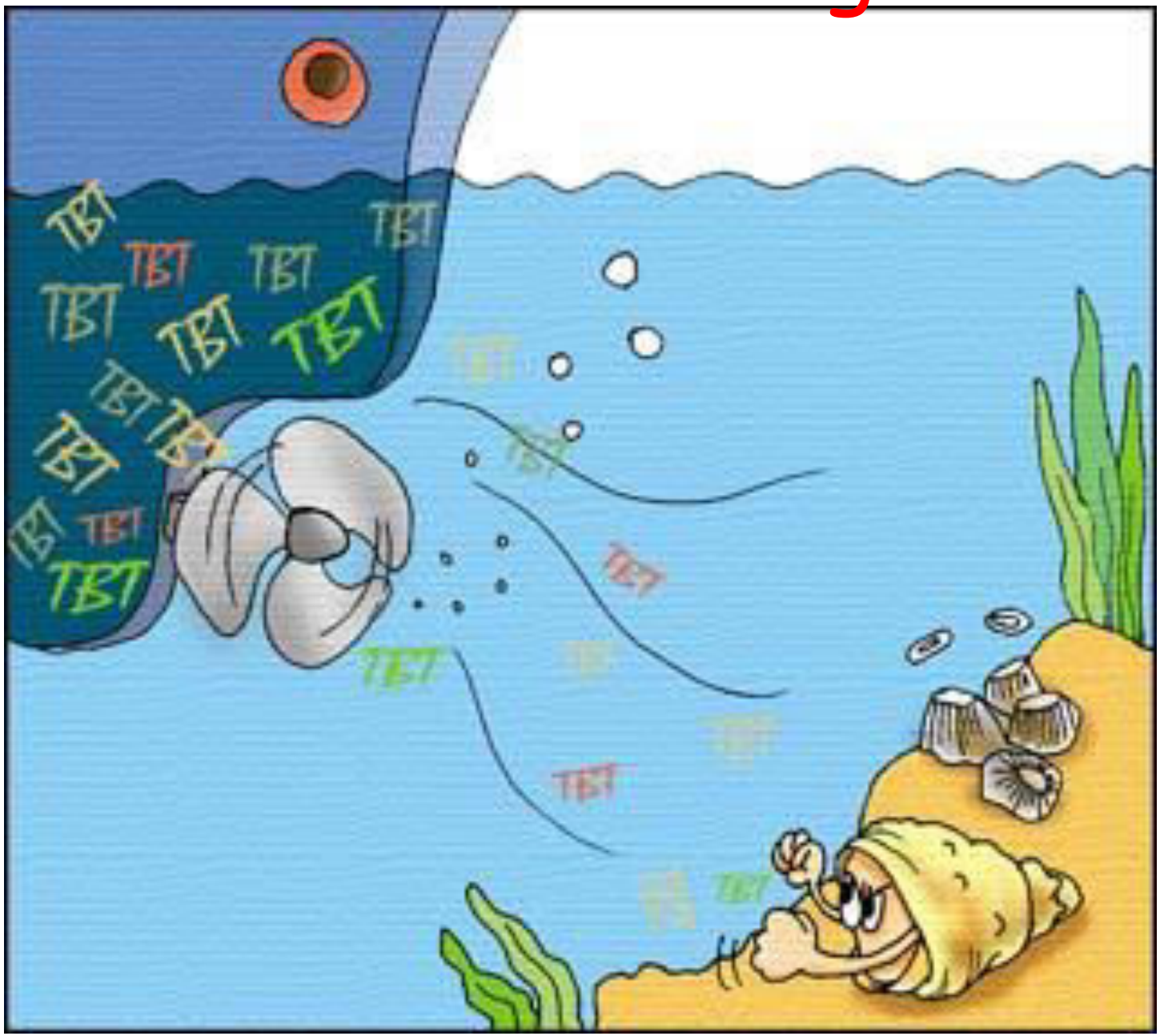
Schematic of the functional classification of planktonic protists as contributors to primary production (on the right) and/or to secondary production (on the left).



Flynn K J et al. J. Plankton Res. 2013;35:3-11

Journal of Plankton Research

Antifouling Paints



Antifouling Paints

Self-polishing co-polymer

↓

Organotin-biocide
Controlled release
Effective life ~ 5 yrs

↓

Diffusion
Hazardous to marine life

↓

Toxic effect observed
- ✓ Shell malformation in bivalves
- ✓ Depletion of oyster population
- ✓ Imposex in gastropods

- ➢ Soluble matrix
- ➢ Contact leaching

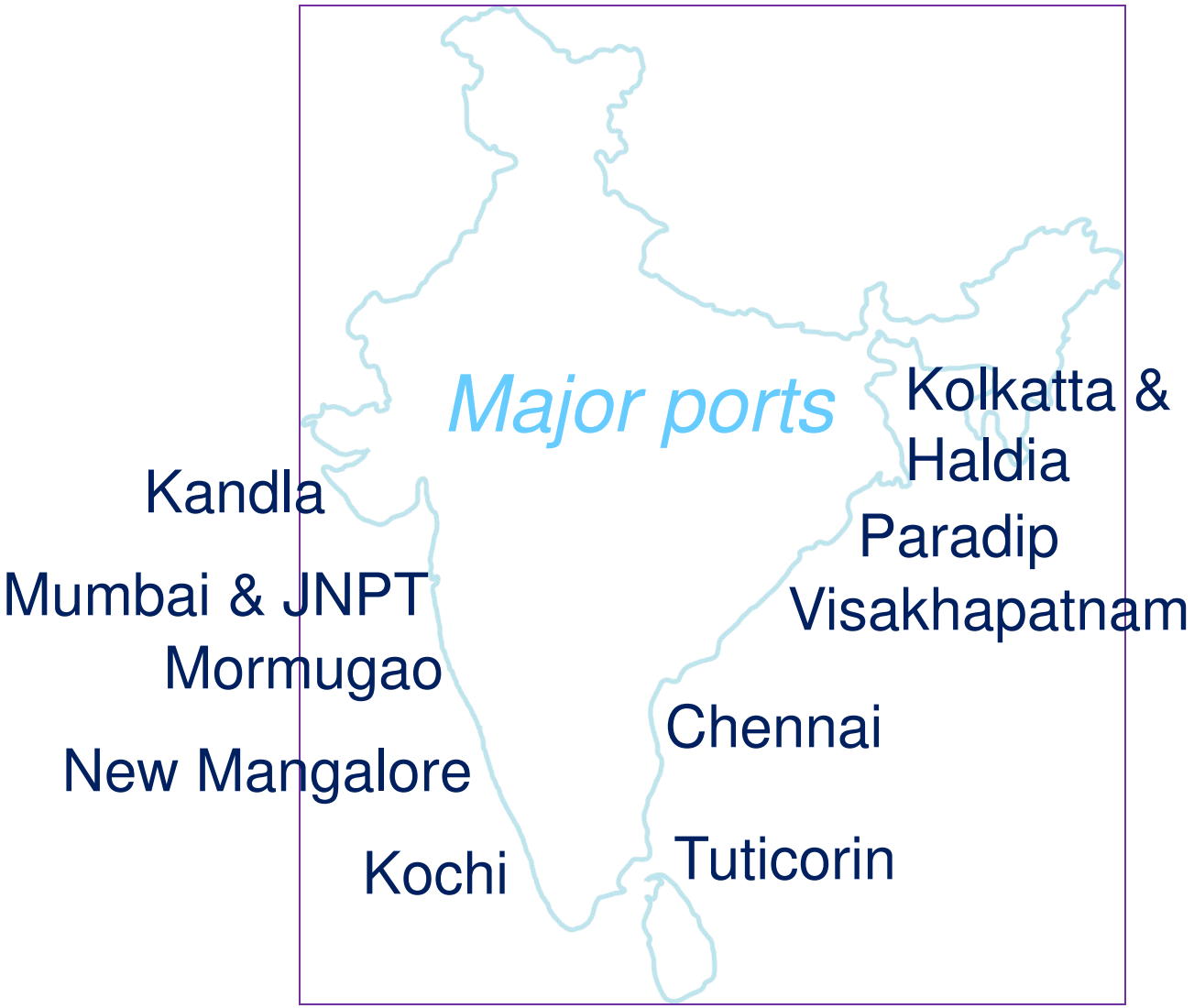
↓

Cuprous oxide

Primary biocide since mid 19th century

Effective: 18-24 months

- 7500 km coastline
- 12 major ports
- 163 minor and intermediate ports



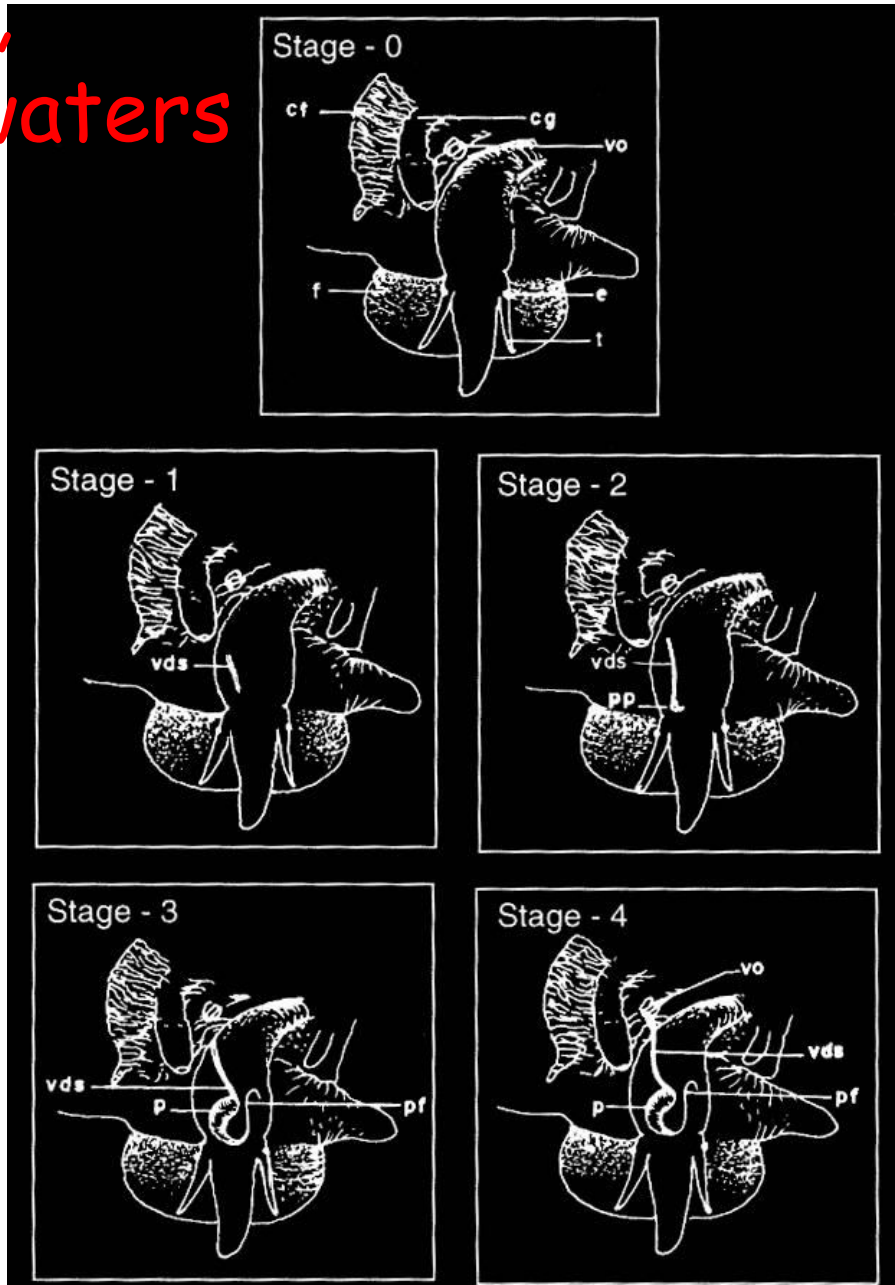
Estimates

- TBT as antifouling agent, is effective at a leaching rate of 16 micrograms/cm^2/day
- On an average each ship bottom of approximately 5000 m^2 below the water level, would leach 800 grams of TBT in a day
- An estimate thus reveals that nearly 20 kg. of TBT/day is released into the water column from the berthed ships alone in major ports (~ 25 ships)

Estimates

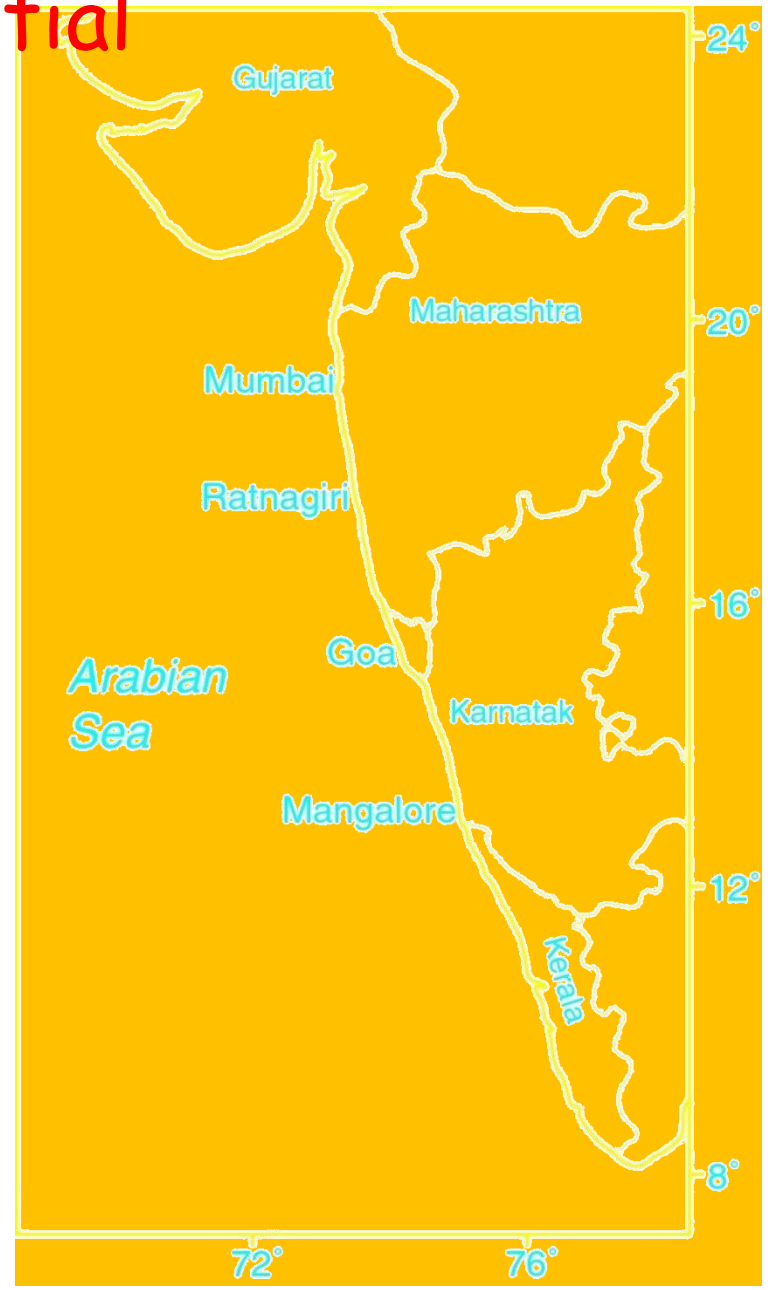
- TBT has been found to be damaging at levels 10-20 nanograms/liter
- 20 Kg. TBT leaching/day can make a water mass of 10^9 cubic meters above safe water target levels
- An area of 8 Sq. km. (15m depth) will be affected by one days leaching from berthed ships in a port

Record of imposex in *Cronia konkanensis* (Gastropoda, Muricidae) from Indian waters



So: Vishwakiran et al., *Mar. Env. Res. 1999*

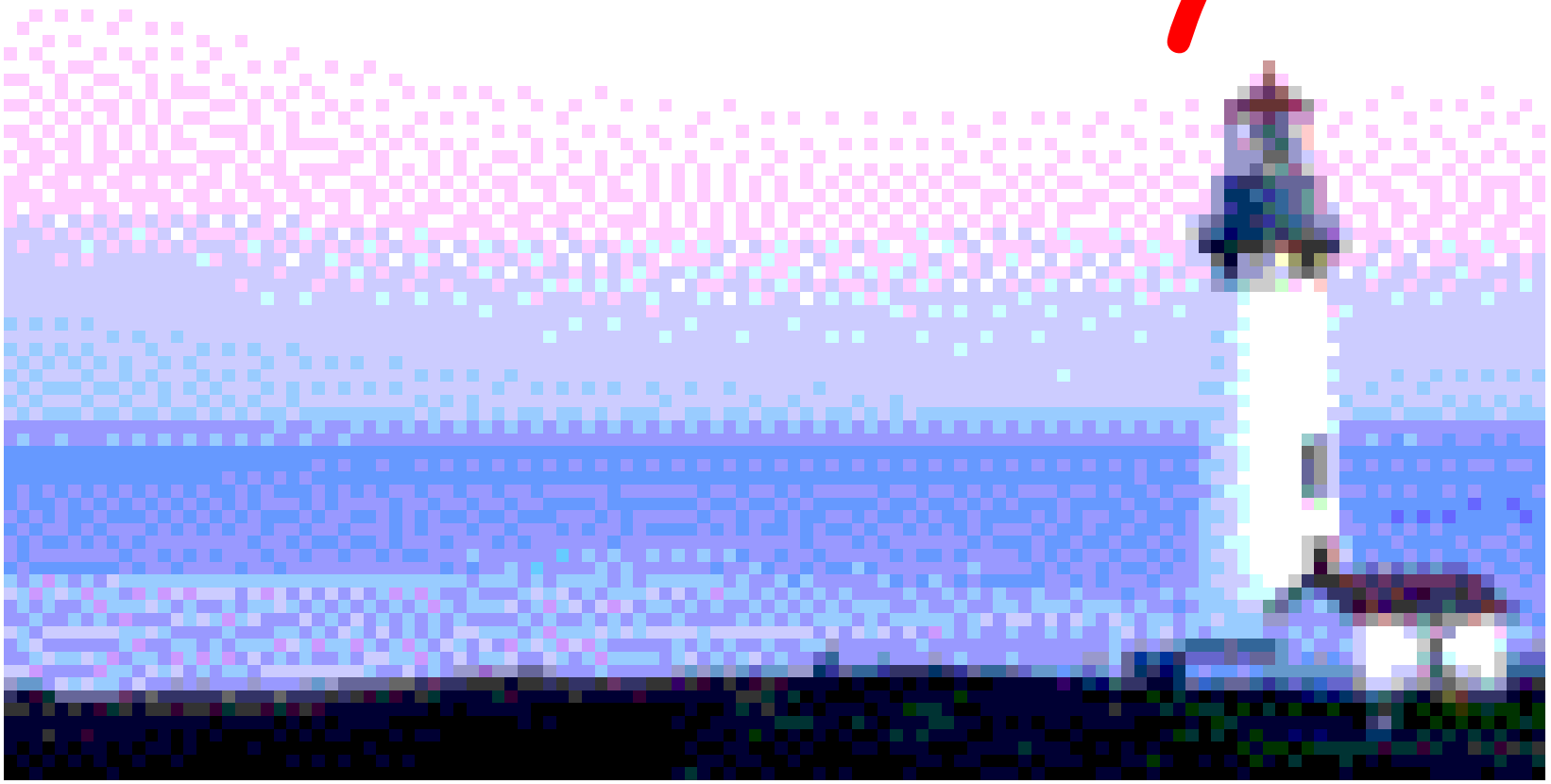
Gyrenium natator: A potential indicator of imposex along the Indian coast



So: Vishwakiran et al., *Chemosphere, 2005*

NIO
understanding the seas

Thank you



Visit: www.nio.org