Regional Assessment of the Seagrass *Cymodocea nodosa* (Ucria) Asch. in the Tropical Atlantic Seagrass Bioregion (Bioregion 2) for the IUCN Red List [1,2]

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PLANTAE - TRACHEOPHYTA - LILIOPSIDA - ALISMATALES - CYMODOCEACEAE - *Cymodocea - nodosa*

Common Names: Slender Seagrass, Little Neptune Grass, Seahorse Grass (English), Algueró (Catalan; Valencian), Alka Rqiqa (Maltese), Nimfa de les aigües marines (Catalan; Valencian), Seba (Spanish; Castilian), seba (Portuguese)

Synonyms: *Zostera nodosa* Ucria, *Cymodocea aequorea* K.D.Koenig, *Cymodocea major* (Willd.) Grande, *Cymodocea preauxiana* Webb & Berthel. *Cymodocea webbiana* A.Juss., *Phucagrostis major* Theophr. ex Cavolini, *Phucagrostis nodosa* (Ucria) Kuntze, *Kernera nodosa* (Ucria) Schult. & Schult.f., *Zostera mediterranea* DC.

Red List Status
VU - Vulnerable, (IUCN version 3.1)
Extent of Occurrence (EOO) in Bioregion 2= 382544 km²
Area of occupancy (AOO) in Bioregion 2= 288 km²

[1] This regional assessment does not constitute the global assessment for this species, given that its global distribution is not limited to the Tropical Atlantic Seagrass Bioregion.

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Red List Assessment

Assessment Information

Assessor(s): Duarte Frade, Ester A. Serrão, El-Hacen M. El-Hacen & Salomão Bandeira

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Time period assessed: 2007-2020

Assessment Rationale

In the Tropical Atlantic region, *Cymodocea nodosa* occurs as extensive meadows, particularly in the Banc d'Arguin National Park, Mauritania. The current population trend in the bioregion is unknown, and new populations are still being found in the bioregion. Ecological niche models suggest that the entire distribution area in the Tropical Atlantic may be lost by 2050 under the RCP 2.6 and RCP 8.5 climate change scenarios (Chefaoui et al., 2018, 2021), qualifying as Vulnerable under criterion E. These projections do not meet the conditions for Vulnerable under criterion A3, as the timeline of these projections (2050) falls beyond the duration of three generations (estimated as 9 years, according to Short et al., 2011). More monitoring studies are needed on the distribution of the bioregional population and its dynamics and trends. Because the species meets criterion E for VU in this region, and the criteria for the highest category of threat that the taxon qualifies for prevails over other criteria. We propose to classify it is VU for Bioregion 2. Globally, its classification will depend on Region 3 assessment.

Distribution

Geographic Range

Globally, *Cymodocea nodosa* occurs in the Mediterranean and nearby Atlantic coasts from central Portugal to Senegal and The Gambia, as well as the Canary Islands and Madeira (den Hartog, 1970; Wirtz, 1995). Based on population genetics, four main regions have been identified for the species (Alberto et al., 2008, Masucci et al. 2012): High-latitude Atlantic (SW Iberian Peninsula and Atlantic coast of Morocco), Low-latitude Atlantic (Madeira, Canary Islands, Mauritania, Senegal), Western Mediterranean (Strait of Gibraltar to Sicily–Tunisia Strait), and Eastern Mediterranean (east of Sicily–Tunisia Strait). Subpopulations in the Tropical Atlantic were found to be very genetically distinct from all other populations along the species distribution and to represent ancient persistent populations that survived cooler conditions during glacial periods (Alberto et al., 2008, Chefaoui & Serrao 2017).

In the Tropical Atlantic bioregion, *Cymodocea nodosa* is restricted to West Africa from the north of Mauritania to Senegal (Cunha & Araujo 2009, Masucci et al. 2012) and The Gambia (Sidi Cheikh et al 2023)). It forms very extensive *Cymodocea nodosa* meadows in the Banc d'Arguin National Park (Araujo & Campredon, 2016; Trégarot et al., 2021) and in Baie de l'Etoile (Ly, 2009), both in Mauritania.

Elevation / Depth / Depth Zones

Depth Lower Limit (in metres below sea level): 4 m
Depth Upper Limit (in metres below sea level): 0
Depth Zone: Shallow photic (0-50m)

Map Status

Map Status	How the map was created, including data sources/methods used:	Please state reason for map not available:	Data Sensitive?	Justification	Geographic range this applies to:	Date restriction imposed:
Done	-	-	-	-	-	-

Occurrence

Countries of Occurrence

Country	Presence	Origin	Formerly Bred	Seasonality
Mauritania	Extant	Native	-	Resident
Senegal	Extant	Native	-	Resident
The Gambia	Extant	Native	-	Resident
Cabo Verde	Extant	Native	-	Resident

FAO Area Occurrence

	Presence	Origin	Formerly Bred	Seasonality
27. Atlantic - northeast	Extant	Native	-	Resident
34. Atlantic - eastern central	Extant	Native	-	Resident

Map Status

Map Status	How the map was created, including data sources/methods used:	Please state reason for map not available:	Data Sensitive?	Justification	Geographic range this applies to:	Date restriction imposed:
Done	Data points compiled from the literature and unpublished data.	-	-	-	Global (species is endemic to Bioregion 2).	-

Regional Assessment Map



Population

The current population trend of West African populations is unknown although the species is widespread in Senegal (Sidi Cheikh et al 2023). Intertidal seagrass coverage in the Banc d'Arguin National Park has reportedly increased between 1986 and 2014, based on satellite imagery (El-Hacen et al., 2020), but it is unclear if this trend is also true for subtidal *Cymodocea nodosa*. The species forms extensive meadows in the Banc d'Arguin National Park, Joal and other sites in Senegal. Mauritania, estimated to cover 300 km² (Araujo & Campredon, 2016) to 374 km² (Clavier et al., 2014), where as a lower estimate of 221,7 km² focused only on the southern part of the Banc d'Arguin (Trégarot et al. 2021). In a northern part of the Banc d'Arguin, the population might be increasing, as previously emersed areas have been colonised by the species following the rupture of dune cords (Trégarot et al., 2021). *Cymodocea nodosa* occurs also in the north of Banc d'Arguin, particularly in the Baie de l'Etoile, near Nouadhibou, Mauritania, where Ly (2009) has estimated that the species covers around 113 ha in the bay. The species has also recently been discovered in The Gambia (Sidi Cheikh et al 2023). Nonetheless, ecological niche modelling under two climate change scenarios (RCP 2.6 and RCP 8.5) predicts habitat loss in the southern range edge by 2050, potentially resulting in the loss of the entire occurrence area of the species in the Banc d'Arguin and further south, in this period (Chefaoui et al., 2018), thereby running the risk of disappearing from the tropical Atlantic region entirely.

Population Information

Continuing decline in mature individuals?	Qualifier	Justification
-	Projected	Ecological niche models predict habitat unsuitability in the bioregion by 2050

Continuing decline in number of subpopulations	Qualifier	Justification
-	Projected	Ecological niche models predict habitat unsuitability in the bioregion by 2050

Habitats and Ecology

In the Tropical Atlantic, *Cymodocea nodosa* grows in mobile sandy or muddy sediments, occurring in channels and other subtidal areas (Araujo & Campredon, 2016), mostly between 0 and 2-4 meters in depth (depending on water turbidity) inside the Banc d'Arguin (Ester A. Serrão and El-Hacen, personal observations, Sidi Cheikh et al 2023). However, just north of this region, in the transparent waters of the Canary Islands, the species occurs down to depths of 30 m (Alberto et al. 2006). The species co-occurs with two smaller seagrasses in West Africa, *Zostera noltei* and *Halodule wrightii*, with *C. nodosa* dominating in subtidal areas (Araujo & Campredon, 2016, Sidi Cheikh et al. 2023). It forms mixed meadows with *H. wrightii* at very shallow depths of 0-0,5 m in the Banc d'Arguin (Ester A. Serrão, personal observation), but not with *Z. noltei*, which always occurs above *C. nodosa*, in the intertidal zone. These can appear mixed along sand banks with mixed depth profiles where pools of water that never dry occur along the intertidal zone.

In Senegal, *C. nodosa* occurs subtidally in fine sandy or muddy sediments, up to 4 m, as observed in locations such as Joal Saloum Delta (Sidi Cheikh et al 2023). In The Gambia, *C. nodosa* is widespread in Kartong, Gunjur Bijol Islands, occurring in both intertidal and subtidal areas, growing in monospecific and mixed meadows with *Halodule wrightii*. Beach cast of this species was also found in several places along the Gambian coastline (Sidi Cheikh et al 2023). *C. nodosa* has also been documented at Baia da Angra, Santiago Island in Cape Verde (Associação Caboverdiana de Ecoturismo ECOCV, pers. com.)

C. nodosa tolerates salinities of 17-56 PSU, with mortality or loss of vitality outside these values (Fernández-Torquemada & Sánchez-Lizaso, 2011; Pagès et al., 2010; Tsioli et al., 2019). Optimum growth temperature was experimentally determined as 30 ºC, though growth and high photosynthetic activity were retained at 34–35°C (Tsioli et al., 2019) and plants failed to grow at 10 ºC (Tsioli et al., 2019). Plants of *C. nodosa* from the Banc d'Arguin survived better but grew less at 31 °C than those from Atlantic Iberia and were also more infected by parasites than those located further north (Medina 2020). The *C. nodosa* growing at Banc d'Arguin showed on average a lower standing biomass and growth compared to the more northern populations in the Mediterranean (van Lent et al., 1991; Vermaat et al., 1993). Distribution models estimated minimum and maximum temperatures, nutrients, salinity and wave action to be the main predicting factors for the species distribution (Chefaoui et al. 2015).

Cymodocea nodosa is a dioecious seagrass, with male and female flowers on separate plants. The investment in sexual reproduction varies markedly in different areas (Máñez-Crespo et al., 2020). The species forms nearly single-clone meadows at the northernmost Atlantic range edge (Alberto et al., 2001) including a 43 km male clone estimated to be thousands of years old (Berkovic et al. 2018), but further south in the Atlantic it reaches high levels of sexual reproduction in Mauritania and the Canary Islands (Alberto et al., 2008). Seeds are produced in pairs at the base of the female shoots (i.e. under the sediment) and tend to settle near the maternal meadows (Alberto et al., 2005; Buia & Mazzella, 1991; Caye & Meinesz, 1985), where they can form large seed banks (up to 220 seeds per m^2 in Terrados, 1993,

and in Mauritania 112 seeds per m^2 were recorded in Ile d'Arguin in 2020, Ester Serrão personal observations). Generation length (defined as the time between germination and seed production) has been estimated as 3 years (Short et al., 2011).

IUCN Habitats Classification Scheme

Habitat	Season	Suitability	Major Importance?
9.4. Marine Neritic -> Marine Neritic - Subtidal Sandy	-	Suitable	-
9.5. Marine Neritic -> Marine Neritic - Subtidal Sandy-Mud	-	Suitable	-
9.9. Marine Neritic -> Marine Neritic - Seagrass (Submerged)	-	Suitable	-
12.2. Marine Intertidal -> Marine Intertidal - Sandy Shoreline and/or Beaches, Sand Bars, Spits, Etc	-	Suitable	-

Life History

Generation Length	Justification	Data Quality
3	Recruitment time	-

Breeding Strategy

Does the species lay eggs?
No

Does the species give birth to live young
No

Does the species exhibit parthenogenesis
No (but it propagates clonally)

Does the species have a free-living larval stage?
No (but it has seeds)

Does the species require water for breeding?
No (but it requires seawater for pollen transportation)

Systems

System: Marine

Threats

The largest meadows of *Cymodocea nodosa* in the bioregion are protected from human-induced mechanical damage within the Banc d'Arguin National Park, Mauritania, and seem to have colonized some new areas following the formation of new coastal lagoons (Trégarot et al., 2021). Nonetheless, subpopulations of *Cymodocea nodosa* in the Tropical Atlantic appear to be threatened by climate change. Ecological niche models predict that the entire distribution area in the bioregion can be lost by 2050 under RCP 2.6 and RCP 8.5 climate change scenarios (Chefaoui et al., 2018). In this region, *Cymodocea nodosa* is also frequently extensively colonized by epiphytic colonial invertebrates (ascidians, bryozoans, particularly invasive ones) that block their access to light (EAS, pers obs).

Conservation

The largest meadows within the bioregion occur within the Banc d'Arguin National Park, Mauritania. Other large meadows in the region occur in Saloum Delta, Joal in Senegal, several location within The Gambia and also just outside the National Park of Banc d'Arguin in the Baie de l'Etoile, near the city of Nouadhibou, Mauritania, which is known for its large-scale industrial mining and fishery activities that could affect the stability of the nearby *C. nodosa* population.

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