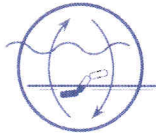




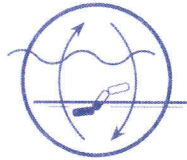
Marine Microbial Diversity and Genomics



Frank Oliver Glöckner



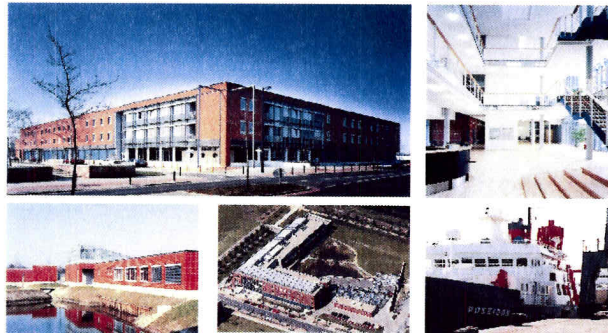
JACOBS
UNIVERSITY



Max Planck Institute for Marine Microbiology

Investigation of the role, diversity and features of microorganisms

Interactions with physical and chemical processes in marine and other aquatic habitats



Founded 1992 in Bremen, Germany

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Why study marine microorganisms?

- ▶ 70% of the Earth (361 Mio Km²) are covered by oceans with an average depth of 3800 m
- ▶ Marine microorganisms are the central catalysts (Gatekeepers!) of global element cycling
- ▶ To advance our knowledge on the diversity and function of marine microbes



Who is out there and

How much of them?

What can they do and

Under which conditions are they doing **what**?

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Abundance

► Prokaryotes: The unseen majority

Table 5. Number and biomass of prokaryotes in the world

Environment	No. of prokaryotic cells, $\times 10^{28}$	Pg of C in prokaryotes*
Aquatic habitats	12	2.2
Oceanic subsurface	355	303
Soil	26	26
Terrestrial subsurface	25–250	22–215
Total	415–640	353–546

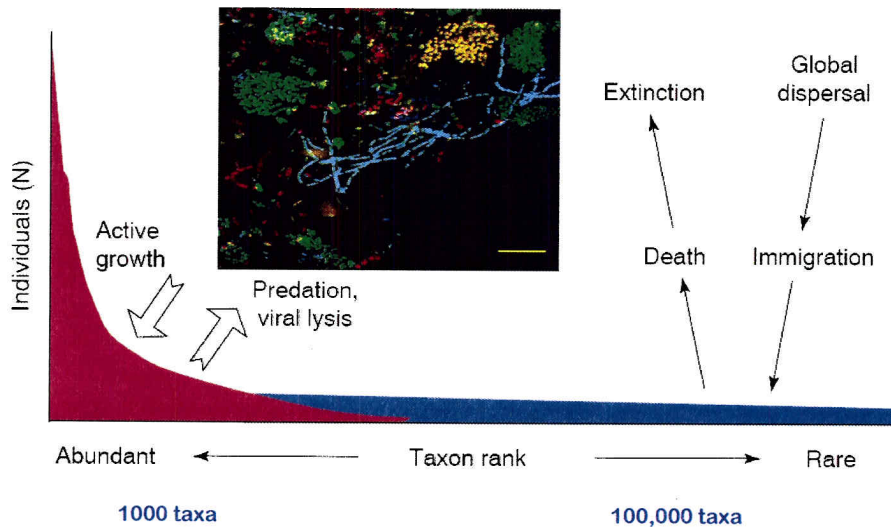
*Calculated as described in the text.

1 Pg = 10^{15} g

Whitman et al., 1998, PNAS 95, p. 6578

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Diversity

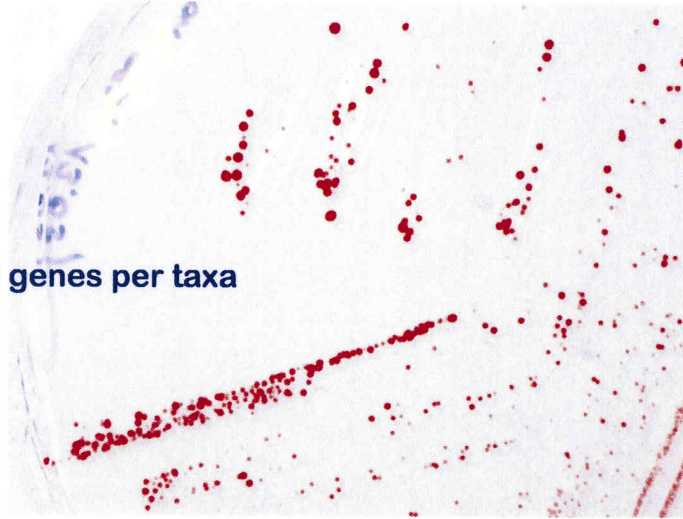


Pedros-Allo, TIM, 6, p. 257

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Genomics

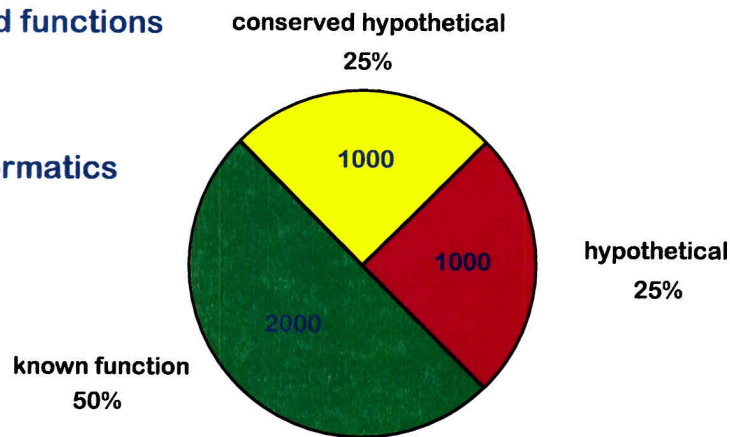
~ 4000 genes per taxa



6

Predicted functions

Bioinformatics



- ▶ **Hypothetical protein:** Predicted gene with no similarities in public databases, unique for the taxa
- ▶ **Conserved hypothetical protein:** Predicted gene with similarities to other genes in the databases, lacking functional assignment

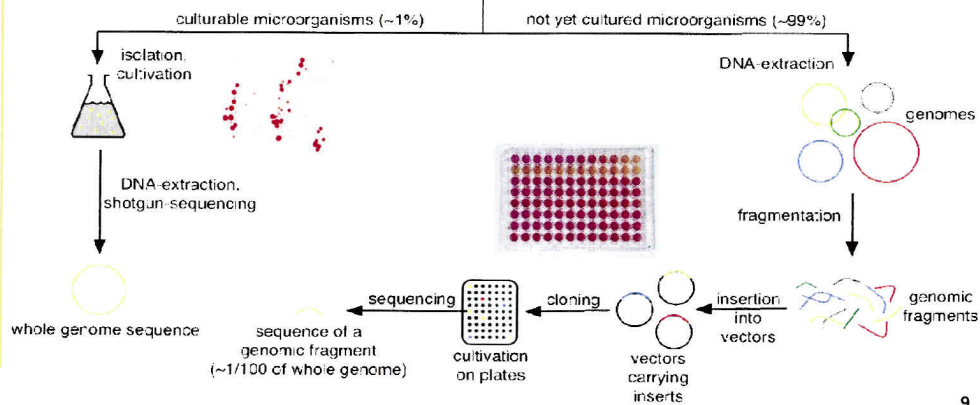
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Cultivability

Habitat	Cultivation rate [%]	Literature
Marine system	0.001 to 0.1	Ferguson <i>et al.</i> 1984
Limnic system	0.25	Jones 1977
Mesotrophic lake	0.1 to 1	Staley & Konopka 1985
Estuary	0.1 to 3	Ferguson <i>et al.</i> 1984
Activated sludge	1 to 15	Wagner <i>et al.</i> 1993
Sediment	0.3 to 23	Jones 1977, Köpke 2005
Soil	0.3	Torsvik <i>et al.</i> 1990

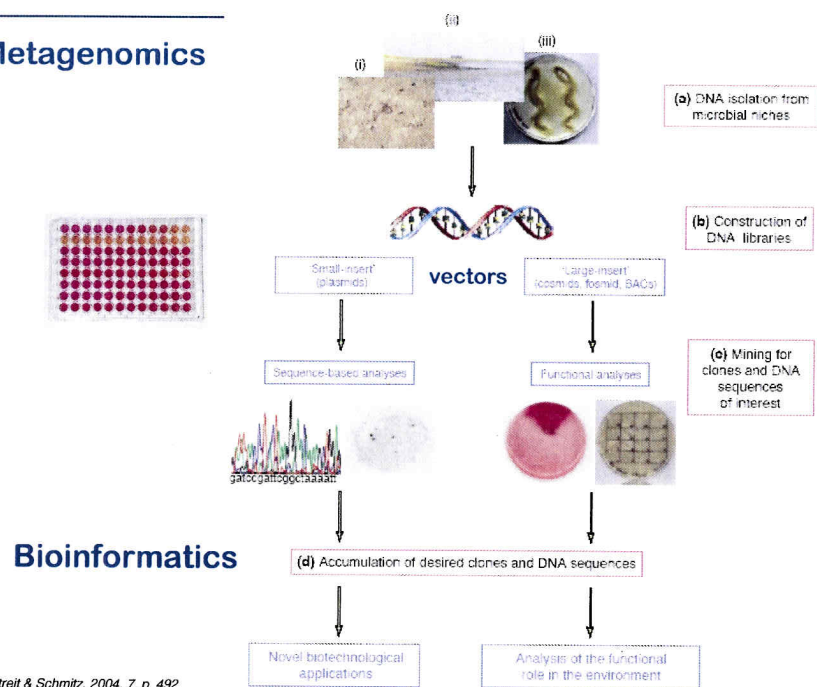
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Genomics & Metagenomics

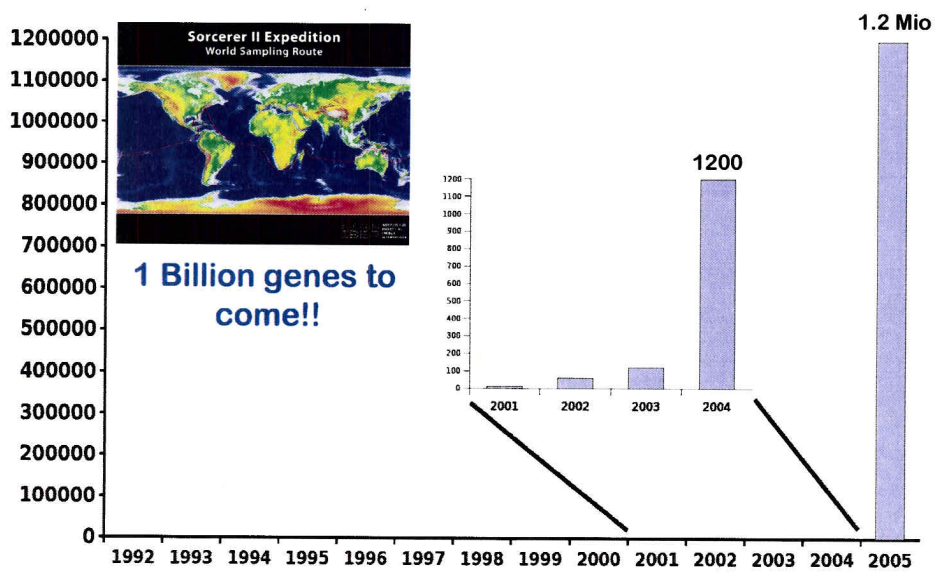


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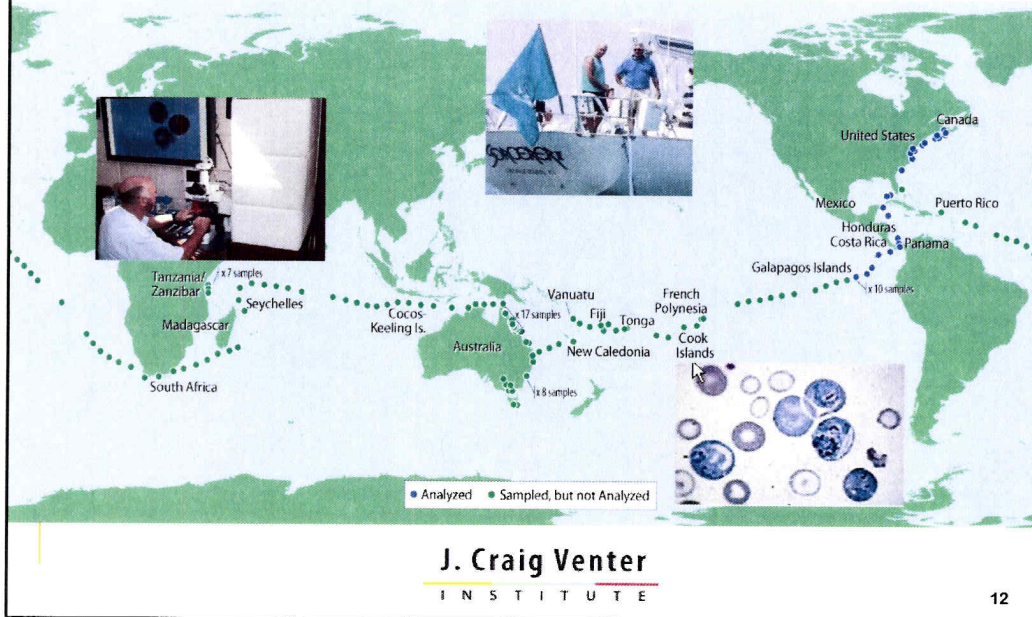
Metagenomics



Genes from (Marine) Metagenome studies



Marine Genome Sequencing Project Measuring the Genetic Diversity of Ocean Microbes



Summary

► Objectives

- High abundances and diversity of microorganisms
- Huge amount of marine genetic resources
 - ◊ Understanding the ecosystem
 - ◊ Commercialization

► Issues

- Infrastructure
 - ◊ Access (ships, technology)
 - ◊ Processing (labs, bioinformatics)
- Management of intellectual property