

UNIVERSITÀ DEGLI STUDI DI NAPOLI “FEDERICO II”



DIPARTIMENTO DI BIOLOGIA

Ph.D. IN BIOLOGIA

XXXV CICLO

Marine forest restoration in a fast-changing Mediterranean Sea

Tutor:

Prof. Simonetta Fraschetti

Ph.D. Student:

Erika Fabbrizzi

Co-tutor:

Prof. Luigi Musco

Dr. Laura Tamburello

A.A. 2021-2022



ABSTRACT

Marine forests are amongst the most important rocky shores habitats worldwide. In the Mediterranean Sea, forests composed by fucal brown algae of the genus *Cystoseira sensu lato* have a crucial role for both intertidal and subtidal ecosystems, supporting marine biodiversity and providing several ecosystem services. In the last twenty years, cumulative impacts of local anthropogenic pressures, combined with global climate changes are driving the decline of these forests in many areas of the basin with cascading effects and severe consequences on the whole marine-coastal ecosystem. Despite the robust legislative framework orbiting around them, specific conservation measures for the protection of these habitat-forming species have never been implemented and restoration represents one of the most promising approach to halt their decline.

To make restoration interventions consistently successful, i) the assessment of their actual status, ii) the evaluation of the stressors that caused their decline or disappearance, iii) a detailed mapping of their present and past distribution, and iv) the identification of sites where restoration interventions are more likely to be effective, are urgently needed. Present thesis has been conceived to address these issues adopting different approaches with strongly connected chapters. In the first Chapter, a Machine Learning technique to develop a Habitat Suitability Model for *Cystoseira s.l.* forests and the analytical tool NEAT (Nested Environmental status Assessment Tool) were applied to assess macroalgal forests status; in the second Chapter, a multivariate statistical approach was adopted to explore critical stressors that may cause forests regression across different spatial scales; in the third Chapter, a systematic literature review allowed to deepen the understanding about past and current forests distribution; in the fourth Chapter, a spatial prioritization analysis was performed to support the planning of future restoration efforts. All analyses were performed at Mediterranean scale with the exception of Chapter 3 where the Italian coasts were selected as case study to assess drivers of changes. Taken as a whole, my thesis support macroalgal forest restoration at basin scale, providing guiding principles and criteria to scale-up and step-up the effectiveness of restoration actions.