

Changing Oceans of Biodiversity



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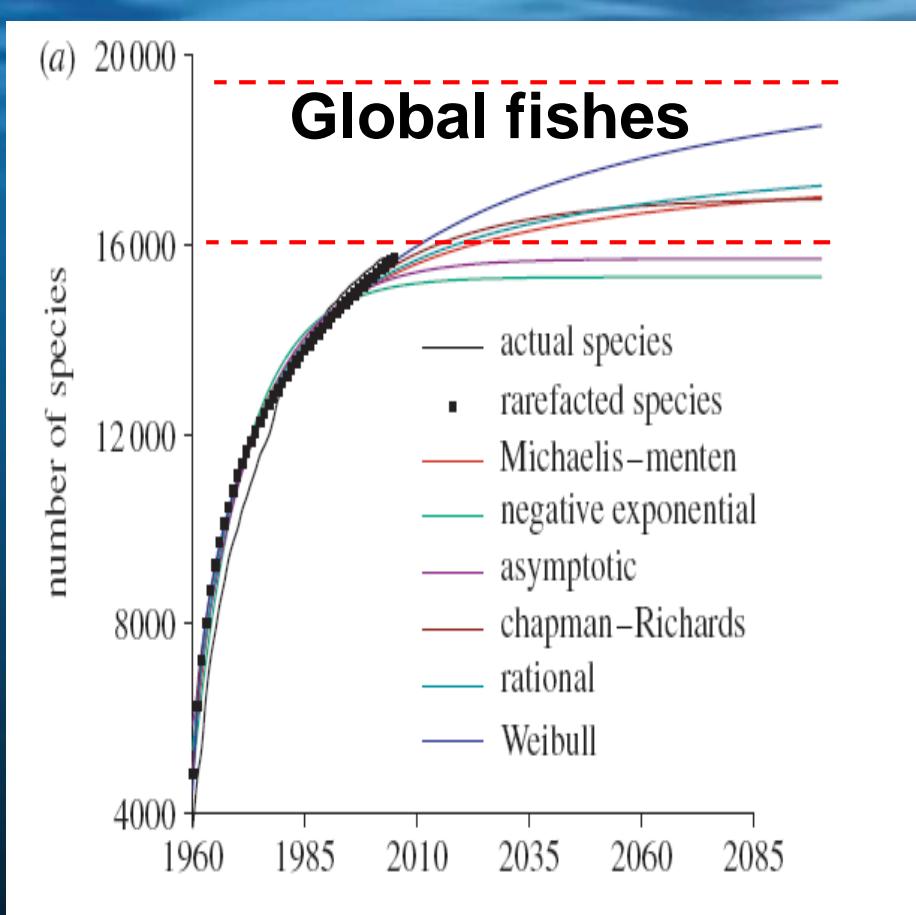




4-5 new species every day

New discoveries everywhere

The Challenge of Unknown Biodiversity

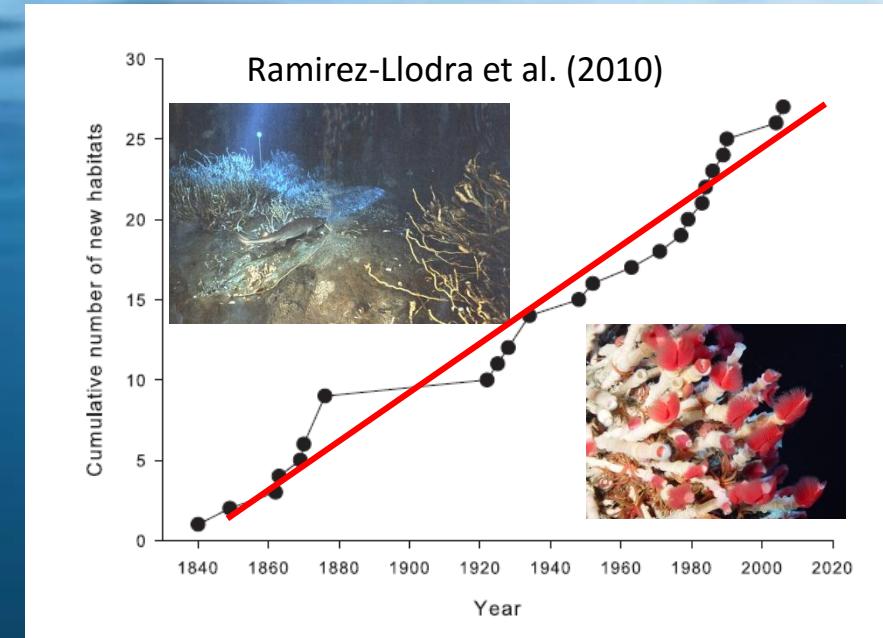
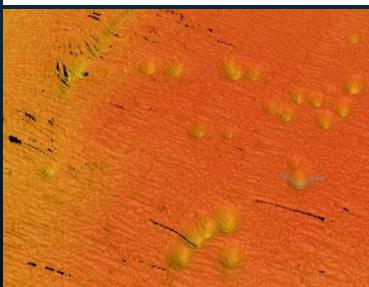


16,475 known, 4000 more to go!



The Challenge of Unknown Habitats

| Deep-sea habitat | Year | Reference |
|-------------------------------------------|------|-------------------------|
| Fine sediment (400 m) | 1840 | Forbes, 1844 |
| Fine sediment (600 m) | 1849 | Sars, 1849 |
| Fine sediment (2000 m) | 1862 | Jenkin, 1862 |
| Submarine canyons | 1863 | Dana, 1863 |
| Seamounts (geologic feature) | 1869 | Ankarcrona, 1869 |
| Sponge fields | 1870 | Thomson, 1873 |
| Open water | 1876 | Challenger Report, 1885 |
| Fine sediment (abyssal) | 1876 | Challenger Report, 1885 |
| Manganese nodules | 1876 | Challenger Report, 1885 |
| Cold-water corals (as distinct ecosystem) | 1922 | Broch, 1922 |
| OMZ pelagic | 1925 | Hentschel, 1936 |
| OMZ benthic | 1928 | Spiess, 1928 |
| Whale falls (as source of food) | 1934 | Krogh, 1934 |
| Mud volcanoes | 1934 | Chhibber, 1934 |
| Trenches | 1948 | Belyaev, 1989 |
| Wood falls | 1952 | Galathea Report, 1956 |
| MOR (as spreading ridges) | 1963 | Vine and Mathews, 1963 |
| Back-arc basins | 1971 | Karig, 1971 |
| MOR (fast spreading) | 1977 | Lonsdale, 1977 |
| Xenophyophore fields | 1979 | Rice et al., 1979 |
| Deep hypersaline anoxic basins | 1983 | Jongsma, 1983 |
| Cold seeps | 1984 | Paull et al., 1984 |
| MOR (slow spreading) | 1986 | Rona et al., 1986 |
| Whale falls (as chemosynthetic habitat) | 1989 | Smith et al., 1989 |
| Brine pool (as chemosynthetic habitat) | 1990 | MacDonald et al., 1990 |
| Asphalt habitat (Chapopote) | 2004 | MacDonald et al., 2004 |
| Large bare rock region South Pacific | 2006 | Rea et al., 2006 |



Redefining habitats





Changing Oceans of Biodiversity



Changing Oceans of Biodiversity



- Better platforms
- Digital imaging
- Genetics
- Better sensors
- Computational power

Better tools to meet the challenges

Changing Oceans of Biodiversity



P Lawton/ROPOS

A. Metaxas/ROPOS

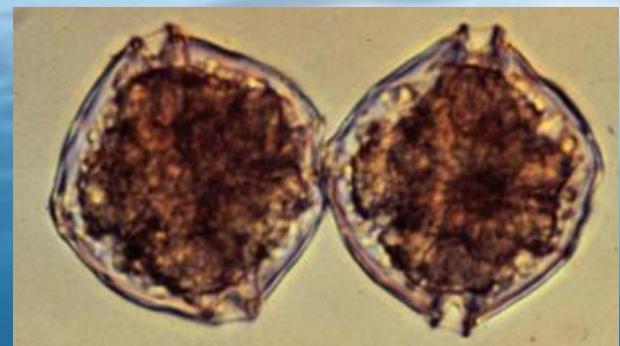
Better platforms & imagery

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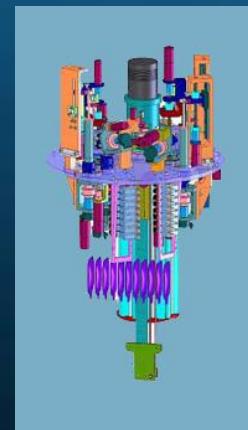
Better sampling platforms

- Detect species
- Detect genes



Alexandrium fundyense

- One strain can kill you
- Another may be harmless



Environmental Sample Processor



WoRMS

World Register of Marine Species

The Rise of WoRMS

- Misnamed
- Double names
- Misspelled names
- Shared names



~231,000 species so far



56 names for *Halichondria panacea*

But what if we still have 91% still
undiscovered?
(Mora et al. 2010)

$$1,800,000 / 1650 / \text{yr} = > 1000 \text{ years}$$

Tools to Meet the Challenges

Morphological Taxonomy

- Standardization challenge
- Historical record
- Ecological inference

Barcode

- Uses specific gene
- Unambiguous
- Some problem groups
- Catalogue incomplete

Molecular Taxonomy

- Creation of reference database

High Throughput (Mass) Sequencing

- Whole genome
- Rad-seq (pop genetics)
- Amplicon of ROI
- Environmental DNA (e.g. microbes)
- RNA-seq

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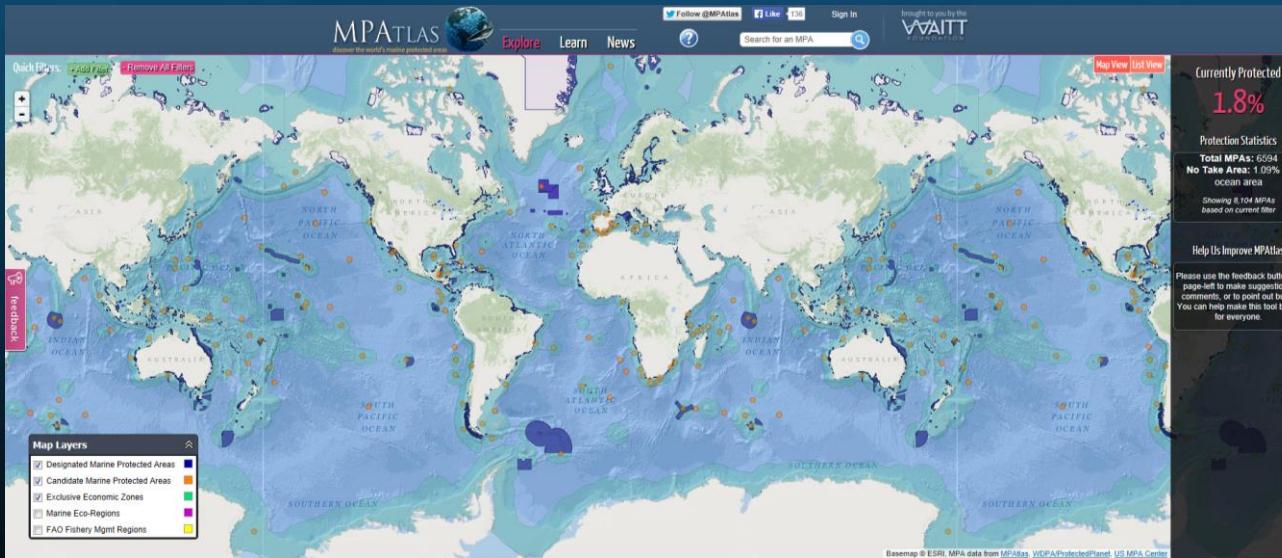
But the clock is ticking....

Marine Protected Areas to Sustain Biodiversity

Ecosystem

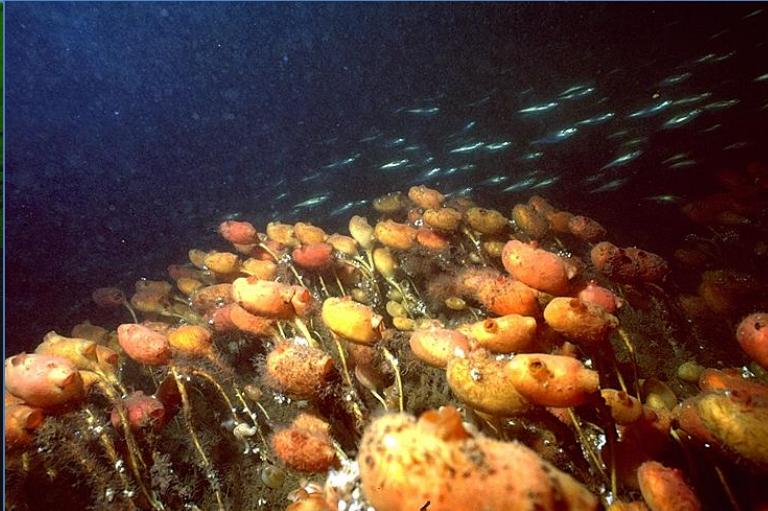
- Protect biodiversity hotspots
- Protect biodiversity by protecting habitat
- Protect spawners
- Protect subsets of population
- Protect source populations
- Protect all life history stages

Species



Changing Oceans of Biodiversity

Mike Strong/Maria Inez-Buzeta



Peter Lawton/Anna Metaxas

Oceans of tomorrow?