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Algarium Veneticum. How to revive a historical collection as a tool for the marine algal biodiversity investigation

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ABSTRACT

A forgotten algal herbarium assembled from the Venice Lagoon by Giacomo Zolezzi, Michelangelo Minio and Nicolò Spada between 1941 and 1950 has been recently found at the Biblioteca Storica di Studi Adriatici, located at the Institute of Marine Sciences (ISMAR-CNR) headquarters in Venice. Considering the relevance of this collection and the renewed interest for biodiversity studies, it has been decided to formally establish the herbarium of the Institute. The new herbarium has been named Algarium Veneticum and recorded under this name by the New York Botanical Garden and added with the code <ISMAR> in the Index Herbariorum. Currently, the "Algarium Veneticum" includes the historical collection entitled "Distribuzione e polimorfismo di Gracilaria confervoides nella Laguna di Venezia", consisting of 19 folders containing more than a thousand samples of *Gracilaria* and a miscellaneous section with specimens of different algal taxa; moreover, a new collection of macroalgae has been initiated and rapidly enriched.
The "Algarium Veneticum" has been established with the purposes: 1) to catalog and digitize the historical collection and upload it on the institutional web platforms; 2) to revise the collection by an integrated approach of both classic taxonomic methods and DNA barcoding techniques; 3) to expand the algarium with new collections from the Venice Lagoon and the Adriatic Sea.

Key words:
algal herbarium, macroalgae, Venice Lagoon, marine biodiversity, collections.

RIASSUNTO

"Algarium Veneticum". Far rivivere una collezione storica come strumento per la ricerca sulla biodiversità delle alghe marine.

Presso la Biblioteca Storica di Studi Adriatici dell'Istituto di Scienze Marine (ISMAR-CNR) è stato recentemente ritrovato un erbario algale della Laguna di Venezia raccolto da Giacomo Zolezzi, Michelangelo Minio e Nicolò Spada tra il 1941 e il 1950. Considerando l'importanza di questa collezione ed il rinnovato interesse per gli studi di biodiversità, si è deciso di istituire formalmente l'erbario dell'Istituto. Il nuovo erbario, denominato Algarium Veneticum, è stato registrato dal New York Botanical Garden con il codice <ISMAR> nell'Index Herbariorum. Attualmente, l'Algarium Veneticum comprende la collezione storica dal titolo "Distribuzione e polimorfismo di Gracilaria confervoides nella Laguna di Venezia", composta da 19 carpette contenenti più di mille campioni di Gracilaria *e una sezione miscellanea con campioni di diversi taxa algali. L'algario è stato recentemente arricchito di una collezione di macroalghe frutto di nuovi campionamenti.*
L'istituzione dell'Algarium Veneticum ha tra i suoi scopi: 1) catalogare e digitalizzare la collezione storica e pubblicarla sui portali web istituzionali; 2) effettuare una revisione tassonomica delle specie algali presenti nella collezione algologica storica, integrando i metodi della tassonomia classica con le tecniche di DNA barcoding; 3) ampliare l'Algarium Veneticum con raccolte algali moderne provenienti dalla Laguna di Venezia e dal mare Adriatico.

Parole chiave:
erbario algale, macroalghe, Laguna di Venezia, biodiversità marina, collezioni.

HISTORICAL PHYCOLOGICAL COLLECTIONS FROM THE VENICE LAGOON

Algae started to be collected at least from the Renaissance: one of the earlier known herbaria including algae still preserved is Ulysses Aldrovandi's "Hortus Siccus" (collected since 1551 until his death in 1605). The "Agardh herbarium" (1822-1828), with 50.000 samples and 6.000 type specimens, contains one of the world's most important collections of algae, but significant collections are preserved in several italian institutions.

The study of the algal flora and vegetation in the Venice lagoon has always interested naturalists. The first studies date back to the XVIII century, and were conducted by Olivi (1749). They were followed in the XIX-XX centuries by the classic works of Naccari (1828), Zanardini (1847), De Toni & Levi (1885, 1888a, 1888b), De Toni (1889-1924), Schiffner & Vatova (1937), Sighel (1938), Vatova (1940) and Pignatti (1962).

The "Sylloge algarum" by De Toni includes 6 volumes written in 35 years and represents one of the most comprehensive works on algae, with a description of 14.440 species from around the world.

The "Algarium Zanardini", which dates back to 1840, includes 2.425 algal species and is undoubtedly the most valuable collection of samples mainly from the Venice Lagoon and Adriatic Sea. The "Algarium" is enhanced by a few drawings of the Author bearing the missing parts or the cellular structure of the dried specimens. The collection also includes important specimens from different geographic regions, donated to Zanardini by various and prestigious correspondents (Agardh, Meneghini, Ardissone, etc.). The Natural History Museum of Venice, together with the "Algarium Zanardini", holds the algological collection carried out between 1930-32 by Vatova and Schiffner. This collection includes 170 species of algae belonging to 60 genera and over 150 varieties and forms, 1.406 herbarium sheets and over 500 formalin-preserved samples, and it has been described in the fundamental work "Monografia della laguna di Venezia (Monography on the Venice lagoon)". This collection was donated to the Natural History Museum of Venice by Vatova himself, as reported in the proceedings of the Italian Botanical Society (Minio, 1941).

According to Vatova (1940) "for its extraordinary abundance of forms the Venetian Lagoon was also visited by top phycologists, such as Agardh father and son, Kützing, Meneghini and especially Zanardini, the illustrator of venetian algae, and there they discovered many new species; it is therefore the "locus classicus" of a number of species…". At the same time, the algae of the Venice Lagoon have also attracted economic interest as natural resources.

HISTORICAL BACKGROUND

When Italy entered into the Second World War (1940), the import of most of the goods from abroad decreased progressively. A number of to run low, including the "agar-agar", a natural compound commonly used for food manufacture and in biological laboratories, which at the time was extracted exclusively from red algae (Gracilariaceae) from Japan and Indo-Pacific area. The Commissariato Generale per la Pesca (General Fisheries Commission), the office in charge of the national fishery management policy, assigned to Gustavo Brunelli, Director of the Laboratorio Centrale di Idrobiologia (Central Hydrobiological Laboratory) to find how to extract "agar-agar" from Mediterranean algae. The red algae *Gracilaria* and *Gelidium* were rapidly identified as the most promising local sources (Labranca & Maldura, 1941). The next step was to study their biology and distribution along the Italian coastline. For this reason, every Italian institution then working on marine sciences was asked to investigate on these topics. In 1941, Giacomo Zolezzi, a fishery scientist from the Hydrobiological Lab, was intrusted to manage the project in the Venice Lagoon involving the Istituto di Studi Adriatici (Institute for Adriatic Studies), the Osservatorio di Pesca Marittima di Venezia (Marine Fishery Observatory of Venice) and the Museum of Natural History of Venice. Michelangelo Minio, former Director of the Museum, together with Nicolò Spada, a researcher of the Marine Fishery Observatory, carried on the samplings and studies focusing on *Gracilaria confervoides* (L.) Greville, the most abundant *Gracilaria* species in Venice Lagoon (Zolezzi, 1946, 1947). The expertise of Minio, a naturalist and botanist with pioneering research on phenological studies, combined with the informations provided by Vatova and Schiffner studies, led to the knowledge of reproduction (Minio, 1949), phenology and distribution in the Venice lagoon (Minio & Spada, 1950) and physiological features of *Gracilaria confervoides* (Polli, 1951; Minio & Spada, 1952).

THE COLLECTION "DISTRIBUZIONE E POLIMORFISMO DI *GRACILARIA CONFERVOIDES* NELLA LAGUNA DI VENEZIA"

The historical algal herbarium, established by Zolezzi but mostly developed and studied by Minio and Spada, was found in 2010 in the "Biblioteca Storica di Studi Adriatici" at the Institute of Marine Sciences (ISMAR-CNR) of Venice.

The collection is entitled "Distribuzione e polimorfismo di *Gracilaria confervoides* nella laguna di Venezia" (Distribution and polymorphism of *Gracilaria confervoides* in the Venice Lagoon). This historical

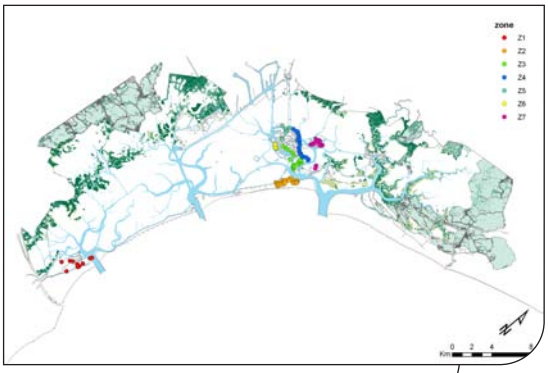

Fig. 1. Venice Lagoon map with 107 sampling stations of the Minio & Spada collection.

"algarium" includes 19 folders with more than a thousand of *Gracilaria* samples collected in the Venice Lagoon between 1941 and 1950. Samples were collected in 107 stations, belonging to 7 sampling zones and distributed around the historical centre of Venice and the islands of Chioggia, Lido and Murano (fig. 1). The specimens are arranged individually or grouped together in the same sheet (fig. 2).

The collection includes also a miscellanea section containing samples of different taxa (labelled as *Porphyra minor*, *Porphyra atropurpurea*, *Ulva lactuca*, *Enteromorpha linza*, *Callithamnion corymbosum*).

For a suitable and proper management of the historical collection, a new herbarium named "Algarium Veneticum" (Index Herbariorum code: <ISMAR>) has been established at the Institute of Marine Sciences.

The cataloging of the collection is still in progress. Each herbarium sheet is provided of a unique code (e.g. ISMAR0148). Original folders with handwritten annotations by the authors were preserved. Each sheet is digitized with a digital planetary scanner Bookeye® 3. The associated metadata (sampling information such as place and date, taxonomic notes for each sample, etc.) are also recorded.

All sampling stations have been georeferenced based on the maps published by the authors (Minio & Spada 1950) as well as on written records and handwritten notes. All the samples pictures will be available online. At present, metadata are already hosted on the platforms "Atlante della Laguna" (see website n. 1), CIGNo (see website n. 2) and on the "Archivio di Studi Adriatici" website (see website n. 3).

PROSPECTS

Next step of this project is to revise the collection by an integrated approach of both traditional taxonomic

Fig. 2. *Gracilaria confervoides* (L.) Grev.. a) Sample (ISMAR0383) from S. Pietro di Castello (Venice); b) Samples (ISMAR0256) from Venice Lido with ecological notes by the Authors.

methods and DNA barcoding techniques, using protocols designed for the study of ancient DNA. Furthermore, the information retrieved from the historical "algarium" may allow to evaluate compositional and ecological changes occurred in nearly one century in the sampling areas. Last but not least, this project is meant to be a case study for the revaluation of museum records in the framework of the molecular age.

Herbaria, dried pressed plant specimens and their associated data, ancillary collections (e.g., photographs) and library materials, are remarkable and irreplaceable sources of information about plants and the world they inhabit (Funk, 2003). They provide the comparative material that is essential for studies in taxonomy, systematics, ecology, anatomy, morphology, conservation biology, biodiversity, ethnobotany, and paleobiology. At the same time, they have educational as well as historical value. Moreover, they are a veritable gold mine of information. For this reason, it has been decided that the "Algarium Veneticum" will be enriched with new algal collections from the Venice Lagoon and the Adriatic Sea. This will be a valuable tool for phycological and ecological studies, allowing to monitor floristic and vegetational changes that may be due to human impacts on the lagoon, in particular the increasing introduction and spread of alien species.

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