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*Professional paper*

# BIOCOENOSIS OF PHOTOPHILIC ALGAE IN THE ROCKY INTERTIDAL AREA OF TRIPORT, VLORA, ALBANIA

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**Abstract**

Albanian aquatic ecosystems, characterized by their rich biodiversity and ecological significance, are undergoing significant changes due to anthropogenic pressures and environmental transformations. Among the key biological components affected are the algal biocoenoses, which play a crucial role in aquatic ecosystems by contributing to primary production and providing the foundational support for food webs. The study of algal communities in these waters not only helps in understanding ecological dynamics but also in assessing the health and sustainability of aquatic environments. Given the escalating environmental challenges, such as pollution and climate change, impacting these ecosystems, there is a pressing need for comprehensive studies focused on algal biocoenoses.

Despite the considerable number of studies conducted, the understanding of algae in Albania remains insufficient. As we delve deeper into our investigations, the extent of our knowledge gaps becomes more evident, emphasizing the necessity for a thorough approach to addressing them. Algae, whether exerting a direct or indirect influence, occupy a pivotal role in our ecosystem. We owe them not only for the oxygen we respire but also for the absorption of carbon dioxide, thus mitigating its accumulation in the atmosphere. Moreover, they gift us a rich tapestry of biodiversity, serving as crucial habitat-forming organisms.

This research aims to analyze the composition, distribution, and health of algal communities across Triporti rocky shore, employing both traditional and advanced scientific methods to provide a detailed insight into their ecological status and responses to environmental stressors. Such studies are essential for informing conservation strategies and ensuring the long-term viability of Albania's aquatic resources. Along the rocky shores of the Triport area, where biodiversity flourishes, our research endeavors have uncovered a diverse array of species spanning multiple phyla, including Ochrophyta, Rhodophyta, and Chlorophyta. Within this ecologically significant area, we have documented the presence of nine Ochrophyta species, ten Rhodophyta species, four Chlorophyta species, and two species of seagrasses. Notably, the majority of these species exhibit a consistent presence across both spring and autumn seasons. While these species contribute significantly to biodiversity maintenance, the emergence of invasive species, such as Caulerpa cylindracea, poses a great threat to indigenous flora and fauna by invading their habitats. Thus, a comprehensive understanding of algae in Albania is important to maintain ecological equilibrium and biodiversity preservation.

*Keywords:* Algae, Ochrophyta, Rhodophyta, and Chlorophyta, Adriatic Sea, Mediterranean Sea, Triport

## 1. Introduction

The macroalgae of the rocky shores along the Albanian coast of the Adriatic Sea have been largely understudied. Existing data on macroalgal communities are sparse and sporadic. Notable studies on the macroalgae of this region include works by Kashta (1987, 1992-93), Kashta L. & Kashta L. (1995-1996), and Kashta L. (1995-1996, 1999, 2006), as well as Xhulaj & Kashta (2007). Most of the available data pertain to the deeper infralittoral and circalittoral zones, while the shallower zones, such as the midlittoral and upper infralittoral, remain poorly investigated. Recent data primarily come from assessments associated with the establishment of marine protected areas along the Albanian Adriatic coast and are often found in technical project reports rather than scientific publications (Kashta et al., 2005; Kashta & Beqiraj, 2009; Kashta et al., 2010; Fraschetti et al., 2011; Maiorano et al., 2011; Beqiraj et al., 2011; Gogo & Kashta, 2013; Beqiraj & Kashta, 2014; Beqiraj et al., 2014; Blanfuné et al., 2016). Some data are also found

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in master's theses and PhD dissertations, but they are not published in scientific journals, conferences, or other scientific venues. The rocky areas of the Albanian Adriatic coast are ecologically and environmentally sensitive, yet they are short segments. Over the past three decades, urban and tourist development has significantly impacted the environment (Fraschetti et al., 2011).
Among the coastal areas between the Gulf of Vlora, the Karaburun Peninsula, and Sazan Island, the coastal area of Triporti and the channels connecting the Adriatic Sea to the Narta Lagoon are the least studied (Ruci et al., 2014; Ruci et al., 2023). Recently, this area has become a focus of study due to the extensive presence of the macroalgal communities *Gongolaria barbata* and *Ericaria crinita* (Nasto et al., 2022; Bakaj et al., 2023). This research aims to analyze the composition, distribution, and health of algal communities along the Triporti rocky shore, using both traditional and advanced scientific methods to provide a detailed understanding of their ecological status and responses to environmental stressors.

## 2. Material and Methods

*2.1.The research area:* Located at the southern terminus of the Adriatic littoral, the Triporti region features a prominent rocky coastline characterized by low-lying, stratified sandstone elevations, with pronounced topographic variations. Spanning a linear extent of 8 kilometers, this coastal configuration manifests as a narrow strip, measuring between 50 and 100 meters at its minimum breadth and expanding to approximately 2 kilometers towards the southern extremity. Noteworthy are the sand dunes, arranged in 2-3 linear arrays, exhibiting nearly parallel alignment but diverging from the axial orientation of the coastline, which intersects at an oblique angle. The cliffs of Triporti, inherently susceptible to erosion due to their relative instability, exhibit notable elevations and steep gradients. Comprising a triad of hills interconnected by sandy isthmuses, the Triport hill assemblage attests to its former insular status, conjoined through sedimentary accretion facilitated by the persistent flow dynamics of the Vjosa currents. These cliffs are particularly vulnerable to heightened erosional dynamics, attributed to their terrigenous lithological composition.

*2.2.Sampling stations:* The stations where the macroalgae were collected include the rocky shores of the Adriatic Sea, specifically the rocky shores of Triport in 4 stations. For the collection of the material, field expeditions were carried out during the spring and autumn seasons, more precisely during May and September.

*2.3.Methodology:* Sampling was carried out according to standard methods for benthic sampling in hard bottoms (according to Cattaneo et al. 1978, Drago et al. 1980, Schlieper 1976, Zenetos et al. 2000) for assessments of the biodiversity of the algal cover. The main goal was sampling in the mediolittoral, but since the exact difference between the mediolittoral and the infralittoral is difficult, the upper limit of the infralittoral was also sampled. The collection aimed at obtaining macroalgae both on the surface of the rocks, as well as those housed in algae. Consequently, samples of the main types of algal cover were also taken, to get a more complete knowledge of the biocenoses. 2 transects were sampled, at a linear distance of 15 m. The samples were taken qualitatively by collecting and evaluating the species present within a test square measuring 50 cm x 50 cm. This quadrat was divided into 25 small quadrats to facilitate the estimation of the number of individuals. Within these squares, the number of individuals or the percentage assessment of the algal cover was made. The collection of the material was done by hand. After taking the samples, the material was stored in a thermos refrigerator and transported to the laboratory for determination through appropriate tools such as a stereomicroscope, various determination switches, etc.

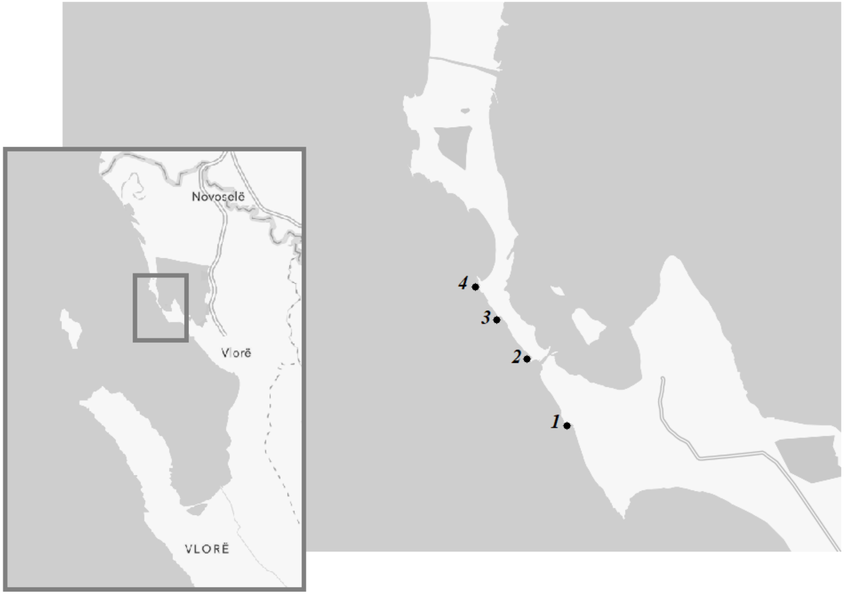


**Figure 1.** Sampling stations in the area of Triport, Vlore, Albania

## 3. Results and Discussion

Table 1 presents the floristic lists indicating the specific presence of each species at the four different research stations. Although no pre-existing floristic lists for the Triporti area were available, Ruci et al. (2023) describe the presence of several taxa at the family or genus level. This study identifies 25 macroalgae and marine plants, including 9 species of Phaeophyta, 10 species of Rhodophyta, 4 species of Chlorophyta, and 2 marine plants (Tracheophyta). According to Boudouresque (1984), these species belong to the following ecological groups: Photophilous-Infralittoral-Thermophilous (PhIT), Photophilous-Infralittoral-Thermophilous-soft bottom (PhISt), Photophilous-Infralittoral-Quiet-environment (PhIQ), Antisciaphilous (AS), and Sciaphilous-Infralittoral-relatively-Quiet-environment (SIQ). Conditions in the Triporti area were relatively calm and subject to significant summer warming. Consequently, the species list from this study mainly comprises algal species typical of Photophilous-Infralittoral-Quiet-environment and Photophilous-Infralittoral-Thermophilous habitats.

During the observations, the invasive exotic species *Caulerpa racemosa var. cylindracea* (Sonder) was also found (Figure 2c). This species was present at three of the four stations, with a particularly high spread at Station 2, where it created underwater meadows in the Photophilous-Infralittoral-Thermophilous-soft bottom assemblages. At Stations 1 and 4, its presence was sporadic, with only a few individuals observed. *C. racemosa* has been observed in the Adriatic Sea since 2003 (Žuljevic et al., 2003), and its presence along the Albanian coast has increased since then (Katsanevakis et al., 2011).

The highest coverage, both in terms of the number of individuals and total biomass assessed during the observations, was dominated by the presence of *Cystoseira compressa*, found throughout the supra- and mediolittoral zones at all three observed stations, except Station 4. At Station 4, the presence of detrital sandy and mollusk substrates hinders the development of this species. In rocky areas exposed to waves, algal associations mainly composed of *C. compressa*, *Palisada perforata*, and *Ericaria amentacea* are often present (Figure 2d). However, *E. amentacea* showed minimal expansion, being present in moderate coverage at only two of our research stations (Table 1).

Species such as *Padina pavonica*, *Jania virgata*, *Dictyota fasciola*, and *Caulerpa racemosa* often form algal associations in the upper infralittoral zone in areas with low hydrodynamism and significant summer warming (Figure 1h). At Station 2, an underwater field extends over 20 meters parallel to the coast at a depth of one meter, dominated by *Jania virgata* and a *Mytilus*

*galloprovincialis* reef. This phenomenon is easily observable during the summer when the biomass of species like *Gongolaria barbata* and *Ericaria crinita* is at a minimum.
Shadier areas often feature algal associations of *Peyssonnelia bornetii* and the cnidarian *Aiptasia mutabilis*, along with dense patches of *Alsidium corallinum*. Small isolated patches of Posidonia oceanica are present at all four observed stations. During the summer, these patches are often exposed at low tide and covered by epiphytes.
All stations are characterized by the presence of suspended sediments and mud, which, despite reducing light intensity, increase sedimentation in some coastal areas. This allows for the colonization of aquatic plants such as *P. oceanica* and *Cymodocea nodosa* (Figure 2e).

**Table 1.** Floristic lists indicating the specific presence of each species at the four different research stations.

| Phaeophyta | St 1 | St 2 | St 3 | St 4 |
|---|---|---|---|---|
| *Ericaria crinita* (Duby) Molinari & Guiry 2020 | + | + | | |
| *Cystoseira compressa* (Esper) Gerloff & Nizamuddin 1975 | + | + | + | + |
| *Ericaria amentacea* (C.Agardh) Molinari & Guiry 2020 | + | | | + |
| *Gongolaria barbata* (Stackhouse) Kuntze 1891 | + | + | + | + |
| *Dictyota fasciola* (Roth) J.V.Lamouroux 1809 | + | | | + |
| *Dictyopteris polypodioides* (De Candolle) J.V.Lamouroux 1809 | + | + | | |
| *Padina pavonica* (Linnaeus) Thivy 1960 | + | + | + | + |
| *Cladostephus hirsutus* f. laxus (C.Agardh) Heesch, Rindi & W.A.Nelson 2020 | | + | | |
| *Stypocaulon scoparium* (Linnaeus) Kützing 1843 | + | + | | + |
| Rhodophyta | | | | |
| *Digenea simplex* (Wulfen) C.Agardh 1822 | | + | | |
| *Jania virgata* (Zanardini) Montagne 1846 | + | + | + | + |
| *Deltalsia parasitica* (Hudson) Díaz-Tapia & Rodríguez-Buján 2022 | + | + | | |
| *Alsidium corallinum* C.Agardh 1827 | | + | | |
| *Halopithys incurva* (Hudson) Batters 1902 | | | + | |
| *Amphiroa rubra* (Philippi) Woelkerling 1983 | + | + | | |
| *Osmundea pelagosae* (Schiffner) K.W.Nam 1994 | | + | + | |
| *Palisada perforata* (Bory) K.W.Nam 2007 | + | | + | + |
| *Laurencia* J.V.Lamouroux, 1813 | + | + | + | + |
| *Peyssonnelia bornetii* Boudouresque & Denizot 1973 | | + | | |
| Chlorophyta | | | | |
| *Ulva lactuca* Linnaeus 1753 | | + | | |
| *Cladophora lehmanniana* (Lindenberg) Kützing 1843 | + | | | |
| *Halimeda tuna* (J.Ellis & Solander) J.V.Lamouroux 1816 | + | + | | |
| *Caulerpa racemosa var. cylindracea* (Sonder) Verlaque, Huisman & Boudouresque 2003 | + | + | | + |
| Tracheophyta | | | | |
| *Cymodocea nodosa* (Ucria) Ascherson 1870 | + | + | + | + |
| *Posidonia oceanica* (Linnaeus) Delile 1813 | + | + | + | + |


**Figure 2.** Phytocoenosis with various algae species at four research stations: **a.** Station 1: *Cystoseira compressa*, *Ericaria crinita*, and *Padina pavonica* on the seabed. **b.** Station 3: Underwater kelp forest of *Cystoseira compressa*. **c.** Station 2: A small meadow of *Caulerpa racemosa* and juvenile *Gongolaria barbata*. **d.** Station 2: Supralittoral algal assemblages of *Cystoseira compressa*, *Palisada perforata*, and *Ericaria amentacea*. **e.** Station 2: Meadow of *Posidonia oceanica*. **f.** Station 3: Assemblages of *Peyssonnelia bornetii* and the cnidarian *Aiptasia mutabilis* in shaded areas. **g.** Station 1: Underwater Forest of *Gongolaria barbata* and *Cystoseira compressa* with floating branches bearing aerocysts at the top. **h.** Station 4: Algal assemblages of *Padina pavonica*, *Jania virgata*, *Dictyota fasciola*, and *Caulerpa racemosa*.

## 4. Conclusions

The coastal area of Triporti features a highly heterogeneous morphology, creating a variety of habitats that support the formation of algal phytocoenoses. The presence of areas with accumulated sediments and rocky zones provides shelter for many invertebrate species associated with the substrate vegetation (Nasto et al., 2022).

According to Boudouresque (1984), these species belong to the following ecological groups: Photophilous-Infralittoral-Thermophilous (PhIT), Photophilous-Infralittoral-Thermophilous-soft bottom (PhISt), Photophilous-Infralittoral-Quiet-environment (PhIQ), Antisciaphilous (AS), and Sciaphilous-Infralittoral-relatively-Quiet-environment (SIQ). Conditions in the Triporti area are relatively calm and subject to significant summer warming. Consequently, the species list from this study mainly comprises algal species typical of Photophilous-Infralittoral-Quiet-environment and Photophilous-Infralittoral-Thermophilous habitats.

The presence of these habitats is quite delicate and is expected to be increasingly threatened by coastal tourism and urbanization in the future. It is important to monitor the evolution of these phytocoenoses and understand the mechanisms that support their survival, to apply this knowledge to conservation or restoration processes in areas with similar characteristics.

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