



BIODIVERSITY: PAST, PRESENT AND FUTURE

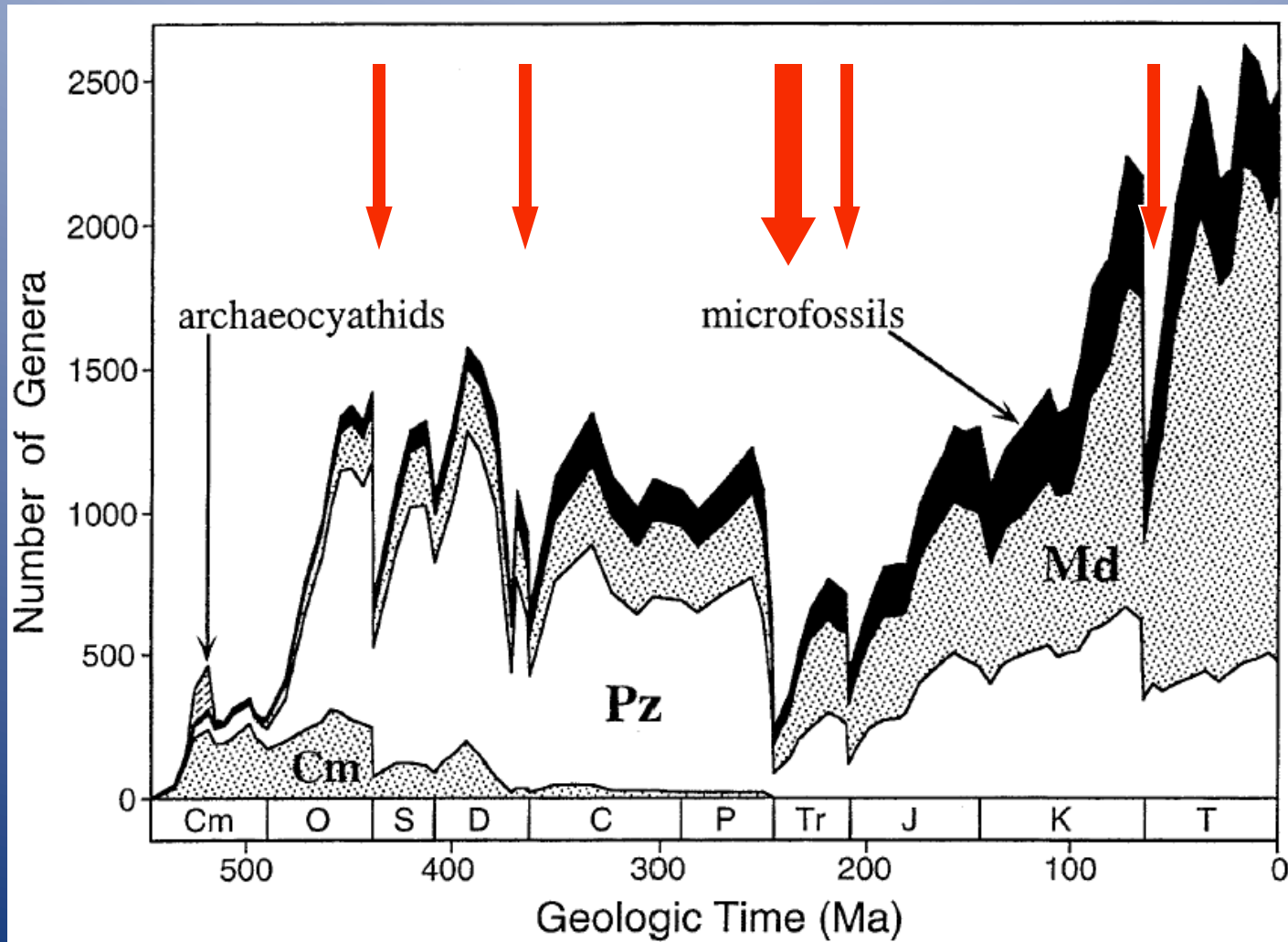
DOUGLAS H. ERWIN
DEPT. OF PALEOBIOLOGY
NATIONAL MUSEUM OF
NATURAL HISTORY



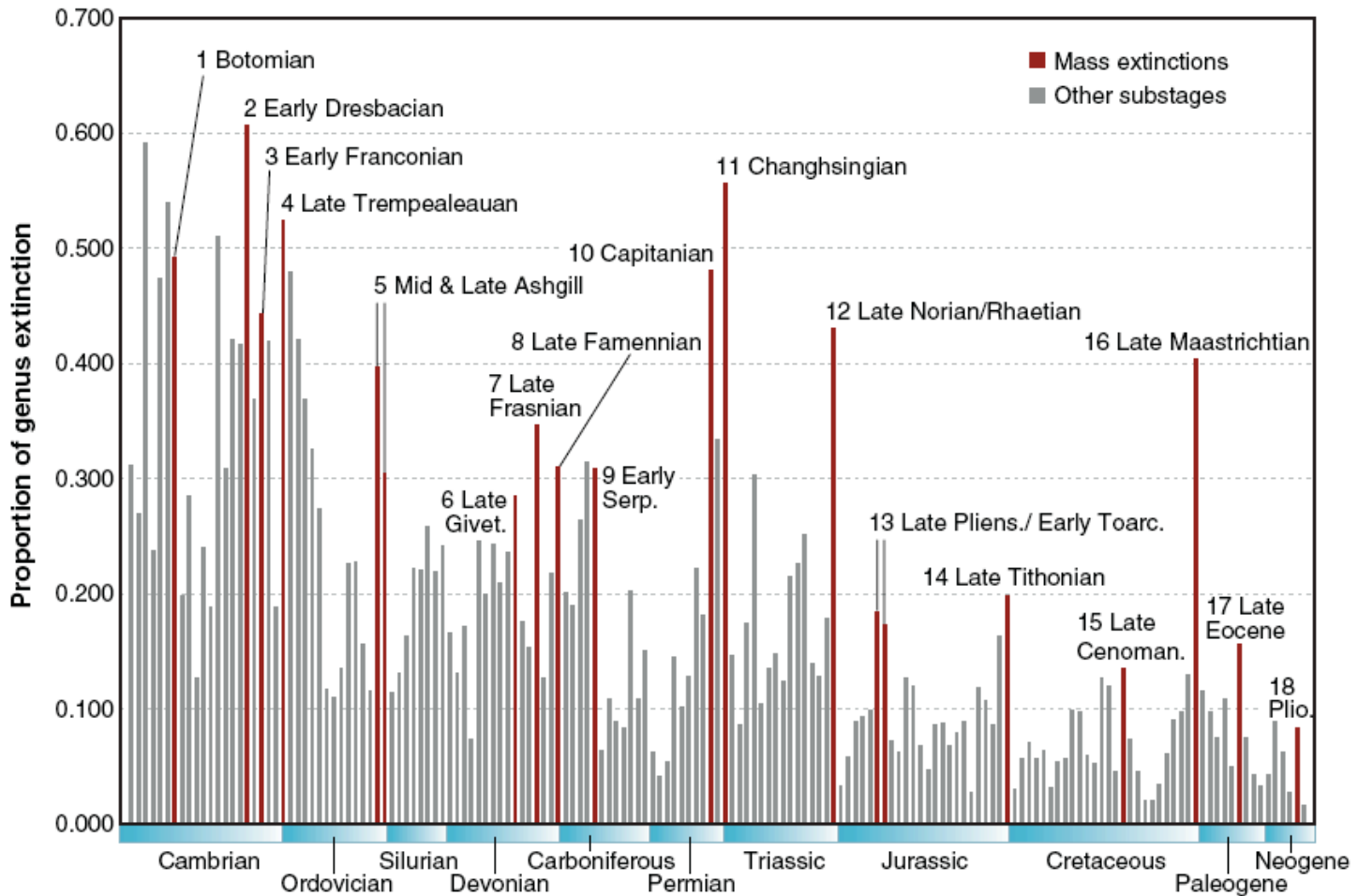
13. Plate 14.
1827 1827.

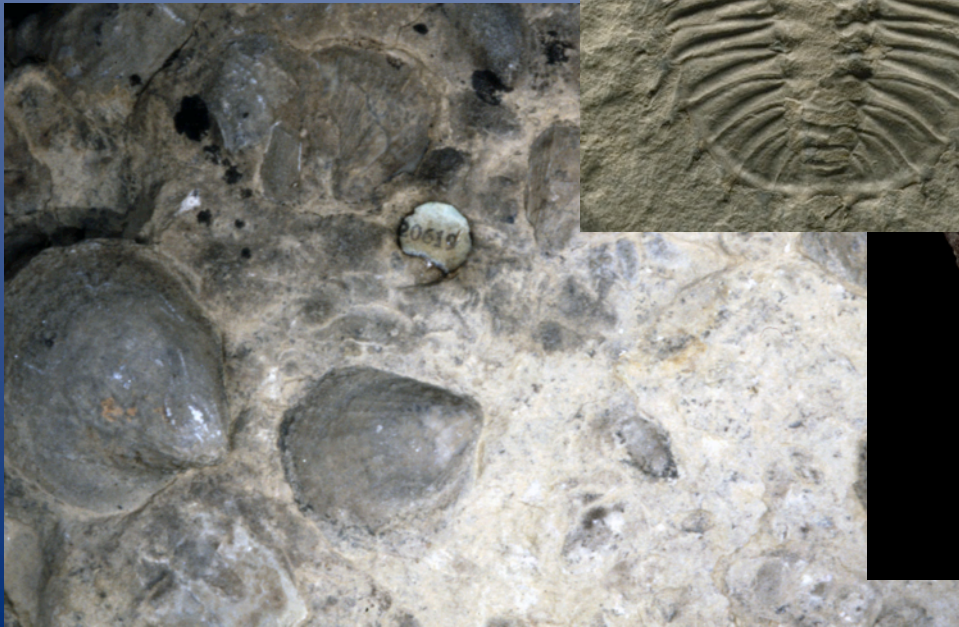
Rock Pouter
Columba migratoria

BIG FIVE MASS EXTINCTIONS

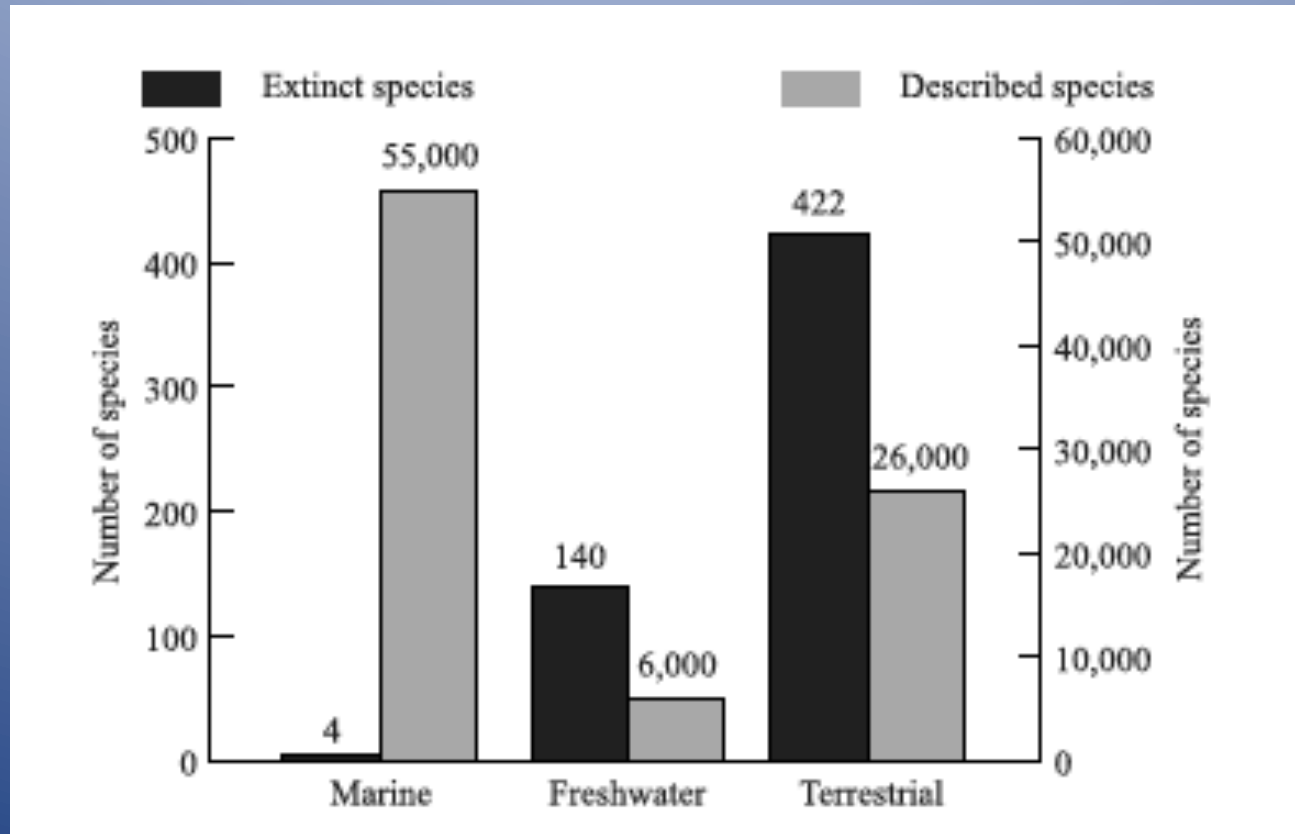


PHANEROZOIC MASS EXTINCTIONS

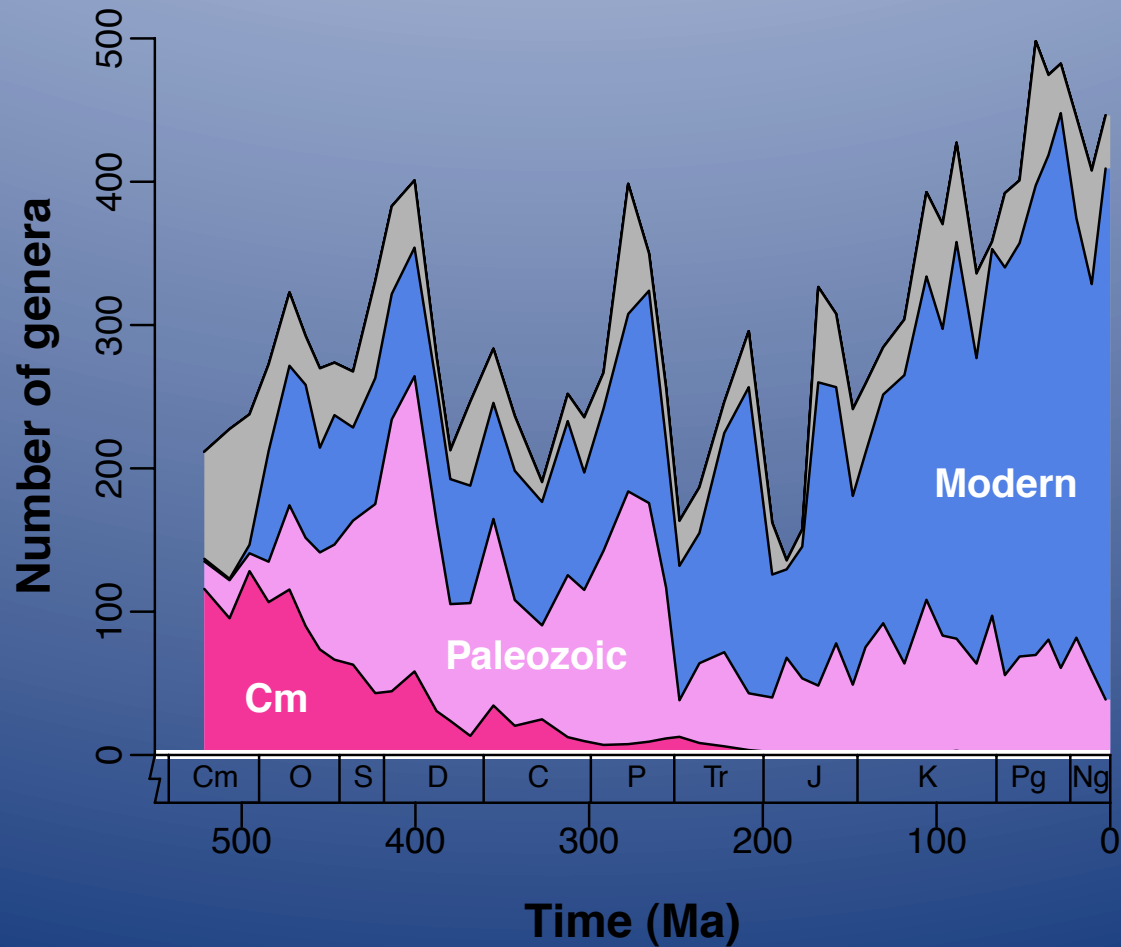




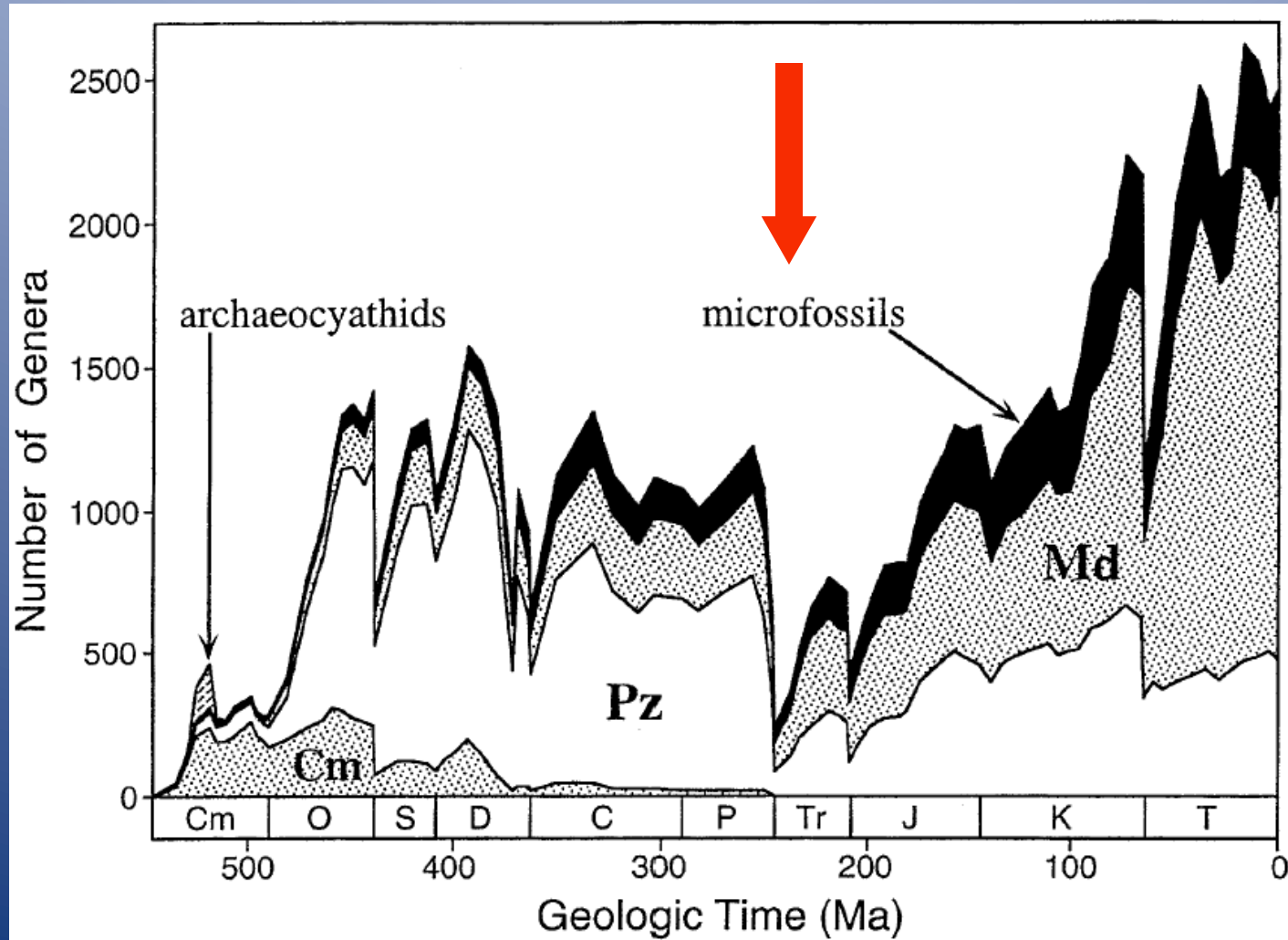
'MISSING' EXTINCTIONS



PHANEROZOIC HISTORY OF MARINE GENERA



END-PERMIAN MASS EXTINCTIONS



Sepkoski 1999



TRIASSIC SURVIVORS

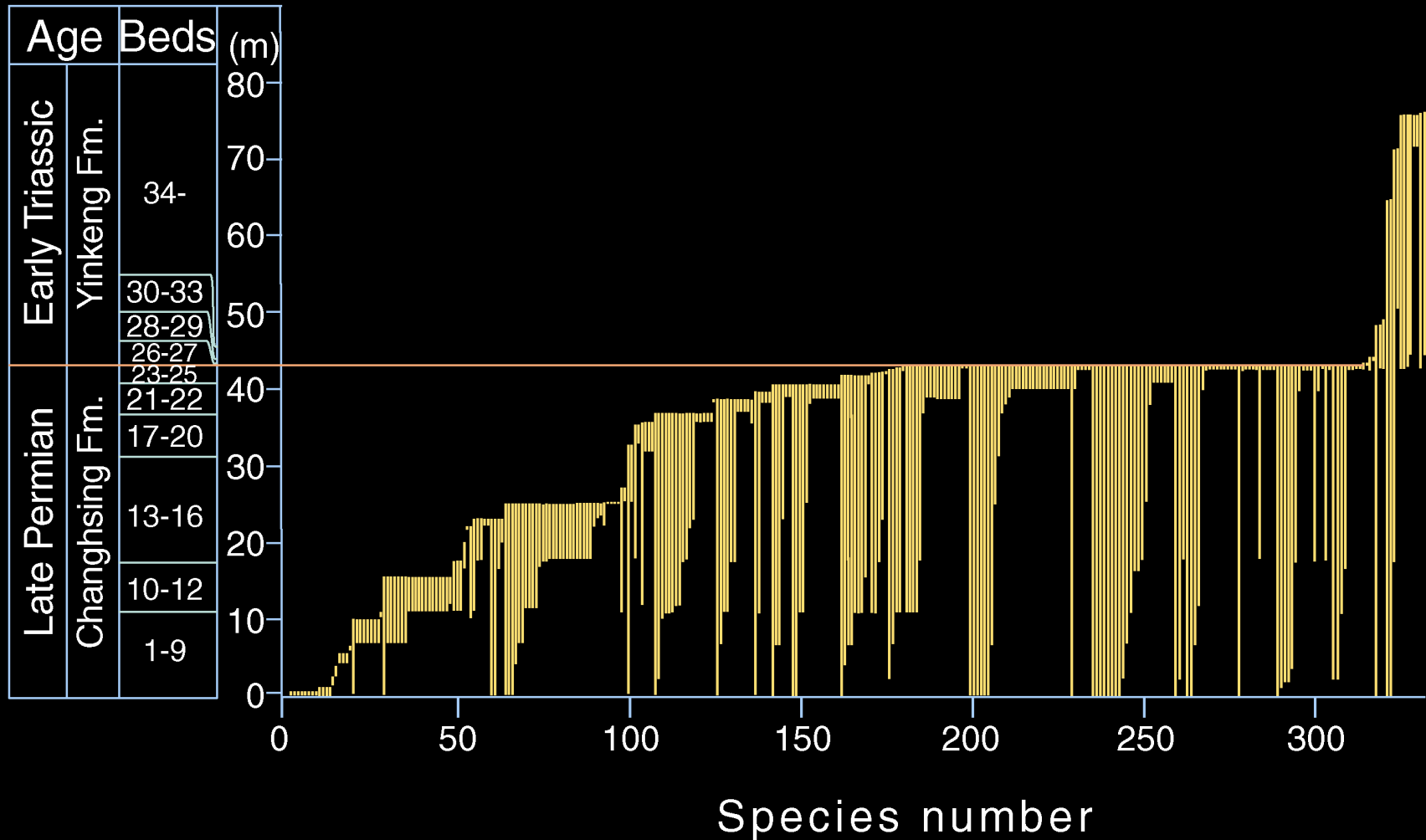


MARINE PT BOUNDARY: MEISHAN, CHINA

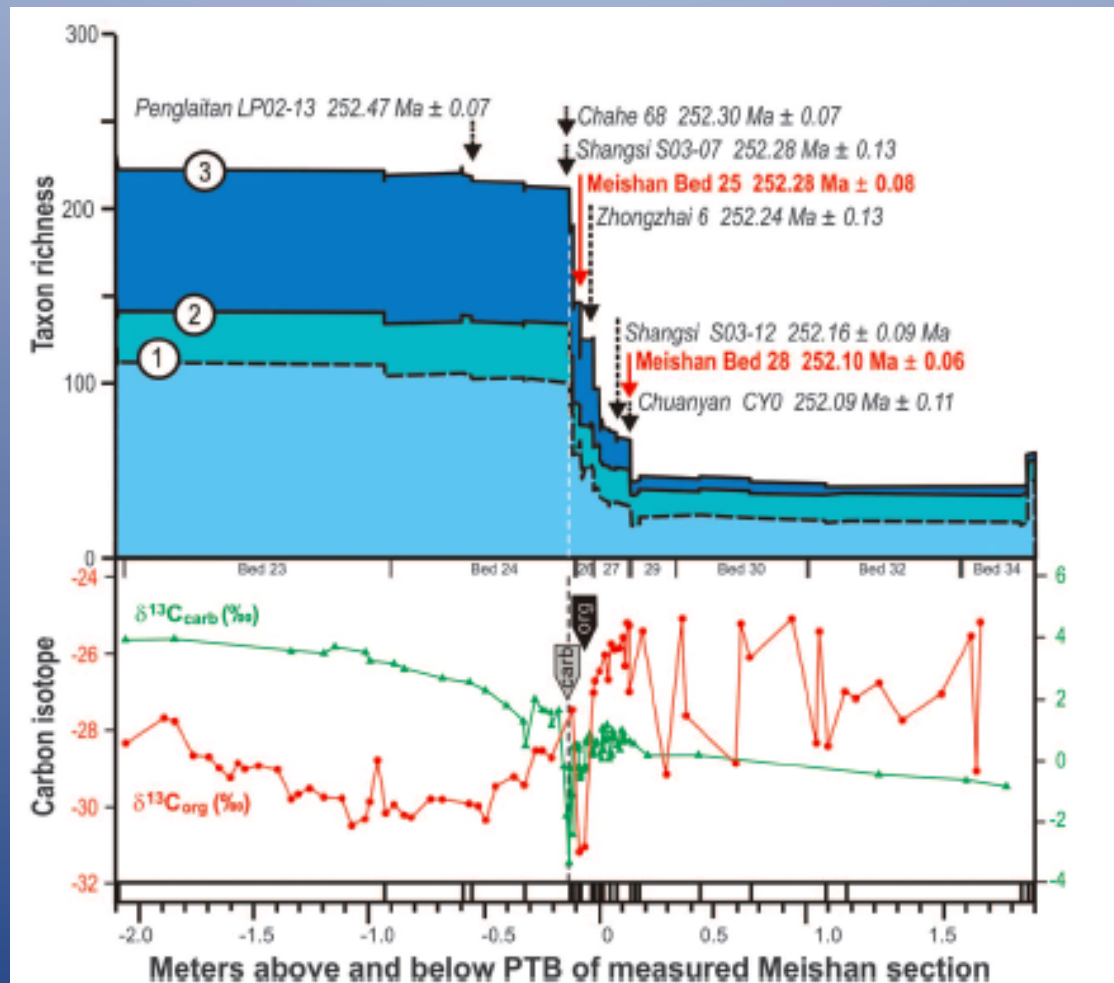


PT BOUNDARY : MEISHAN, CHINA

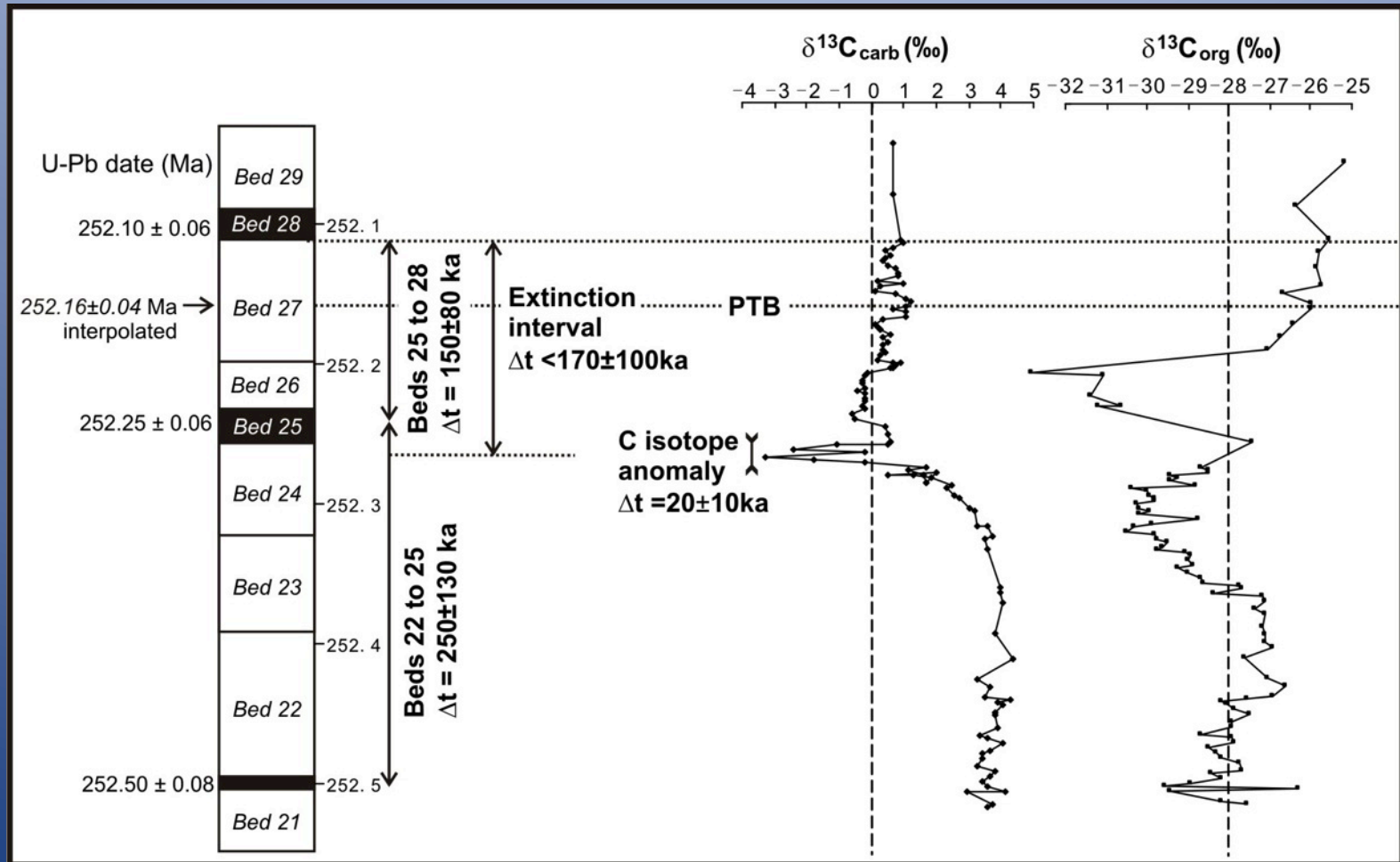
Extinctions by Thickness

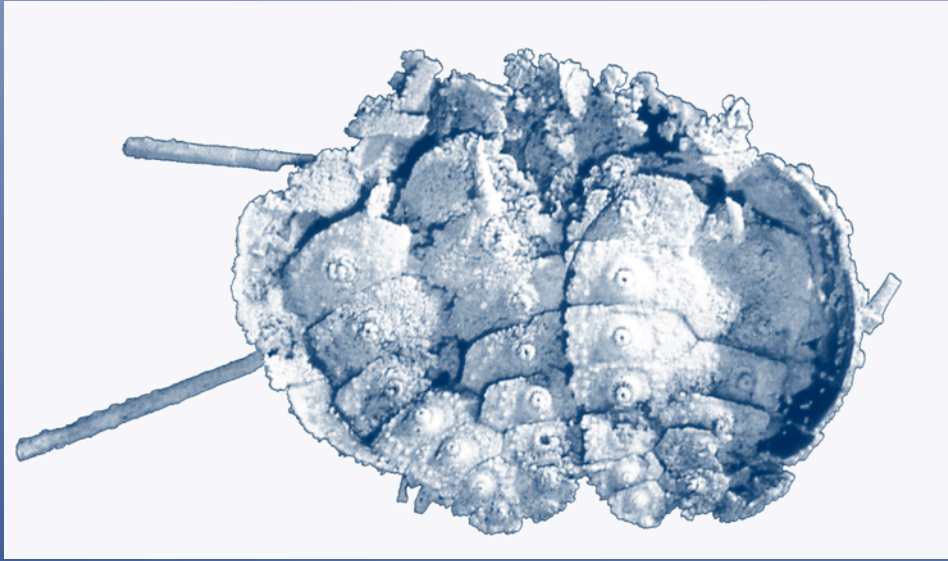


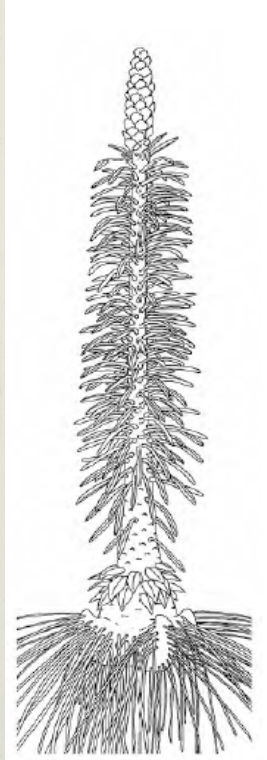
END-PERMIAN MASS EXTINCTION



END-PERMIAN MASS EXTINCTION







SHUMPETERIAN IMPERATIVE



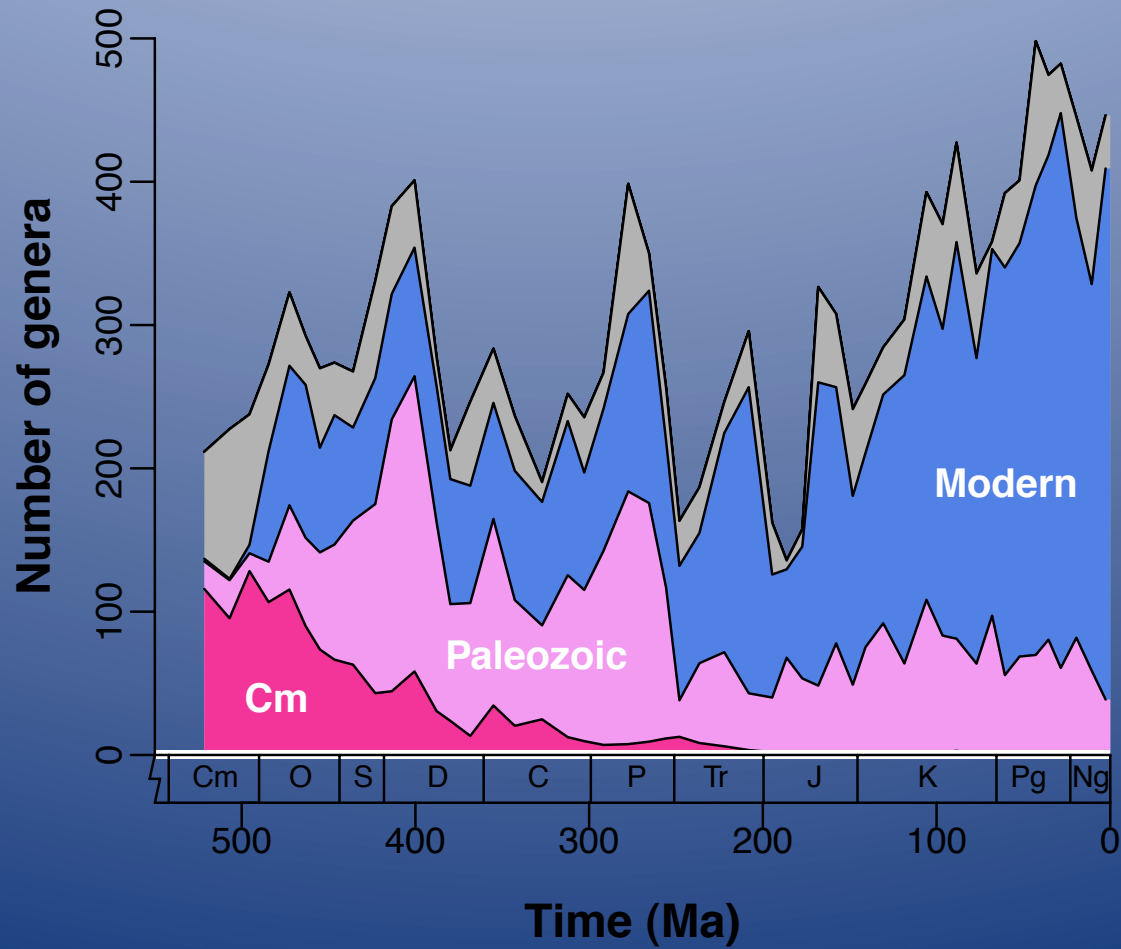
Joseph
Schumpeter
(1883-1950)

"The opening up of new markets and the organizational development from the craft shop and factory to such concerns as US Steel illustrate the process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one ... [The process] must be seen in its role in *the perennial gale of creative destruction*; it cannot be understood on the hypothesis that there is a perennial lull."

"Capitalism, Socialism and Democracy" (1942)

Joseph Schumpeter

TAXIC DIVERSITY



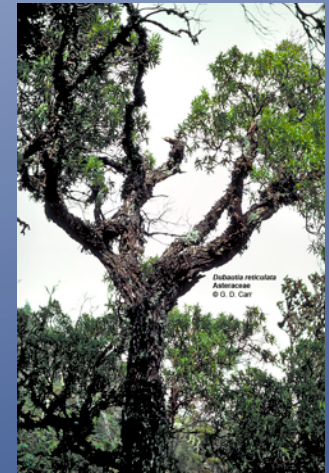
ADAPTIVE RADIATION OF HAWAIIAN SILVERSWORDS



Carlquistia
California



Argyroxiphium
sandwicense
ssp. macrocephalum



Dubautia
reticulata



Dubautia waialealae

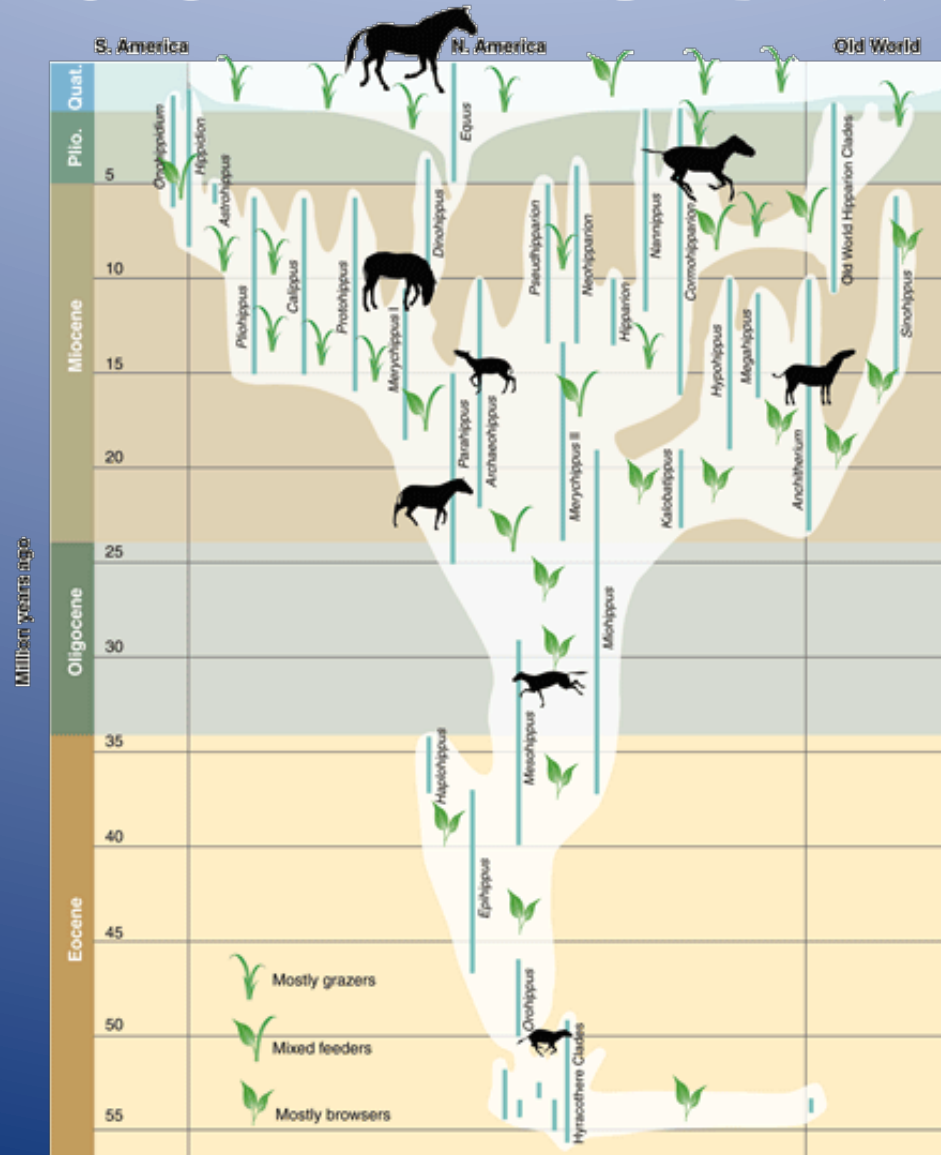


Dubautia latifolia

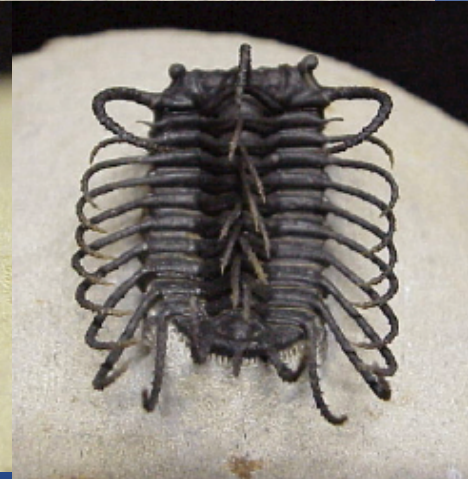
All photos from Hawaiian Silversword Alliance website



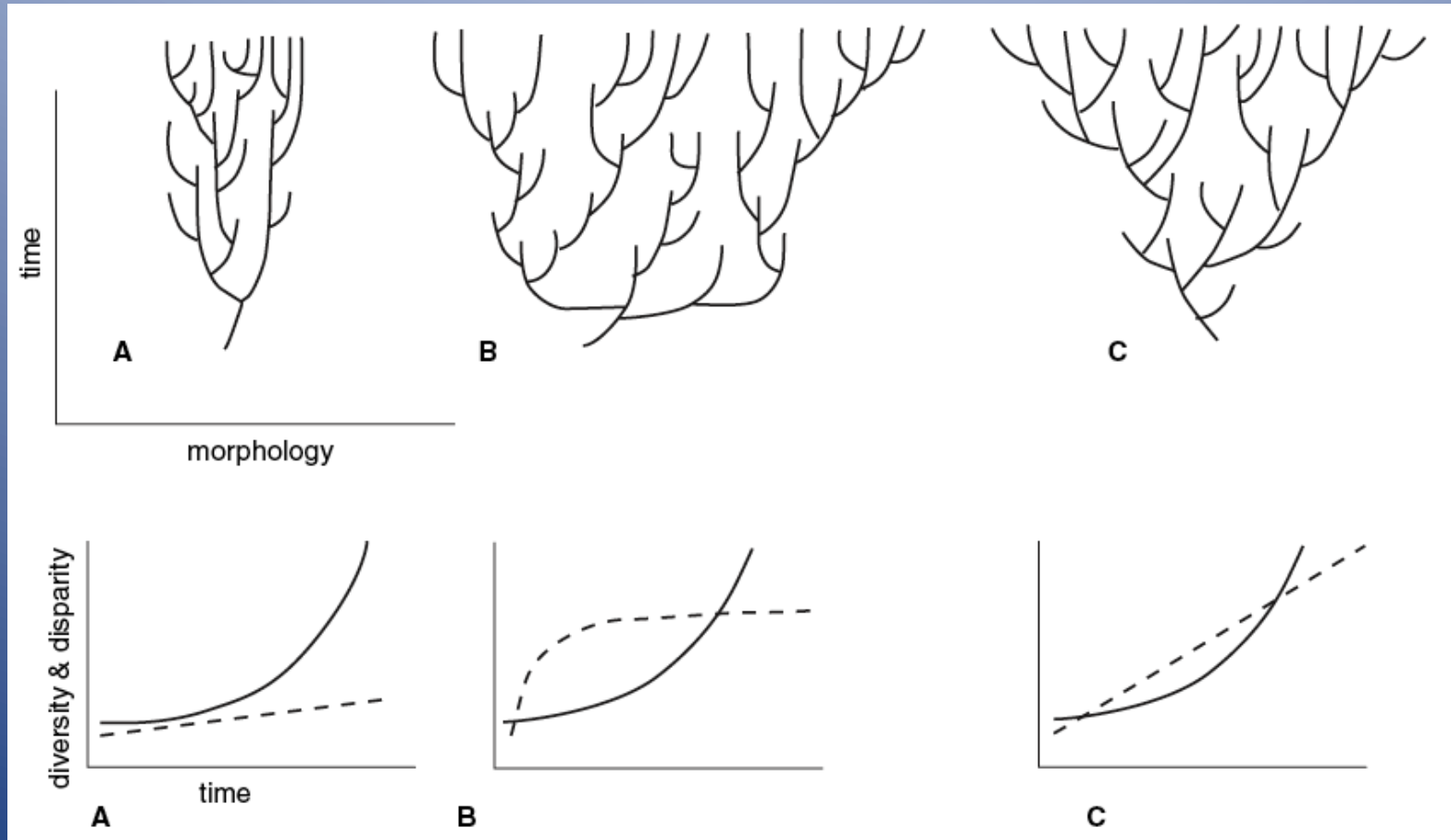
PHYLOGENETIC DIVERSITY



MORPHOLOGIC DISPARITY



DISPARITY VS. DIVERSITY



FUNCTIONAL DIVERSITY



THE SANAK ISLAND BIOCOMPLEXITY PROJECT

Razor Clam



Butter Clam



Gaper Clam



Sea Urchin



Harbor Seal*



Smelt*



Black Katy Chiton



Pacific Sandfish*



Hairy Triton



Jingle



Surf Clam*



Horse mussel



Steller Sea Lion*



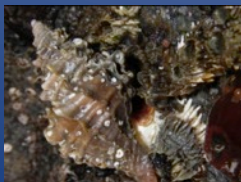
Channeled Dogwinkle



Christmas Anemone



Frilled Dogwinkle



Dulse (Red Algae)

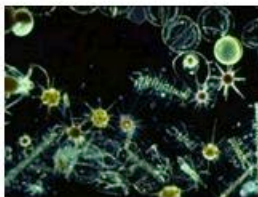


Littleneck Clam



Red Sea Urchin*





Aleut



Steller Sea Lion



Great Sculpin

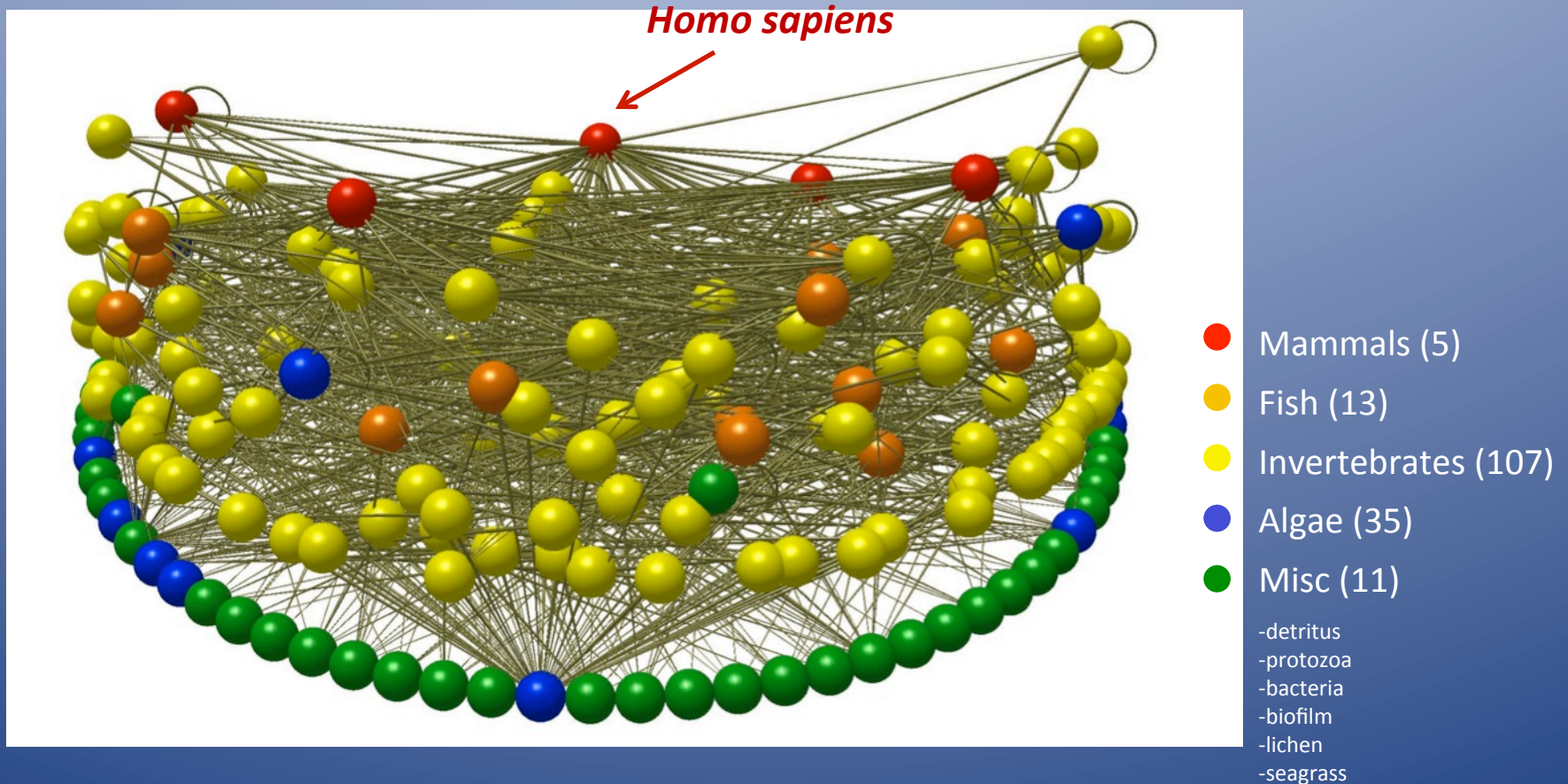


Cleaner Shrimp



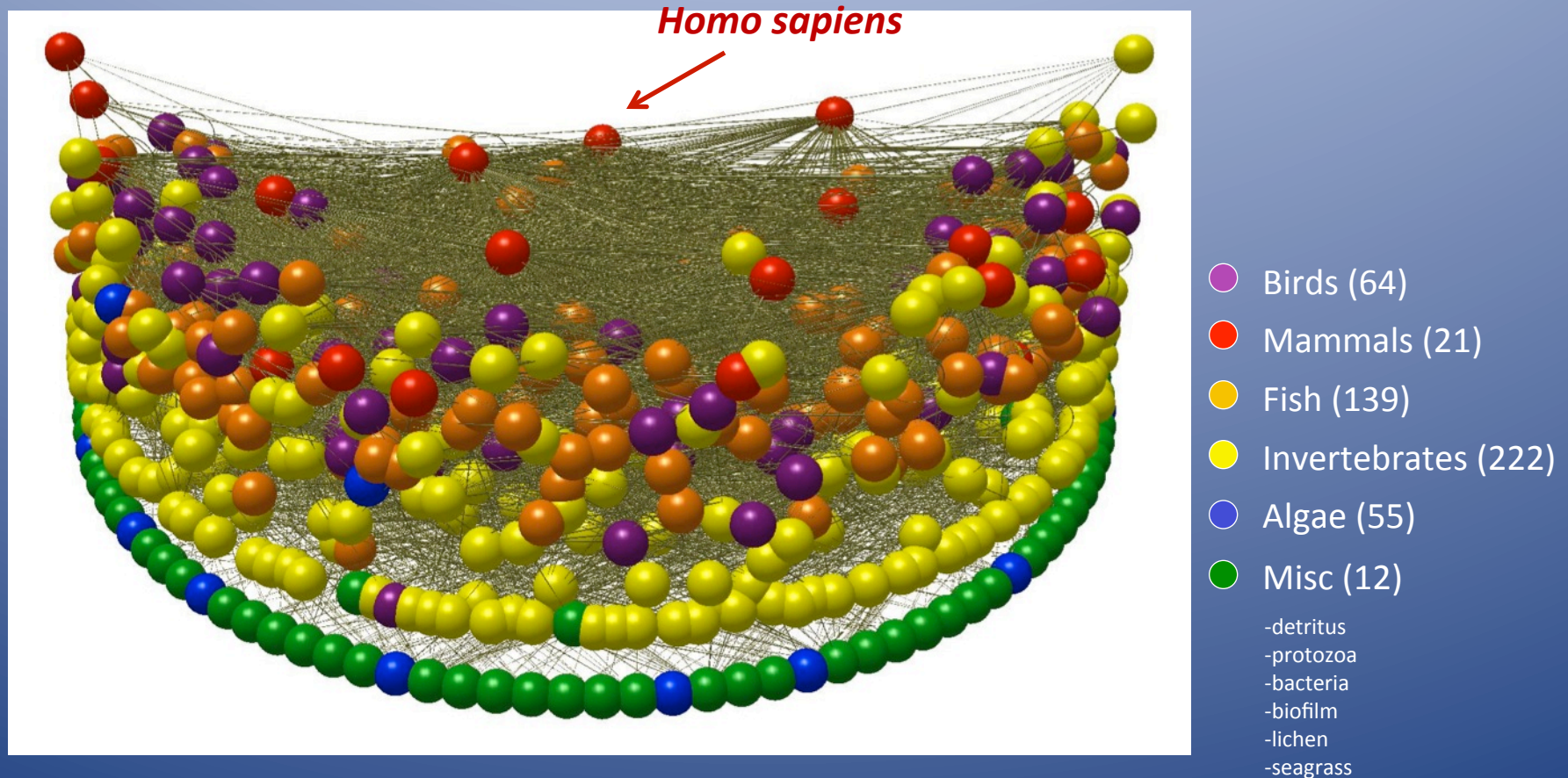
Phytoplankton

SANAK INTERTIDAL FOOD WEB



171 taxa, **1079** feeding links, **6.3** links per species

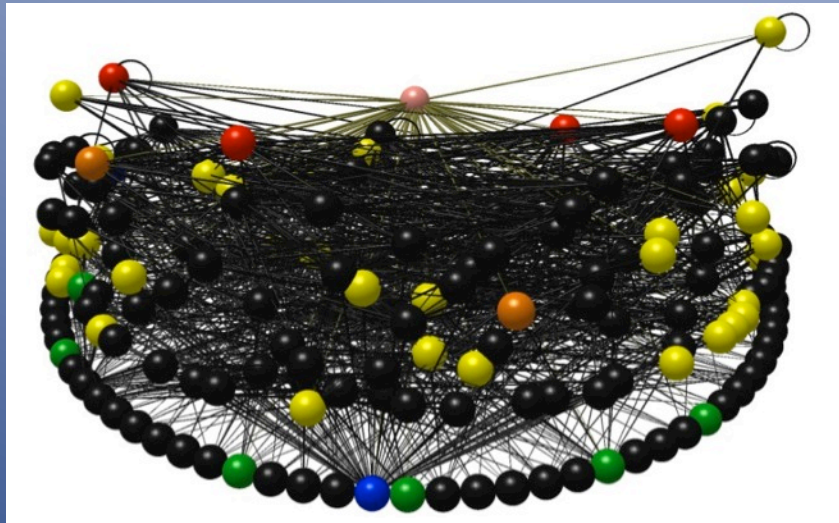
SANAK MARINE FOOD WEB



513 taxa, 6774 feeding links, 13.2 links per species

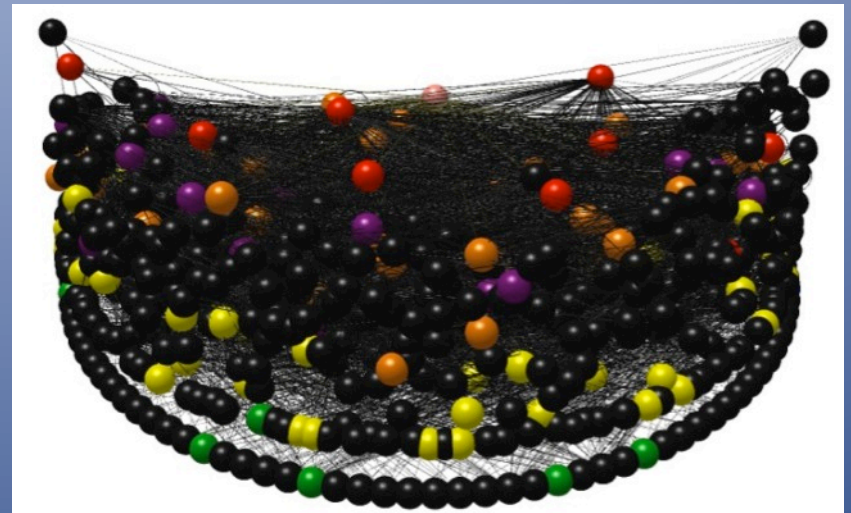
HUMANS FED ON...

50 species (29%)



Intertidal Food Web

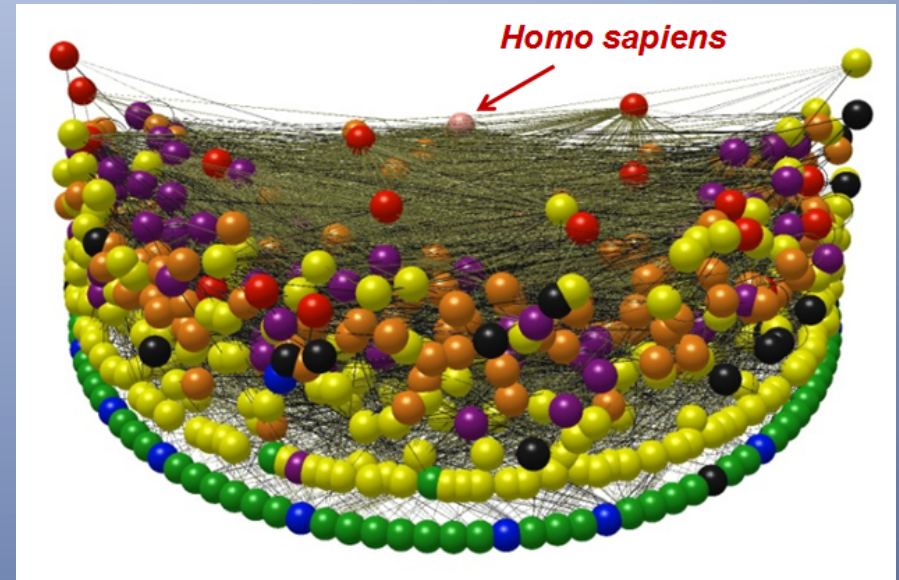
122 species (24%)



Marine Food Web

The Aleut were:

- Super generalists
- Extremely connected
- Highly omnivorous



Aleut were positioned to have great effects on local diversity.
But no apparent extinctions due to human predation.

ARCHITECTURAL DIVERSITY

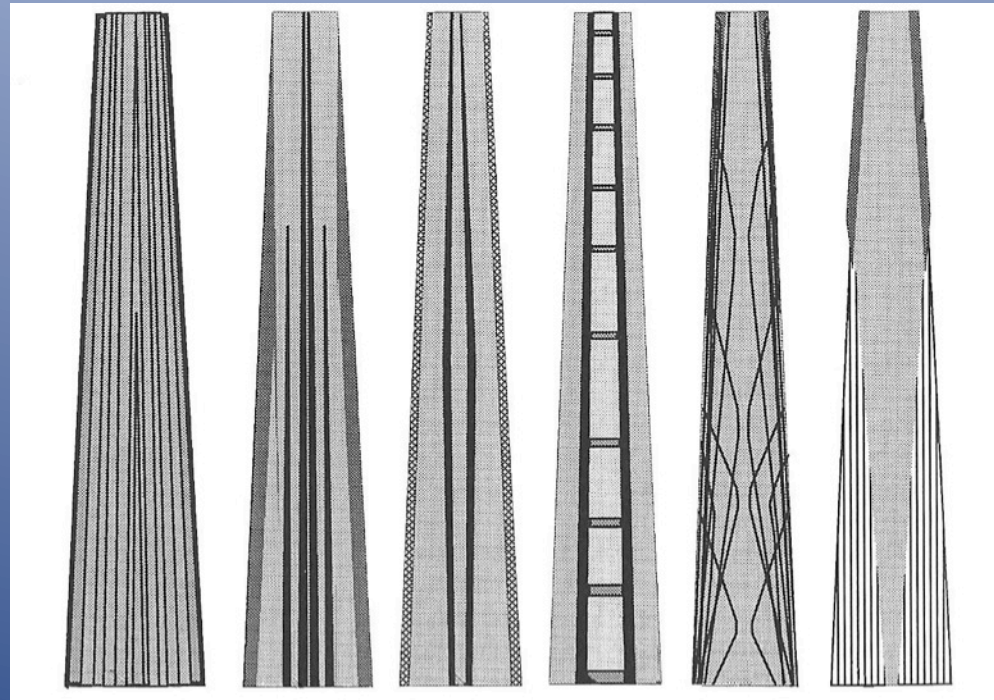


ARCHITECTURAL DIVERSITY



A Carboniferous Coal Swamp

ARCHITECTURAL & DEVELOPMENTAL DIVERSITY OF TREES



Woody
Dicots &
conifers

cycad

Calamites

Tree fern

lepidodendrid

Tree palm

BEHAVIORAL DIVERSITY



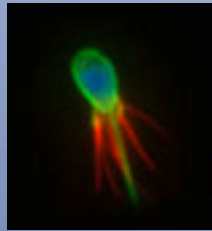
BEHAVIORAL DIVERSITY



DEVELOPMENTAL DIVERSITY



GENOMIC COMPLEXITY



	<i>Monosiga</i>	<i>Amphimedon</i>	<i>Trichoplax</i>	<i>Nematostella</i>	<i>Drosophila</i>
genome size (Mb)	41.6	167	98	450	180
No. genes	9,100	?	11,514	18,000	14,601
No. cell types	1	12	4	20	50
No. T.F.'s	?	57	35	min. 87	min. 87
No. T.F. families	5	6?	9	10	10
microRNAs	0	8	0	40	152

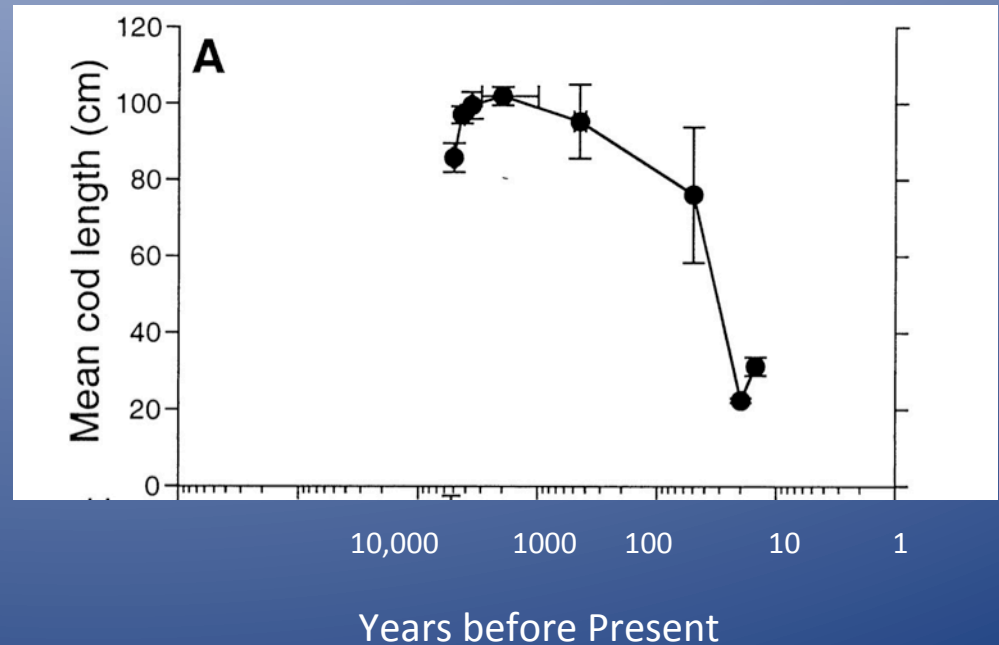
TYPES OF DIVERSITY:

- Taxic (no. of species)
- Phylogenetic
- Morphologic disparity
- Functional
- Ecospace
- Architectural
- Social/behavioral
- Developmental

IMPACTS OF MASS EXTINCTIONS

	Ordovician	Devonian	Permian	Triassic	Cret.
Taxic (gen/ fam)	60/26%	57/22%	82/52%	53/22%	47/16%
Phylo.	?	?	high	?	?medium
Disparity	high	medium	high (v)	?	? med
Functional	medium	high	medium	low	medium
Ecospace	low	high	high	low	medium
Architectural	low	high	high	high	low
Behavioral	low	?	high	medium	medium

COD IN THE GULF OF MAINE



SHIFTING BASELINES

Species	Timespan (yrs)	Baseline	Recent
Atlantic Cod	3550	Mean length >1 M	Mean length 30cm
Monk Seal	> 300		extinct
White Abalone	30	> 2000/ ha	c. 1/ ha
Green Turtle	> 300	> 16.1 x10 ⁶ 50 kg turtles	> 1.1 x10 ⁶ 50 kg turtles
Stellar's Sea Cow	➤300	Herd size > 5,000	Extinct

SMITHSONIAN INSTITUTION GLOBAL EARTH OBSERVATORIES (SIGEO)



Forest Dynamics, Climate Change, Conservation

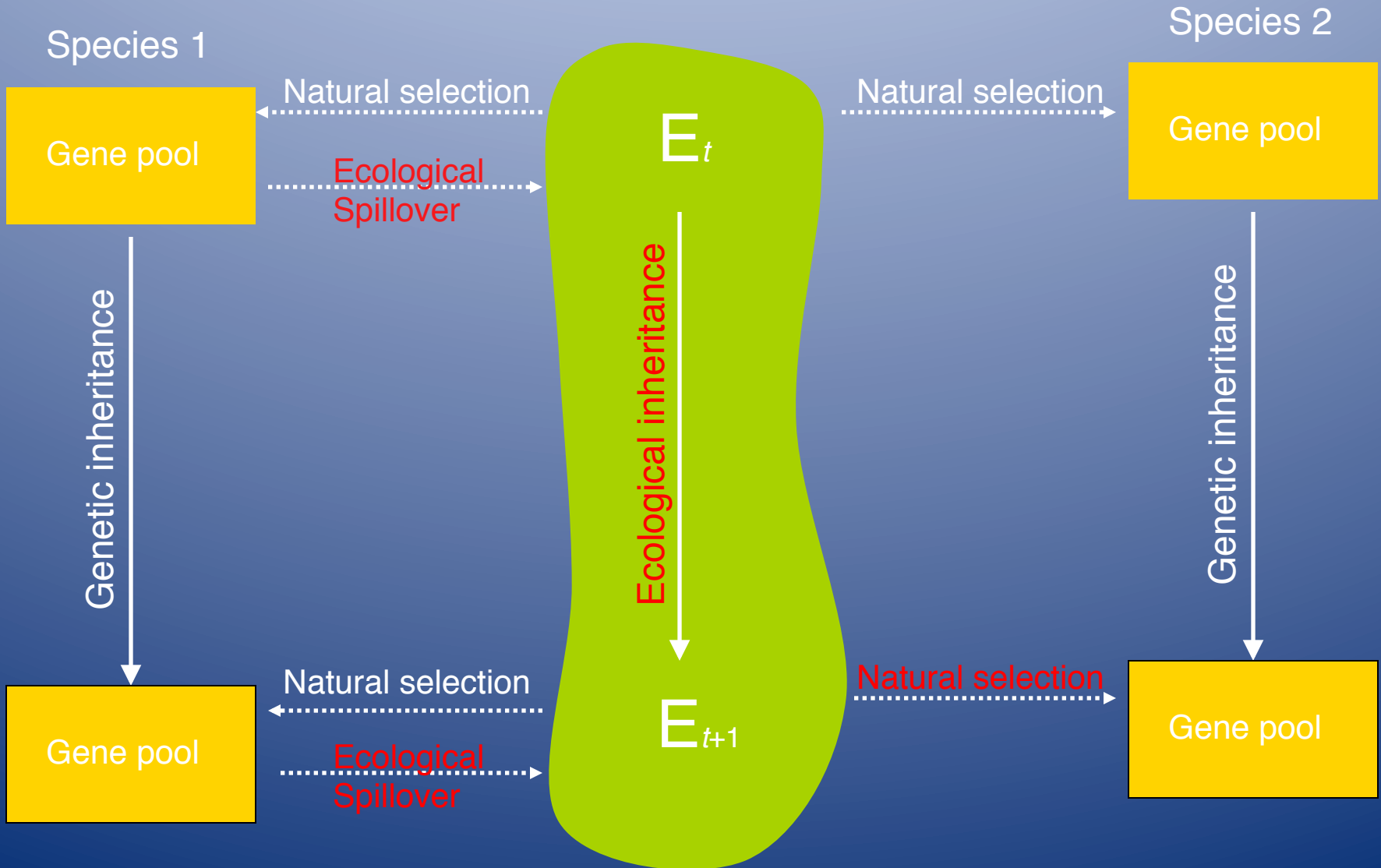


CRASSOSTREA VIRGINICA



Image: WHOI

ECOSYSTEM ENGINEERING



OYSTERS IN CHESAPEAKE BAY

- The virtual elimination of the oysters has shifted the Chesapeake estuary from an ecosystem with extensive benthic and pelagic primary productivity, high mesozooplankton density and abundant fish stocks, to one dominated by ctenophores, jellyfish, pelagic microbes, and particulate organic carbon.

