The Macroalgal Herbarium Consortium

ACCESSING 150 YEARS OF SPECIMEN DATA TO UNDERSTAND CHANGES IN THE MARINE/AQUATIC ENVIRONMENT

Objectives

1. Create a Macroalgal Herbarium Consortium (MHC), a network of 49 U.S. herbaria, to develop and share tools, workflows, knowledge and experience that will streamline specimen digitization and data access.
2. Digitize 1.2 million herbarium specimens and make the data electronically accessible in a way that will:
    a) help researchers document ecological changes in marine, estuarine and freshwater environments;
    b) engage the public and promote an appreciation of the importance of macroalgae and natural history collections.

Document Ecological Changes
in marine, estuarine and freshwater environments

- **Bioinvasions** - *Temporal and spatial data on macroalgal distribution can be used to track the spread of invasive species, identify the dispersal vectors, assess the impact on native communities*

- **Climate Change -** *The data will provide a sensitive tool for assessing effects of climate change*

- **Human Impact** *-Temporal changes in the geographic distribution of macroalgae can be used to understand the impact of human activity.*

Bioinvasions

Examples

- Nyberg, CD. 2007. **Introduced marine macroalgae and habitat modifiers: their ecological role and significant attributes**. Ph. D. Thesis, Univ. Göteborg, Göteborg, Sweden, 66 pp.
- Hofmann, LC, JC Nettleton, CD Neefus, and AC Mathieson. 2010. **Cryptic diversity of *Ulva* (Ulvales, Chlorophyta) in the Great Bay Estuarine System (Atlantic USA): introduced and indigenous distromatic species**. Europ. J. Phycol. 45: 230-239.
- Nettleton JC, AC Mathieson, C Thornber, CD Neefus and C Yarish. 2013. **Introduction of *Gracilaria vermiculophylla* (Rhodophyta, Gracilariales) to New England, USA: estimated arrival times and current distribution**. Rhodora. 115: 28–41.

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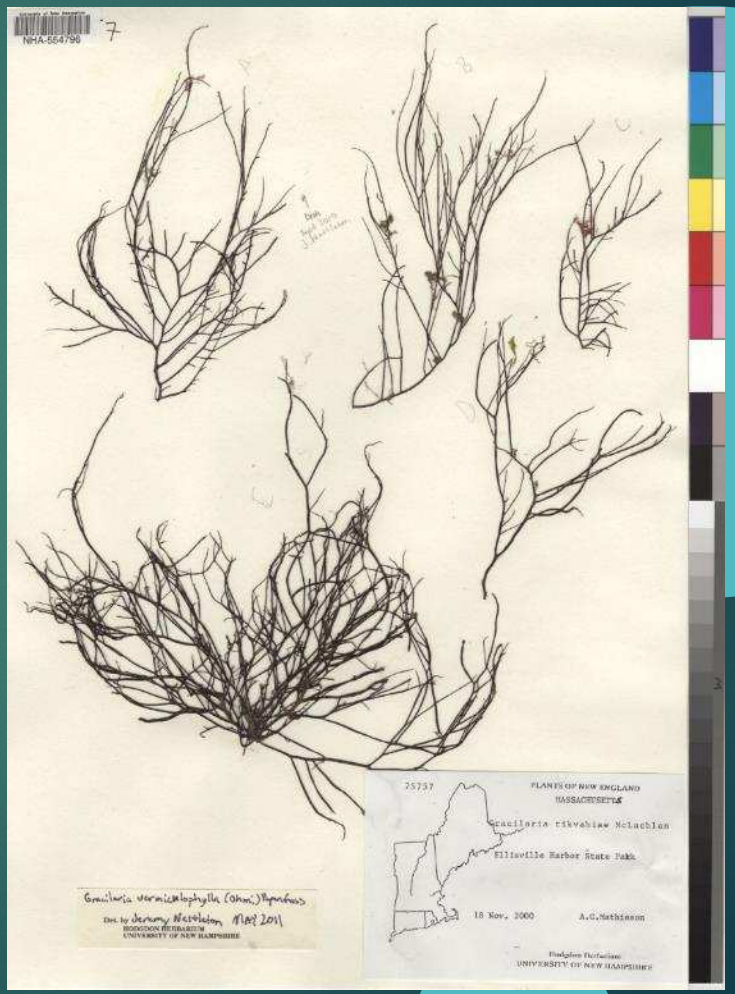

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Used Herbarium Specimens to

- Locate sites for new collections
- Track the temporal and spatial distribution of the introduced species, *G. vermiculophylla*
- Determine changes in the distribution of native species *G. tikvahiae*

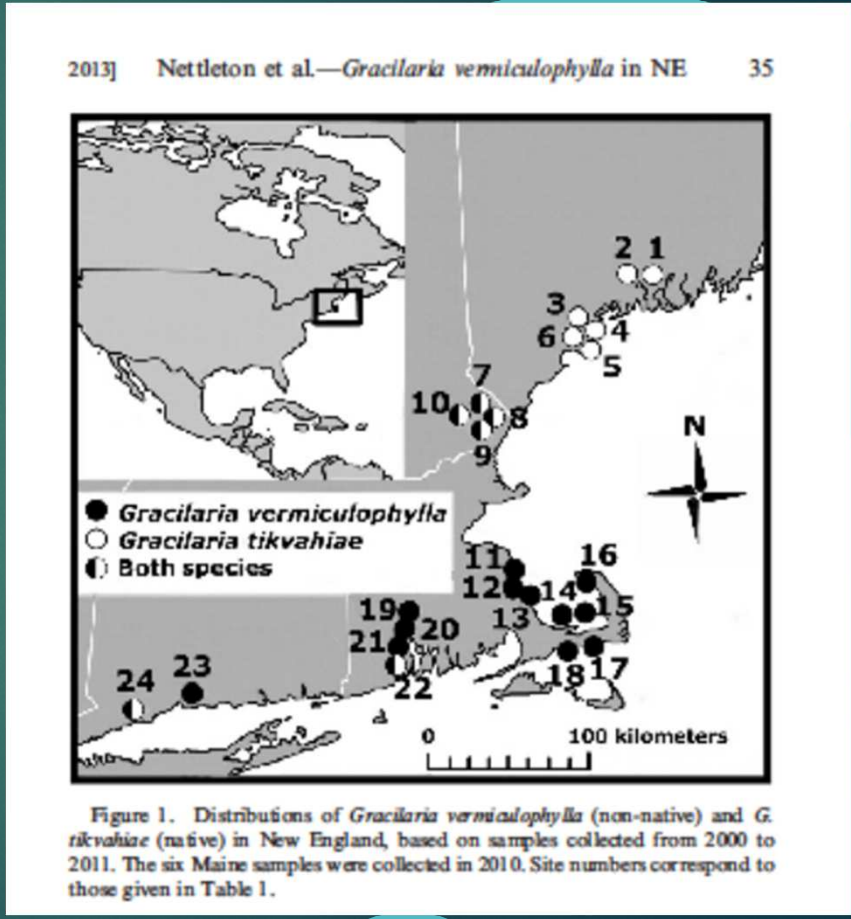


Figure 1. Distributions of *Gracilaria vermiculophylla* (non-native) and *G. tikvahiae* (native) in New England, based on samples collected from 2000 to 2011. The six Maine samples were collected in 2010. Site numbers correspond to those given in Table 1.

Climate Change

Examples

- Primack, R. 2003. **The special role of historical plant records in monitoring the impact of climate change**. Arnoldia 62: 12–15.
- Primack, D., C. Imbres, R.B. Primack, A.J. Miller-Rushing, and P. Del Tredici. 2004. **Herbarium specimens demonstrate earlier flowering times in response to warming in Boston**. American Journal of Botany 91: 1260.
- Bartsch, I. & Kuhlenkamp, R. (2000). **The marine macroalgae of Helgoland (North Sea): an annotated list of records between 1845 and 1999**. *Helgoland Marine Research* 54: 160-189.
- Doty, MS 1948. **The flora of Penikese, seventy-four years after. I. Penikese Island marine algae**. Rhodora 50: 253-269
- Mathieson, AC, EJ Hehre, CJ Dawes, and CD Neefus. 2008a. **An historical comparison of seaweed populations from Casco Bay, Maine**. Rhodora 110: 1-102.

Human Impact

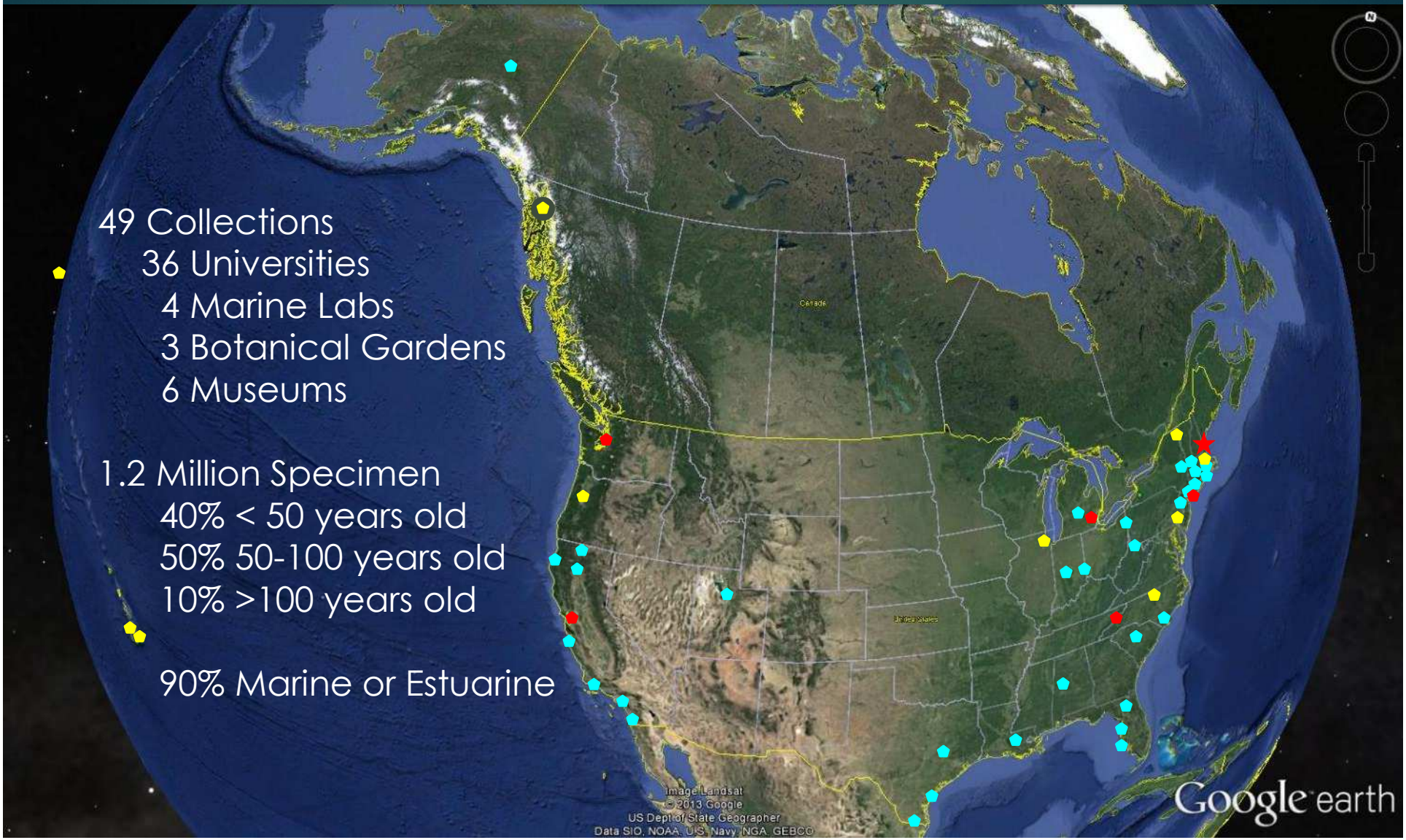
Examples

- Littler, MM and SN Murray. 1975. **Impact of sewage on the distribution, abundance and community structure of rocky intertidal macro-organisms**. Mar. Biol. 30: 277-291.
- Mathieson, AC, EJ Hehre, CJ Dawes, and CD Neefus. 2008a. **An historical comparison of seaweed populations from Casco Bay, Maine**. Rhodora 110: 1-102.

Mathieson, AC, EJ Hehre, CJ Dawes, and CD Neefus. 2008a. **An historical comparison of seaweed populations from Casco Bay, Maine**. Rhodora 110: 1-102.

- Examined >10,000 specimens from NHA, YU, FH, NY, MICH, UC, and BKL.
- Including Collections of Pike, Hooper, Farlow, Setchell, Kemp, Clark, Collins, Holden, Fuller, Norton, Chamberlain, Mathieson and others
- Collection Dates from 1850 to 2000
- Similarity of historic and current floras in Casco Bay as a whole was 77.7% but as low as 41.5% at some sites.
- 40 species disappeared
- 33 species appeared
- Changes were attributes to bioinvasions, climate change and human activity

Collection Demographics



Joseph F. Rock Herbarium (HAW)

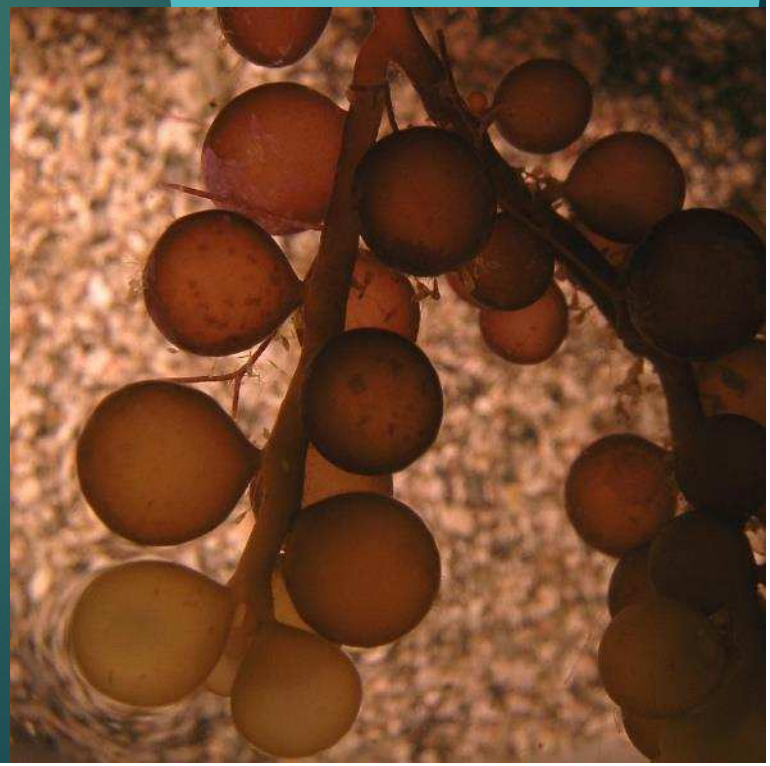
- Founded in 1908, renovated in mid-2000s
- Housed in the Department of Botany at the University of Hawai'i
- Official University repository for botanical plant specimens (includes the Lyon Arboretum specimen collection)
- Main collections from decades of plant exploration by some of the leading researchers in the Pacific basin
- Holdings: approximately 50,000 dried plant specimens

Joseph F. Rock Herbarium (HAW)

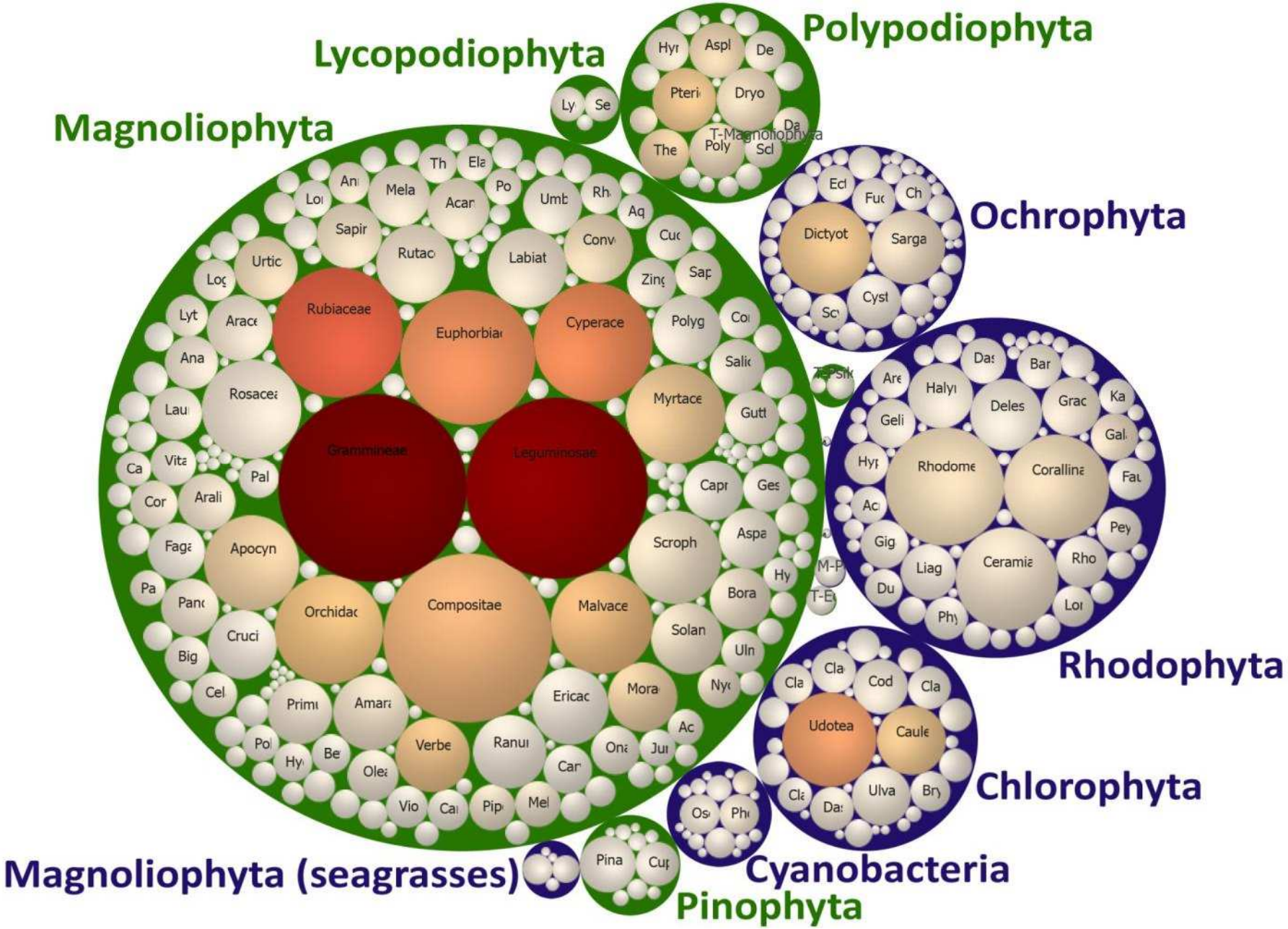
- Macroalgal Collection:
  - Maxwell Doty collection (2,249 specimens from 1960-1980s)
  - PICRC digitized records (Palau) (487 records)
  - HAW collections (ca. 50 specimens)

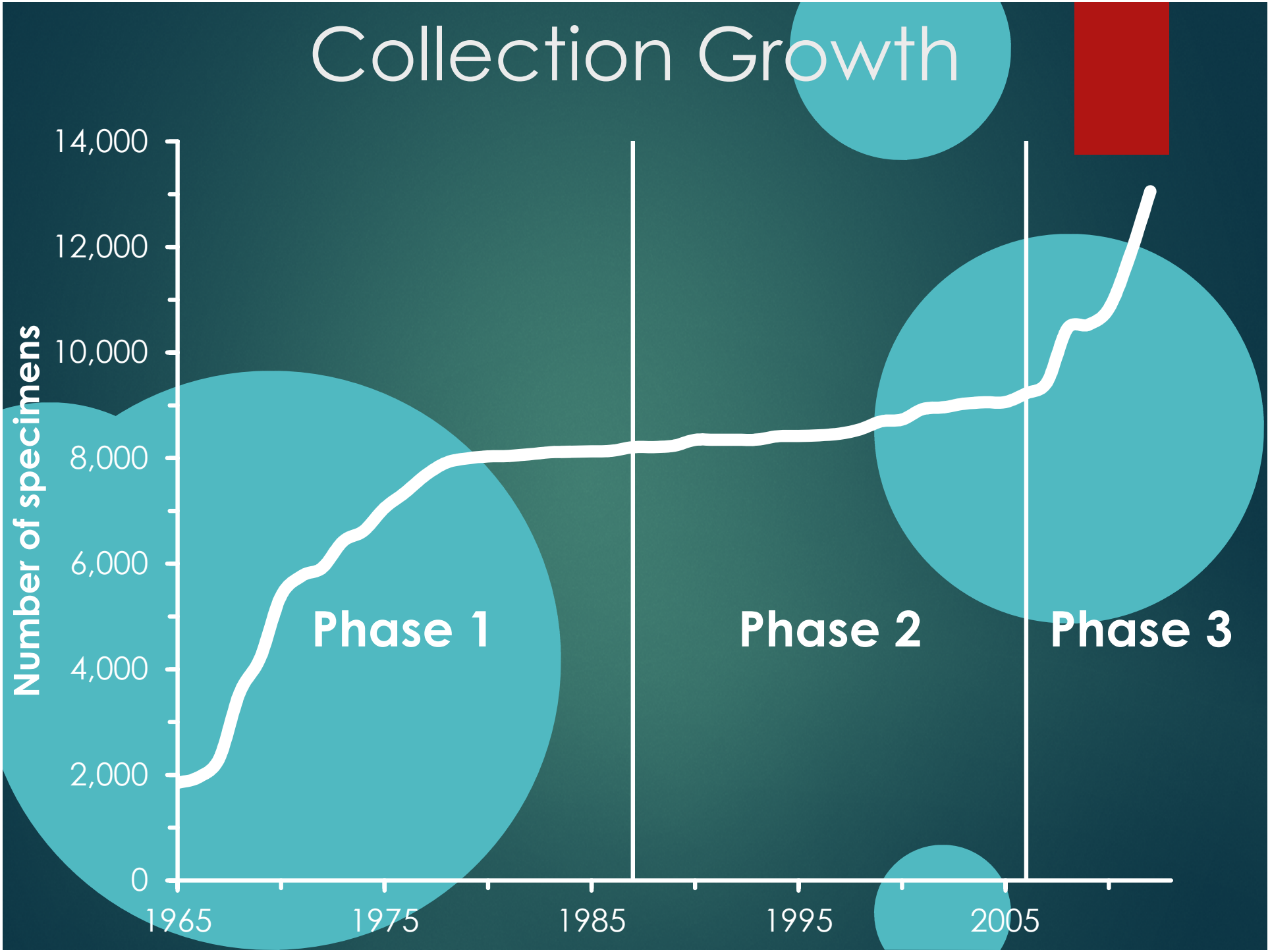
University of Guam Herbarium (GUAM)

- Marine Plant Collection:
  - Started 1967
  - 14,253 Specimens
  - 1,798 Species
  - Research Areas
    - Taxonomy and Natural History
    - Molecular Assisted Taxonomy
    - Invasive Species
    - Chemical Ecology
    - Natural Products

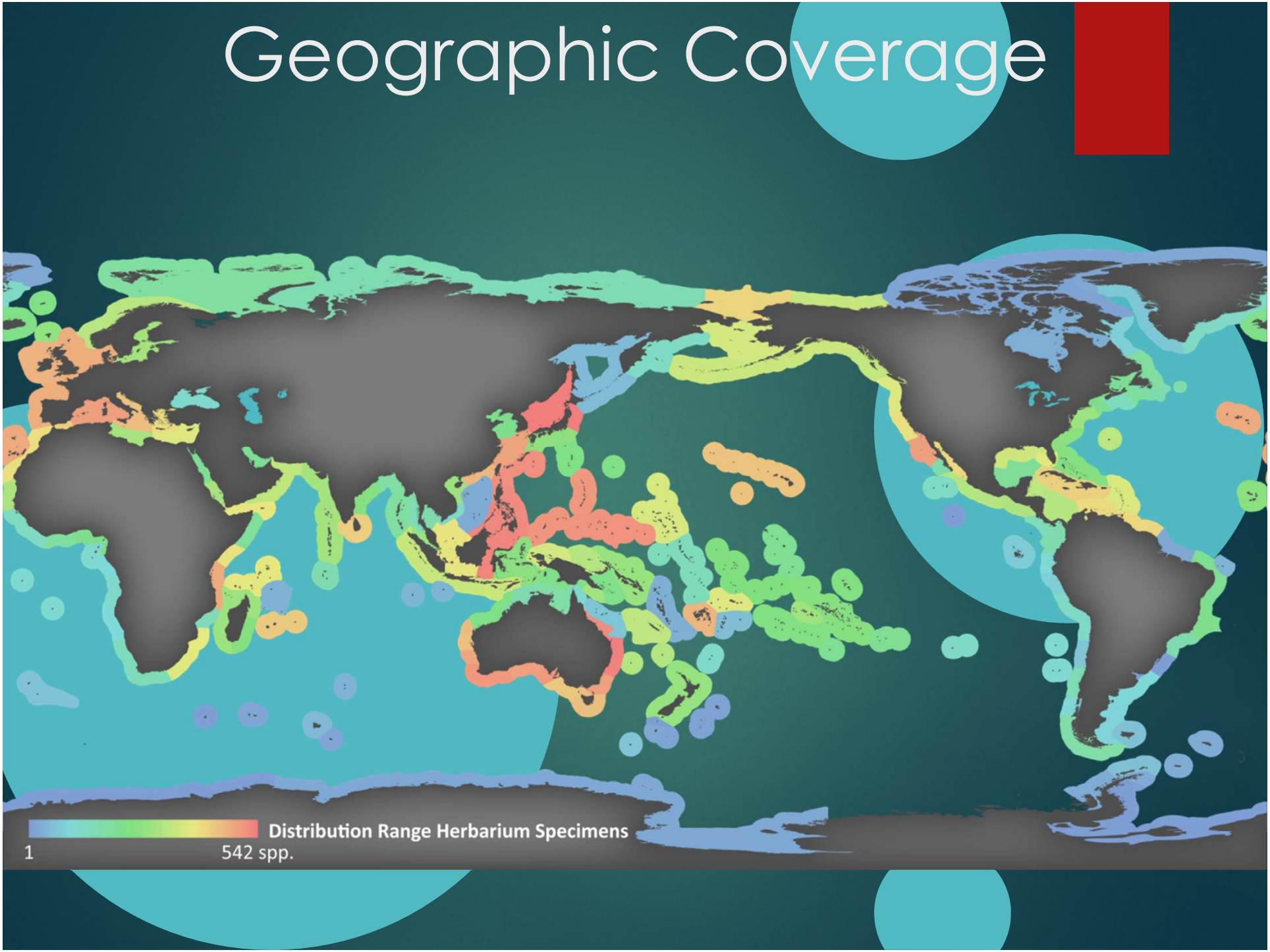


Taxonomic Diversity




Collection Growth
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Number of specimens
1965
1975
1985
1995
2005
Phase 1
Phase 2
Phase 3

Geographic Coverage



Herbarium Pacificum (BISH)

R. Tsuda
with technician V. Magoon

Macroalgal Collection

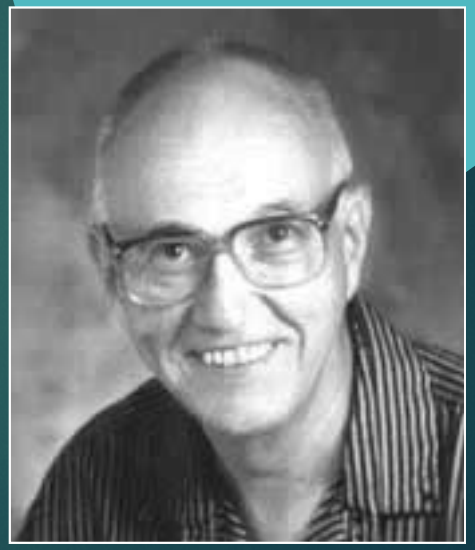
- Approx. 79,000 specimens
- Primarily Hawaii & Pacific
  - 40% Hawaii
  - 14% Continental US, Territories, Canada & Mexico
  - 10% Polynesia
  - 13% Micronesia
  - 22% Other

- Collected over the past 250 years
- 35% from the past 50 years
- Collections of more than 1,500 phycologists

Herbarium Pacificum (BISH)

I.A. Abbott

E.Y. Dawson
G.J. Hollenburg
H. Kylin
J.W. Newhouse,
H.E. Womersley



M.S. Doty