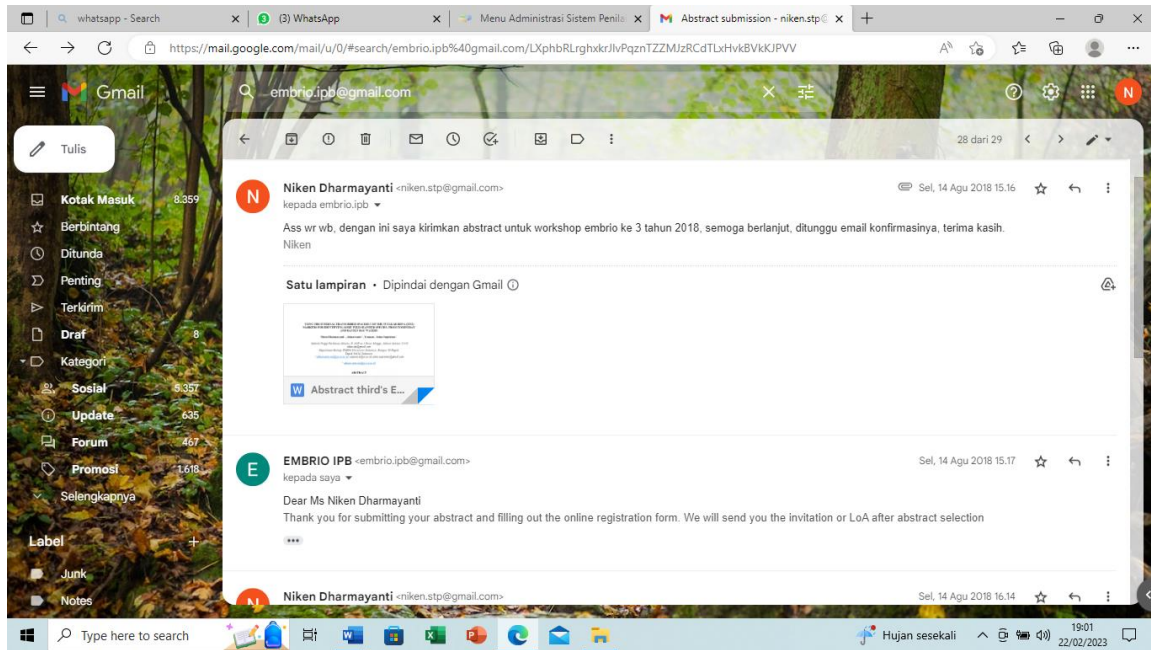
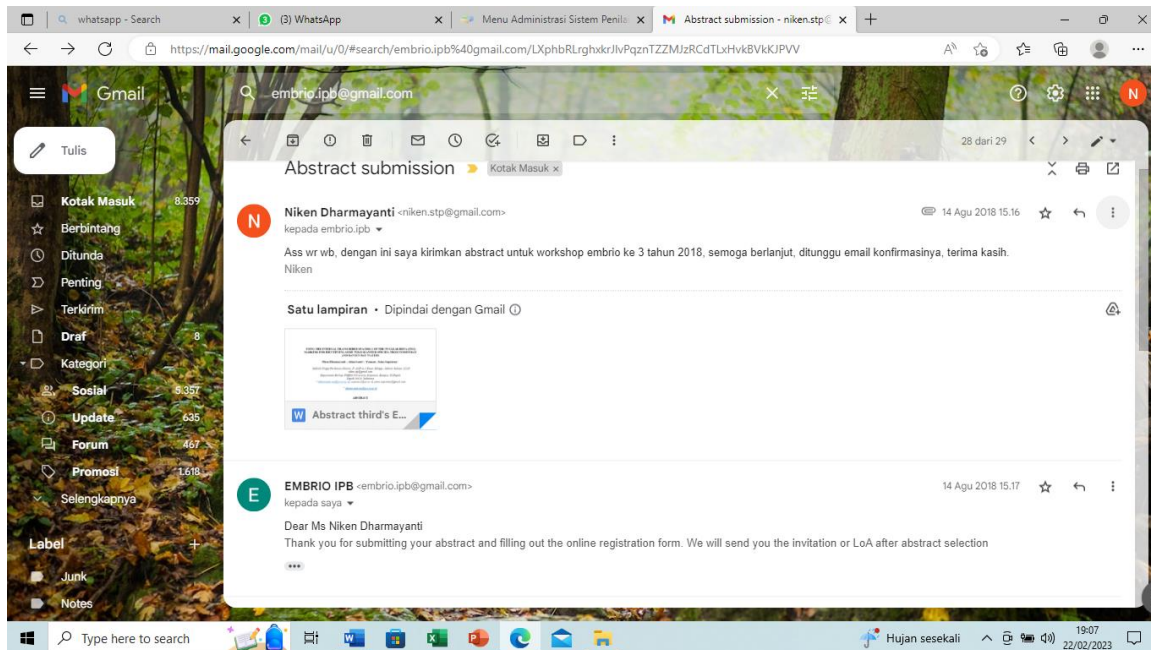


## Bukti Submission Abstract Proceeding Konferensi Internasional EMBRIO IPB 14/08/2018



## Bukti Penerimaan Submission abstract tgl 14/08/2018



# USING THE INTERNAL TRANSCRIBED SPACERS 2 OF THE NUCLEAR rDNA (ITS2) MARKERS FOR IDENTIFYING SOME WILD SEAWEED SPECIES, FROM TOMINI BAY AND BANTEN BAY WATERS

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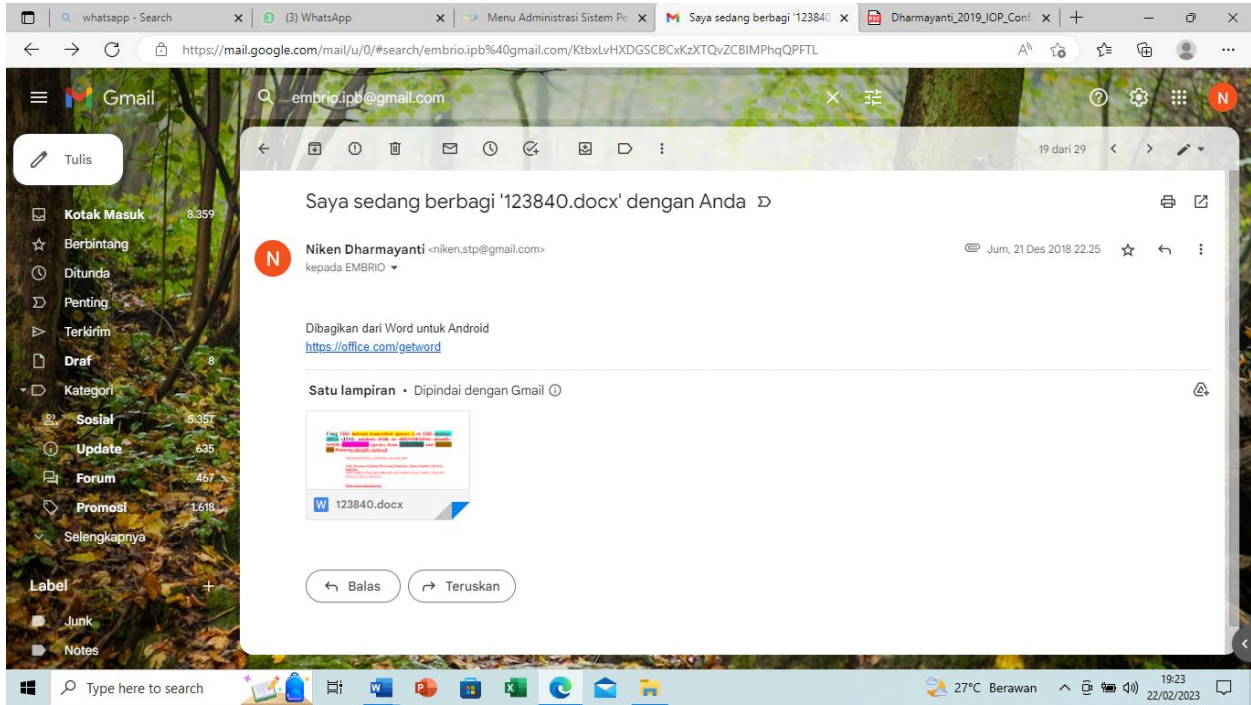
\* [abinawanto.ms@sci.ui.ac.id](mailto:abinawanto.ms@sci.ui.ac.id)

## ABSTRACT

An increasing attention to learn more about marine organisms, especially seaweed has arisen<sup>1</sup>. Tomini Bay and Banten Bay are two of the potential waters where the economic seaweeds are produced, but the wild seaweed is less noticed. This is the basis of the research on the potential and diversity of wild seaweed. Sample collected from the coastal area by diving and using a boat. The fresh seaweed morphologically identified while the dried sample collected to be used on DNA testing. Previous research shows there is an influence from environmental parameters on seaweed composition in a specific area<sup>2</sup>, so that the water quality testing was carried out to determine the dominance of wild seaweed that occupies the coast by its parameters of water quality. We then proceeded to the classification and DNA testing result of the collected seaweeds which are distributed at Tomini bay as *Agarum clatharum*, *Polysiphonia akkeshiensis*, *Palmaria lucida* dan *Ectocarpus sp.* and at Banten bay as *Sargassum polycystum*. This study evaluated the feasibility of using the Internal Transcribed Spacers 2 of the nuclear rDNA (ITS2) markers for identifying some wild seaweed species, from Tomini Bay and Banten Bay waters. Five wild seaweed species collected from these waters were submitted to DNA barcoding. Currently available universal primers for ITS2 region amplification were sufficient to successfully amplify and sequence all of the samples. ITS2 Compensatory Base Change (CBC) region phylogenetic analysis, together with morphological inspection, confirmed the identification accuracy. In conclusion, the data presented here indicates that ITS2 are useful markers for DNA barcoding of wild seaweed, with advantage for ITS2 due to the larger availability of analytical tools and reference barcodes deposited at databases for this marker.

*Key words* : ITS2, Wild seaweed, Tomini Bay, Banten Bay

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# Using THE internal transcribed spacers 2 of THE nuclear rDNA (ITS2) markers FOR to IDENTIFYING identify SOME wild seaweed species, from Tomini Bay and Banten Bay Waters to identify seaweed

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**Abstract.** ~~Abstract. During recent years~~ An increasing attention to learn more about marine organisms, especially seaweed has arisen<sup>1</sup>. Tomini Bay and Banten Bay are two of the potential waters where the economic seaweeds are produced, but the wild seaweed is less noticed. This is the basis of the research on the potential and diversity of wild seaweed. Samples ~~were was~~ collected from the coastal area ~~two coastal areas~~ by diving and using a boat. The fresh seaweed ~~were~~ morphologically ~~morphologically~~ identified while the dried samples ~~were~~ collected to be used on DNA testing. Previous research ~~has been shown shows that~~ there is an influence from environmental parameters on seaweed composition ~~in a specific area~~<sup>2</sup>, so that the water quality testing was carried out to determine the dominance of wild seaweed ~~water that occupies the coast by its parameters of~~ water quality. We then proceeded ~~to conducted the classification and DNA genomes extraction, PCR amplification, DNA sequencing testing, alignment with MEGA 7 application and made phylogeny tree, results of the collected seaweeds,~~ which are distributed at Tomini bay *Dictyota sp., Halimeda sp., Padina sp., Polysiphonia sp., Halimeda sp., Polysiphonia sp., Dictyota sp., Padina sp.* and at Banten bay as *Sargassum sp.* This study evaluated the feasibility of using the Internal Transcribed Spacers 2 of the nuclear rDNA (ITS2) markers ~~for to identify identifying~~ some wild seaweed species, from Tomini Bay and Banten Bay waters. Five wild seaweed species collected from these waters were submitted to DNA barcoding. Currently available universal primers for ITS2 region amplification were sufficient to ~~be~~ successfully amplified and ~~the result of amplification DNA continue to be sequence~~ sequence all of the samples. ITS2 Compensatory Base Change (CBC) region phylogenetic analysis, together with morphological inspection, confirmed the identification accuracy. In conclusion, the data presented here indicates that ITS2 are useful markers for DNA barcoding of wild seaweed, with advantage for ITS2 due to the larger availability of analytical tools and reference barcodes deposited at databases for this marker.

**Key words** : ITS2 Markers, Wild -seaweed, Tomini Bay and Banten Bay

## 1. INTRODUCTION

The identity of five wild seaweed ~~species~~ has been determined by amplification of the Internal Transcribed Spacer ~~s-2~~ of the nuclear rDNA (ITS2) markers. This allows the detection of specificity patterns for each species and provides an alternative method, when morphological or biological species concept's methods fail. Total genomic DNA suitable for amplification was extracted from the dried tip of a leaf's alga following the CTAB method. We then proceeded to the clasification and DNA testing result of the collected seaweeds ~~which are distributed at Tomini bay as Halimeda sp., Polysiphonia sp., Dictyota sp., Padina sp. and at Banten bay as Sargassum sp.~~

**Commented [SK1]:** Usually title should have 14-16 words. you have 23

Containing 3-4 topics..

You have 5 topics (see colours)

**Commented [SK2]:** Delete the colours I put in to see your topics

**Commented [SK3]:** I dont know..to be sequenced???

Seaweed The wild seaweed are found and ecologically important species in the Tomini and the Banten Bay waters. This genus inhabits rocky substrates of the infralittoral zone where they play an important ecological role in providing habitat, food and shelter as well as spawning and -nursery grounds for a wide variety of organisms ([1]GOMEZ-GARETTA, 2000; reviewed in DRAISMA [2]et al., 2010). However, in recent years, seaweed stands have been significantly reduced or disappeared habitat destruction, overgrazing and eutrophication ([3]THIBAUT et al., 2005; SUSINI [4]et al., 2007a and [5]b; [6]MANGIALAJO et al., 2007, [7]2008). Despite its ecological importance, the taxonomy of species within the genus is still poorly understood and No. studies have yet explored the genetic diversity of wild seaweed species in the Tomini and Banten Bay. The ecomorphs differ greatly from the average morphology of the species, that makes difficult to distinguish which morphological variation is an adaptation to ecological conditions, wand which is a characteristic of a different species. Species determination is made even more difficult by the lack of comprehensive identification keys for the genus. -The oTnly he only currently available key for the wild seaweed species ([8]ERCEGOVIĆ, 1952) based on morphology is outdated and was written in a period when sampling possibilities, and thus also determination, were limited. Difficulties arise while identifying the species, as several names may have been applied to the various populations or ecomorphs belonging to a single species, i.e. the morphological variability of the species has been overlooked. The situation is similar for other Sargassaceae genera such as for example the genus *Sargassum* Sargassum ([9]MATTIO & PAYRI, 2014). The current method of determining relations within the genus based primarily on morphological characteristics, is shown as being insufficient to unambiguously separate some species of this genus. Because of this, the focus is increasingly shifting to molecular methods of studying marine algae phylogeny, particularly brown algae, and this genus. In order to overcome morphological ambiguities in the identification of species, molecular markers are nowadays used [10] (JEGOU et al., 2010). Several different molecular markers have been used in recent studies of brown algae molecular taxonomy and phylogeny. The most common ones are nuclear ribosomal markers, ITS, SSU and LSU, ([11]; [12]; [13]). (ROUSSEAU et al., 2001; LE CLERC et al., 1998; HARVEY & GOFF, 2006.), ITS2 [10] (JEGOU et al., 2010), plastid markers, rbcL and psaA ([14]BITTNER et al., 2008; [15]CHO et al., 2006), and mitochondrial markers, mt 23S and mt spacer ([16]COYER et al., 2006; [2]DRAISMA et al., 2010). However, most of these markers have been used for delineation among the higher taxonomic units such as genera and families and rarely for distinguishing between the species. This is especially the case in the order Fucales, the family Sargassaceae, and the genus *Cystoseira*, which require highly variable markers to determine relations between the taxa [17] (DE REVIERS et al., 2007). [5]SUSINI et al. (2007b) have noted high genetic variations in the populations of the genus *Sargassum*, and suggest that 2 tis2 those variations the populations should be considered separately when studying the ecology of the genus. Recently, [2]DRAISMA et al. (2010) have underlined the usefulness of the mitochondrial 23S in the delineation of *Sargassaceae* genera and the potential of the mt23S-tRNAVal spacer at below genus level. Molecular markers have to be tested to better understand the taxonomy and evolution of the seaweed species research. TWith the purpose of this research is identifying the appropriate Internal Transcribed Spacers 2 of the nuclear Rdna (ITS2) molecular marker with which species distinction of the wild seaweed could be achieved, we choose to test molecular markers in a preliminary study. Four wild seaweed Tomini Bay's species and one wild seaweed Banten Bay's species. -The data was then compared to published sequences of Tomini and Banten bay's species. Bay's spesies.

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## 2. METHOD

Sample collection and DNA preparation; The individual of each species were sampled from the rocky bottom between 20 and 80 cm of depth. Four wild seaweeds was collected from the Tomini Bay at Avulua Village 10 km north to Parigi Moutong with coordinates 0°39'53.4"S 120°04'25.7"E in April 2018, and wild seaweed *Sargassum* sp from the Banten Bay at Pulau Lima waters (6°0'5.6376"S - 106°9'15.3684 "E) in Februari 2018. Morphological analysis was guided with characteristics described



by [8] ERCEGOVIĆ (1952). Immediately after collection, a part of the branch least overgrown by epiphytes was separated from each specimen. Visible epiphytes were then mechanically removed from the sampled part, ~~the tip of talus~~ ~~was~~ was washed with distilled water and stored in silica gel. ~~The 3~~ ~~is~~ ~~3~~ ~~if~~ ~~the~~ ~~talus~~ ~~was~~ ~~stored~~ ~~in~~ ~~4%~~ ~~formaldehyde~~. Total DNA was isolated from silica dried algal tissue using Qiagen Plant mini kit and additionally purified using Qiagen Plasmid mini kit. PCR primers, PCR and sequencing Primers published by [2] DRAISMA *et al.* (2010) for the mt 23S and the mt23S-tRNAVal spacer were used for PCR amplification and sequencing. Primers, PCR conditions and reaction ingredients are listed in Table 1. The thermo cycler used in PCR amplification of all regions was Applied Biosystems 2720. The amplified DNA fragments were purified using QIAEX II gel extraction kit 150 (Qiagen). Sequencing was done by Macrogen in Korea using an ABI PRISM 3100 Avant Genetic Analyzer.

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**Table 1.** Primers used to isolate molecular markers with annealing temperature (AT) and bibliographic source

No	Markers	AT	Primers	Primer sequences
1	ITS2 Nuclear	55	5.8S-BF	5'-GATGAAGAACGCAGCGAAATGCGAT-3'
			25 BR-2	5'-TCCTCCGCTAGTATATGCTTAA-3'
2	COX3 Mitochondria	42	CAF4A:	ATGTTTACTTGGTGRAGRA
			CAR4A:	CCCCACCARTAWATNGTNAG

Source: [18]

Data analysis raw sequences were edited and trimmed manually using ~~the~~ ~~new~~ version of Molecular Evolutionary Genetics Analysis v. ~~7.2~~ (MEGA ~~7.2~~). The number of sequences determined by using GenBank database which is hosted at NCBI (National Center for Biotechnology Information, USA) [Link: <http://www.ncbi.nlm.nih.gov/>]. NCBI hosts a number of biological databases for example whole-genome databases for human, mouse, chimp, seaweed or algae and another specific genom of organisms.

The number of polymorphic sites and phylogenetically informative sites were determined using the DnaSP v5 [19] (LIBRADO & ROZAS, 2009). Alignment of sequences was processed using ClustalX [20] (LARKIN *et al.*, 2007) and visualized in GeneDoc [21] (NICOLAS *et al.* 1997) for each marker independently. A total of 11 sequences for other Mediterranean *Cystoseira* species available on GenBank and published by [2] DRAISMA *et al.* (2010) were included in the analyses. The most suitable model of nucleotide evolution was determined by the Akaike Information Criterion, AIC, [22] (AKAIKE, 1974) as implemented in JmodelTest [23] (POSADA, 2008); for the 23S Rdna the selected model was TrN+G with gamma=0.013, and for the -mt spacer the selected model was HKY, with ti/tv=1.4910. Bayesian analyses were performed using MrBayes 3.1.1 [24] (HUELSENBECK & RONQUIST, 2001). The parameters of the Markov Chain Monte Carlo (MCMC) analysis comprised two runs (four chains each) for 500000 Species generations, with the sample frequency set to 100 and discarding first 1250 trees as the burn in. Thus, the posterior probabilities of the clades were determined from 3750 trees and the 50% majority-rule consensus tree was built.

### 3. RESULTS AND DISCUSSION

Data analysis of sequences after trimmed by using MEGA X, resulting a vary sequences that equals for their pairs. -Here the sequences based on their correct pairs.

#### 1. POLYSIPHONIA #3217322\_1N\_ITS2-5\_8S-BF

GGTCACAAGTGACGCTGCTTGCCGCCGAGGGCGGCCCGCTGGCGGTTCGAGCCAGACAAC  
TGACTGACTGACTGACCATCGTGGGTCGACCGCAAAGCCTAATAGCGGGCCTGGAC  
ATCACCCGCACACCTCGCCCCGTGGGGACAAGGCGGGGCGCCGAGTCTCGATCGCCCC  
TCGCGTACCCACGCCCCCCCCCTGCCAAGAGAAAATGGCGGGAGAGAGGAATGGGGAC  
GGGCAAGAAACATTGGCCCTCCACTAGTCGCAATGCCGCAATCATACTTCTTAGGCCGGC  
TCACGAGACGAAGCTCGCGCCGGCTCATAGTCCGCCGCCCGGAGCGCGCGGAGTCA  
CCATTTCTGGCGTCTCAAGCGGGCCACGCACGGGGGGCGAGTGGGGTGGACAGACACT  
CCGACAAGCATGCTCCAGGAGTATCCCGGAAGCGCAAGATGCGTTCAAAGGTTTGATG  
ATTAC

2. POLYSIPHONIA #3217324\_2N\_600bp\_ITS2-5\_8S-BF

GAGATCCCGTAGGAAATAAGGACTGCTGCTTTTTTTTCTAGGAAATAAAAAACAGCATT  
GACAGCCTAAAATACCCACATTTCTGTAGATATACTGTGATCTGAGCGTTGTAATGTAA  
AAATCGAAAGCCATGATCACTCATTATTTTGAACCTTTGATATCTCTCCACCTCAACA  
AAGCAAGAACAAGTAAACTCTGAATGACAAGTTCAATTCATGCCTGCCGGCTCAAAGA  
ATCAATTCATTTTTGTAACAAAAACAAAGCGCGCAAAAAACACTGGAAATACACTTT  
CTACAAGTAAATTCAGGTGACCCCGCTGTAGGTTATTCAAGCTGGTAGCAAGGACG  
CACCCATCAGCTGCGATTTCCGTGCGGTGACACCGCTAAAATCGCAAAGTTATGTTGTGA  
AATTTTACCTACACATGGGACACTCACACAGGTATGCTCGCAGATTAACCCGCGAGCGCC  
ATTTGCGTTCAAATAATTCGATGATTCA

3. HALIMEDA #3217326\_2N\_1400bp\_ITS2-5\_8S-BF

CCAAAAGCAGGACCGCTACCAACGCCACCTCGCCTCCACAAACACACACTCAACACT  
CCGACTCAGACGGACCTGCAAATGCCAAGCCCTAACAAACCCGCAAGCACGCACACA  
CACACACACGCACACACACCCACCAGTGCAGGACTCAACTTCAGCACTCACACCCGCC  
GCTTTCGGAACAAGCACAACACATCCATGAATTCATCTACACCAACAAGCGCGCGCA  
CGCAGCACACACATACACTCACACGAAAGCTCAAACACAGAAGTTTCGACATACAC  
AGCACCGCCACCAGTTCACACTCCGCACACCAACTGCTCCGATCAAAGATTGCTCCTT  
ACCTTACAGCCAGTGAATTGTAGTAACCGATCCCCAACAAACGAAGCCATGCGCACAGG  
TCGCCCTGCACACTGCCTCTATTCCACATCCCGTCGCCTACTAAGTTCACCAGAACTA  
AAGAATGCCTCAACTCGCTTCCACAAAGCAGGACTCAGCTTTGGCTTGCCTCCACGAA

4. PADINA #3217328\_3N\_ITS2-5\_8S-BF

CCACTATCCACAGCAGTCACTGGATCGTAGTTACTTCCCAGAGACTGAGCAAAAAAAA  
GGGGGAAGGGATGGGATAACGTTTTCCAACCTGTGCGACCGAAACAACAGAAGTTTCTC  
TTCCGAAAACCTCCTACACCCCCCTCCCTTCTTCTTCTTCCAGGACCCAGAACCGCAA  
AAGACAACCAAGCTAATATAGTACAATACACACACACAAATCCATTTCTCCCTTCTTGTA  
TAATATTCTTCCACAGTTCAGTGAAGAAAGTGAACCGGTAAGGAACCAAAAAGTGA  
GAAAGTGGGCGCGCTTTGGGTTCTCAAGTATTCCATAAGCCAGATGTTTGTATATTTTA  
GCAAAACACAACTTTCGCGGATGCGGTGTCGACACGCTGTACCAACTGGCCGTGTC  
CAGTTGATACTATTAAGAGGCAAGAGAATGTCACCTTCTCCTGGTTTCGCACACTCAC  
GAAAAGTCAAACGCTTGGGGAAAAACAGTAACAACACTGGTTTCT

5. DICTYOTA #3217330\_4N\_ITS2-5\_8S-BF

CGGAGGTCCGTAAAGACGACGCTGCCCGATAGCAAGCAAGCAAGCAAGCAAGTAA  
CTAACGGGACGTCCTTACCTGACCGGGTCCGAGGGGTCTCGGCGGGCCGGACGGTCCG  
GGTGAAGGGCAGCACCGCAACAGCAGAAATCGATCAATCACTCGATCAATGGATCAAA  
CAATCAACACAACCTCGCCGCCACGGGCCACACGGCCACCCAACTTCTACTCTCGCTCT  
CTGCTACTCGGCGCAACCCGACTTGCGCCGACTAACGCTGCCGCGTATACGATCCGA  
GACCCTTCTCCGGGTTGGACAGTTTTGCTACTCTTCGCGGGGCTCGGCGATGGTCTTC  
GCACGTCGGTAGAGGAGACGAAGAGACAGCTAGGATAACAACAACAACAACAACA  
ACAACAACAACAACAAGCAGACTACCATCATCGTCATCATCATCGTCATCATCATCAT  
CACCATCATCATCAGCATCCCTACTACCACCGGAGAACGGCCACCACCGCGCTCG  
CATAGTCCGCCAAAGTACTCACCCTTTCCCGCCGCGGCCAAGTCATCTTGGTACCGCGA  
GAAGCGGTGCCGCGATGACGAGGTAGGCGAAGACCGAGTGTGCACAAGGACGAGTGG

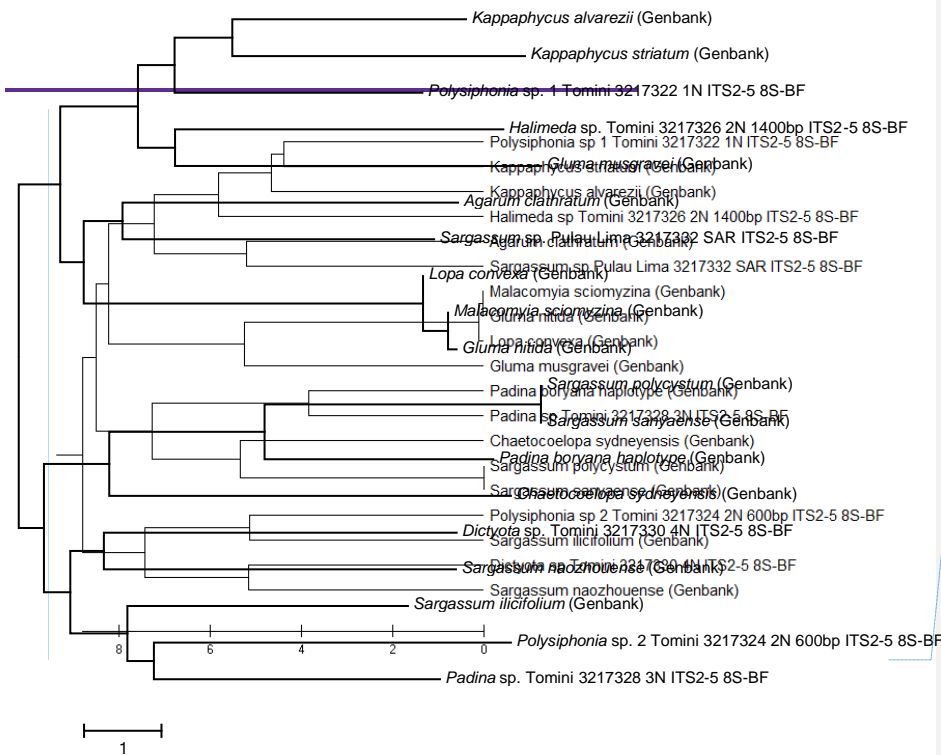
GGTGAACGAAGACTCCGACAAGCATGCTCCCAGGGATATCCCAGGAAAGCGCAAGATGCGT  
TCAAAGTTTTGATGATTTCG

6. SARGASSUM #3217332\_SAR\_ITS2-5\_8S-BF

CATAATCATAATCACCGGCTCTCACCGTACTCTCGAGACTACCTACCGTCCTAAGCCT  
CAAGTCCACCCGCGCATCCCCGGCGACCCGTCGTGTCCCCGCCCGCGATAGGGGGC  
GCCGTCAACAACGATCCTCCGGAGGACGCAAGGTGAACTTGCTCCAGCGACGCCTCC  
AGCGCCGGAAGACAACAGAGGGCCAGACAATCGGTAACCTCTAGGCTTGGGTGGACT  
CAGGGGACGAGCAGGGAGCATGTACAAAAATACACCGCACTACCGTCCCCGGAACACT  
CATATTCCGCTCCACCGCCTTGAGGTGCGAGATCGAACCCTAAAGCTGTGGGCGAGTTTTCG  
CCTCCTCTCCCCGACAAGCATGCTCCCAGGCATATCCCAGGAGCGCAAGATGCGTTTCA  
AGTTTTCGATGATTACAGAGAT

A total of four sequences for the mt23S Rdna (394 pb) and 15 sequences for the mt intergenic spacer (mt23S-tRNAVal) (333 pb) were successfully amplified and sequenced. The sequences were deposited in GenBank.

Genetic ~~analysis-analysis~~ of the gene as the samples collected from Tomini Bay and Lima Island revealed a unique similarities to other species which is different from estimated sample as in described by their morphological characteristics as well as from their herbarium. Analysis of the rbcL gene in these samples revealed some species as we look on ~~figure 1.~~ **Figure 1.**



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Figure 1. Neighbor joining consensus trees using partial sequences of GenBank-NCBI.

Blast of the ~~the~~ ITS2 Tomini bay Bay sampel against the GenBank database did not support precise genetic identification for all samples. One sample shown 100% similarity, although come from different clade that is *Sargassum* sp from Lima Island. In the other branch (clade) *Padina* sp from Tomini Bay was located within a very well supported branch (clade) with *Padina boryana*. More morphological and molecular studies have to be carried out before a definitive conclusion can be made. ~~And more molecular markers have to be tested to better understand the taxonomy and evolution of the wild seaweed.~~

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#### 4. CONCLUSION

ITS2 are useful marker for DNA barcoding of wild seaweed, with advantage for ITS2 due to the larger availability of analytical tools and reference barcodes deposited at databases for this marker.

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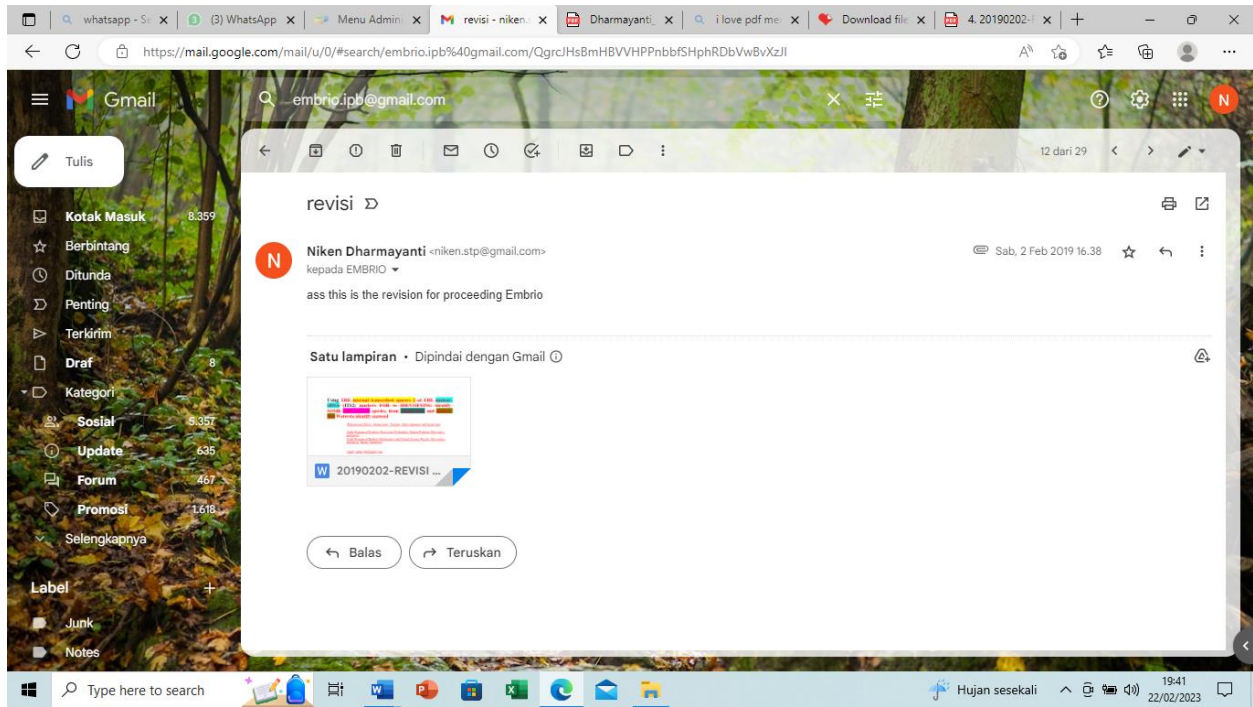
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# Using THE internal transcribed spacers 2 of THE nuclear rDNA (ITS2) markers FOR to IDENTIFYING identify SOME wild seaweed species, from Tomini Bay and Banten Bay Waters to identify seaweed

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**Abstract.** ~~Abstract. During recent years~~ An increasing attention to learn more about marine organisms, especially seaweed has arisen<sup>1</sup>. Tomini Bay and Banten Bay are two of the potential waters where the economic seaweeds are produced, but the wild seaweed is less noticed. This is the basis of the research on the potential and diversity of wild seaweed. Samples ~~were was~~ collected from the coastal area ~~two coastal areas~~ by diving and using a boat. The fresh seaweed ~~were~~ morphologically ~~morphologically~~ identified while the dried samples ~~were~~ collected to be used on DNA testing. Previous research ~~has been shown shows that~~ there is an influence from environmental parameters on seaweed composition ~~in a specific area~~<sup>2</sup>, so that the water quality testing was carried out to determine the dominance of wild seaweed ~~water that occupies the coast by its parameters of~~ water quality. We then proceeded ~~to conducted the classification and DNA genomes extraction, PCR amplification, DNA sequencing testing, alignment with MEGA 7 application and made phylogeny tree, results of the collected seaweeds,~~ which are distributed at Tomini bay *Dictyota* sp., *Halimeda* sp., *Padina* sp., *Polysiphonia* sp., *Halimeda* sp., *Polysiphonia* sp., *Dictyota* sp., *Padina* sp. and at Banten bay as *Sargassum* sp. This study evaluated the feasibility of using the Internal Transcribed Spacers 2 of the nuclear rDNA (ITS2) markers ~~for to identify identifying~~ some wild seaweed species, from Tomini Bay and Banten Bay waters. Five wild seaweed species collected from these waters were submitted to DNA barcoding. Currently available universal primers for ITS2 region amplification were sufficient to ~~be~~ successfully amplified and ~~the result of amplification DNA continue to be sequence~~ sequence all of the samples. ITS2 Compensatory Base Change (CBC) region phylogenetic analysis, together with morphological inspection, confirmed the identification accuracy. In conclusion, the data presented here indicates that ITS2 are useful markers for DNA barcoding of wild seaweed, with advantage for ITS2 due to the larger availability of analytical tools and reference barcodes deposited at databases for this marker.

**Key words** : ITS2 Markers, Wild -seaweed, Tomini Bay and Banten Bay

## 1. INTRODUCTION

The identity of five wild seaweed ~~species~~ has been determined by amplification of the Internal Transcribed Spacer ~~s-2~~ of the nuclear rDNA (ITS2) markers. This allows the detection of specificity patterns for each species and provides an alternative method, when morphological or biological species concept's methods fail. Total genomic DNA suitable for amplification was extracted from the dried tip of a leaf's alga following the CTAB method. We then proceeded to the clasification and DNA testing result of the collected seaweeds ~~which are distributed at Tomini bay as Halimeda sp., Polysiphonia sp., Dictyota sp., Padina sp. and at Banten bay as Sargassum sp.~~

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Containing 3-4 topics..

You have 5 topics (see colours)

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Seaweed The wild seaweed are found and ecologically important species in the Tomini and the Banten Bay waters. This genus inhabits rocky substrates of the infralittoral zone where they play an important ecological role in providing habitat, food and shelter as well as spawning and -nursery grounds for a wide variety of organisms ([1]GOMEZ-GARETTA, 2000; reviewed in DRAISMA [2]et al., 2010). However, in recent years, seaweed stands have been significantly reduced or disappeared habitat destruction, overgrazing and eutrophication ([3]THIBAUT et al., 2005; SUSINI [4]et al., 2007a and [5]b; [6]MANGIALAJO et al., 2007, [7]2008). Despite its ecological importance, the taxonomy of species within the genus is still poorly understood and No. studies have yet explored the genetic diversity of wild seaweed species in the Tomini and Banten Bay. The ecomorphs differ greatly from the average morphology of the species, that makes difficult to distinguish which morphological variation is an adaptation to ecological conditions, wand which is a characteristic of a different species. Species determination is made even more difficult by the lack of comprehensive identification keys for the genus. -The oTnly he only currently available key for the wild seaweed species ([8]ERCEGOVIĆ, 1952) based on morphology is outdated and was written in a period when sampling possibilities, and thus also determination, were limited. Difficulties arise while identifying the species, as several names may have been applied to the various populations or ecomorphs belonging to a single species, i.e. the morphological variability of the species has been overlooked. The situation is similar for other Sargassaceae genera such as for example the genus *Sargassum* Sargassum ([9]MATTIO & PAYRI, 2014). The current method of determining relations within the genus based primarily on morphological characteristics, is shown as being insufficient to unambiguously separate some species of this genus. Because of this, the focus is increasingly shifting to molecular methods of studying marine algae phylogeny, particularly brown algae, and this genus. In order to overcome morphological ambiguities in the identification of species, molecular markers are nowadays used [10] (JEGOU et al., 2010). Several different molecular markers have been used in recent studies of brown algae molecular taxonomy and phylogeny. The most common ones are nuclear ribosomal markers, ITS, SSU and LSU, ([11]; [12]; [13]). (ROUSSEAU et al., 2001; LE CLERC et al., 1998; HARVEY & GOFF, 2006.), ITS2 [10] (JEGOU et al., 2010), plastid markers, rbcL and psaA ([14]BITTNER et al., 2008; [15]CHO et al., 2006), and mitochondrial markers, mt 23S and mt spacer ([16]COYER et al., 2006; [2]DRAISMA et al., 2010). However, most of these markers have been used for delineation among the higher taxonomic units such as genera and families and rarely for distinguishing between the species. This is especially the case in the order Fucales, the family Sargassaceae, and the genus *Cystoseira*, which require highly variable markers to determine relations between the taxa [17] (DE REVIERS et al., 2007). [5]SUSINI et al. (2007b) have noted high genetic variations in the populations of the genus *Sargassum*, and suggest that 2 tis2 those variations the populations should be considered separately when studying the ecology of the genus. Recently, [2]DRAISMA et al. (2010) have underlined the usefulness of the mitochondrial 23S in the delineation of *Sargassaceae* genera and the potential of the mt23S-tRNAVal spacer at below genus level. Molecular markers have to be tested to better understand the taxonomy and evolution of the seaweed species research. TWith the purpose of this research is identifying the appropriate Internal Transcribed Spacers 2 of the nuclear Rdna (ITS2) molecular marker with which species distinction of the wild seaweed could be achieved, we choose to test molecular markers in a preliminary study. Four wild seaweed Tomini Bay's species and one wild seaweed Banten Bay's species. -The data was then compared to published sequences of Tomini and Banten bay's species. Bay's spesies.

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## 2. METHOD

Sample collection and DNA preparation; The individual of each species were sampled from the rocky bottom between 20 and 80 cm of depth. Four wild seaweeds was collected from the Tomini Bay at Avulua Village 10 km north to Parigi Moutong with coordinates 0°39'53.4"S 120°04'25.7"E in April 2018, and wild seaweed *Sargassum* sp from the Banten Bay at Pulau Lima waters (6°0'5.6376"S - 106°9'15.3684"E) in Februari 2018. Morphological analysis was guided with characteristics described

by [8] ERCEGOVIĆ (1952). Immediately after collection, a part of the branch least overgrown by epiphytes was separated from each specimen. Visible epiphytes were then mechanically removed from the sampled part, ~~the tip of talus~~ ~~was~~ was washed with distilled water and stored in silica gel. ~~The 3~~ ~~is~~ ~~3~~ ~~if~~ ~~the~~ ~~talus~~ ~~was~~ ~~stored~~ ~~in~~ ~~4%~~ ~~formaldehyde~~. Total DNA was isolated from silica dried algal tissue using Qiagen Plant mini kit and additionally purified using Qiagen Plasmid mini kit. PCR primers, PCR and sequencing Primers published by [2] DRAISMA *et al.* (2010) for the mt 23S and the mt23S-tRNAVal spacer were used for PCR amplification and sequencing. Primers, PCR conditions and reaction ingredients are listed in Table 1. The thermo cycler used in PCR amplification of all regions was Applied Biosystems 2720. The amplified DNA fragments were purified using QIAEX II gel extraction kit 150 (Qiagen). Sequencing was done by Macrogen in Korea using an ABI PRISM 3100 Avant Genetic Analyzer.

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**Table 1.** Primers used to isolate molecular markers with annealing temperature (AT) and bibliographic source

No	Markers	AT	Primers	Primer sequences
1	ITS2 Nuclear	55	5.8S-BF	5'-GATGAAGAACGCAGCGAAATGCGAT-3'
			25 BR-2	5'-TCCTCCGCTAGTATATGCTTAA-3'
2	COX3 Mitochondria	42	CAF4A:	ATGTTTACTTGGTGRAGRGA
			CAR4A:	CCCCACCARTAWATNGTNAG

Source: [18]

Data analysis raw sequences were edited and trimmed manually using ~~the~~ ~~new~~ version of Molecular Evolutionary Genetics Analysis v. ~~7.2~~ (MEGA ~~7.2~~). The number of sequences determined by using GenBank database which is hosted at NCBI (National Center for Biotechnology Information, USA) [Link: <http://www.ncbi.nlm.nih.gov/>]. NCBI hosts a number of biological databases for example whole-genome databases for human, mouse, chimp, seaweed or algae and another specific genom of organisms.

The number of polymorphic sites and phylogenetically informative sites were determined using the DnaSP v5 [19] (LIBRADO & ROZAS, 2009). Alignment of sequences was processed using ClustalX [20] (LARKIN *et al.*, 2007) and visualized in GeneDoc [21] (NICOLAS *et al.* 1997) for each marker independently. A total of 11 sequences for other Mediterranean Cystoseira species available on GenBank and published by [2] DRAISMA *et al.* (2010) were included in the analyses. The most suitable model of nucleotide evolution was determined by the Akaike Information Criterion, AIC, [22] (AKAIKE, 1974) as implemented in JmodelTest [23] (POSADA, 2008); for the 23S Rdna the selected model was TrN+G with gamma=0.013, and for the -mt spacer the selected model was HKY, with ti/tv=1.4910. Bayesian analyses were performed using MrBayes 3.1.1 [24] (HUELSENBECK & RONQUIST, 2001). The parameters of the Markov Chain Monte Carlo (MCMC) analysis comprised two runs (four chains each) for 500000 Species generations, with the sample frequency set to 100 and discarding first 1250 trees as the burn in. Thus, the posterior probabilities of the clades were determined from 3750 trees and the 50% majority-rule consensus tree was built.

### 3. RESULTS AND DISCUSSION

Data analysis of sequences after trimmed by using MEGA X, resulting a vary sequences that equals for their pairs. -Here the sequences based on their correct pairs.

#### 1. POLYSIPHONIA #3217322\_1N\_ITS2-5\_8S-BF

GGTCACAAGTGACGCTGCTTGCCGCCGAGGGCGGCCCGCTGGCGGTTCGAGCCAGACAAC  
TGACTGACTGACTGACCATCGTGGGTCGACGCGCAAAGCCTAATAGCGGGCCTGGAC  
ATCACCCGCACACCTCGCCCCGTGGGGACAAGGCGGGGCGCCGAGTCTCGATCGCCCC  
TCGCGTACCCACGCCCCCCCCCTGCCAAGAGAAAATGGCGGGAGAGAGGAATGGGGAC  
GGGCAAGAAACATTGGCCCTCCACTAGTCGCAATGCCGCAATCATACTTCTTAGGCCGGC  
TCACGAGACGAAGCTCGCGCCGGCTCATAGTCCGCCGCCCGGAGCGCGCGGAGTCA  
CCATTTCTGGCGTCTCAAGCGGGCCACGCACGGGGGGCGAGTGGGGTGGACAGACACT  
CCGACAAGCATGCTCCAGGAGTATCCCGGAAGCGCAAGATGCGTTCAAAGTTTGATG  
ATTAC

2. POLYSIPHONIA #3217324\_2N\_600bp\_ITS2-5\_8S-BF

GAGATCCCGTAGGAAATAAGGACTGCTGCTTTTTTTTCTAGGAAATAAAAAACAGCATT  
GACAGCCTAAAATACCCACATTTCTGTAGATATACTGTGATCTGAGCGTTGTAATGTAA  
AAATCGAAAGCCATGATCACTCATTATTTTGAACCTTTGATATCTCTCCACCTCAACA  
AAGCAAGAACAAGTAAACTCTGAATGACAAGTTCAATTCATGCCTGCCGGCTCAAAGA  
ATCAATTCATTTTTGTAACAAAAACAAAGCGCGCAAAAAACACTGGAAATACACTTT  
CTACAAGTAAATTCAGGTGACCCCGCTGTAGGTTATTCAAGCTGGTAGCAAGGACG  
CACCCATCAGCTGCGATTTCCGTGCGGTGACACCGCTAAAATCGCAAAGTTATGTTGTGA  
AATTTTACCTACACATGGGACACTCACACAGGTATGCTCGCAGATTAACCCGCGAGCGCC  
ATTTGCGTTCAAATAATTCGATGATTCA

3. HALIMEDA #3217326\_2N\_1400bp\_ITS2-5\_8S-BF

CCAAAAGCAGGACCGCTACCAACGCCACCTCGCCTCCACAAACACACACTCAACACT  
CCGACTCAGACGGACCTGCAAATGCCAAGCCCTAACAAACCCGCAAGCACGCACACA  
CACACACACGCACACACACCCACCAGTGCAGGACTCAACTTCAGCACTCACACCCGCC  
GCTTTCGGAACAAGCACAACACATCCATGAATTCATCTACACCAACAAGCGCGCGCA  
CGCAGCACACACATAACACTCACACGAAAGCTCAAACACAGAAGTTTCGACATACAC  
AGCACCGCCACCAGTTCACACTCCGCACACCAACTGCTCCGATCAAAGATTGCTCCTT  
ACCTTACAGCCAGTGAATTGTAGTAACCGATCCCCAACAAACGAAGCCATGCGCACAGG  
TCGCCCTGCACACTGCCTCTATTCCACATCCCGTCGCCTACTAAGTTCACCAGAACTA  
AAGAATGCCTCAACTCGCTTCCACAAAGCAGGACTCAGCTTTGGCTTGCCTCCACGAA

4. PADINA #3217328\_3N\_ITS2-5\_8S-BF

CCACTATCCACAGCAGTCACTGGATCGTAGTTACTTCCCAGAGACTGAGCAAAAAAAA  
GGGGGAAGGGATGGGATAACGTTTTCCAACCTGTGCGACCGAAACAACAGAAGTTTCTC  
TTCCGAAAACCTCCTACACCCCCCTCCCTTCTCTTCTTCCAGGACCCAGAACCGCAA  
AAGACAACCAAGCTAATATAGTACAATACACACACACAAATCCATTTCTCCCTTCTTGTA  
TAATATTCTTCCACAGTTCAGTGAAGAAAGTGAACCGGTAAGGAACCAAAAAGTGA  
GAAAGTGGGCGCGGCTTTGGGTTCTCAAGTATTCCATAAGCCAGATGTTTGTATATTTTA  
GCAAAACACAACTTTCGCGGATGCGGTGTCGACACGCTGTACCAACTGGCCGTGTC  
CAGTTGATACTATTAAGAGGCAAGAGAATGTCACCTTCTCCTGGTTTCGCACACTCAC  
GAAAAGTCAAACGCTTGGGGAAAAACAGTAACAACACTGGTTTCT

5. DICTYOTA #3217330\_4N\_ITS2-5\_8S-BF

CGGAGGTCCGTAAAGACGACGCTGCCCGATAGCAAGCAAGCAAGCAAGCAAGTAA  
CTAACGGGACGTCCTTACCTGACCGGGTCCGAGGGGTCTCGGCGGGCCGGACGGTCCG  
GGTGAAGGGCAGCACCGCAACAGCAGAAATCGATCAATCACTCGATCAATGGATCAAA  
CAATCAACACAACCTCGCCGCCACGGGCCACACGGCCACCCAACTTCTACTCTCGCTCT  
CTGCTACTCGGCGCAACCCGACTTGCGCCGACTAACGCTGCCGCGTATACGATCCGA  
GACCCTTCTCCGGGTTGGACAGTTTTGCTACTCTTCGCGGGGCTCGGCGATGGTCTTC  
GCACGTCCGTAGAGGAGACGAAGAGACAGCTAGGATAACAACAACAACAACAACA  
ACAACAACAACAACAACAGCACTACACCATCATCGTCATCATCATCATCATCATCAT  
CACCATCATCATCAGCATCCCTACTACCACCGGAGAACGGCCACCACCGCGCTCG  
CATAGTCCGCCAAAGTACTCACCTTTCCCGCCGCGGCCAAGTCACTTTGGTACCGCGA  
GAAGCGGTGCCGCGATGACGAGGTAGGCGAAGACCGAGTGTGCACAAGGACGAGTGG

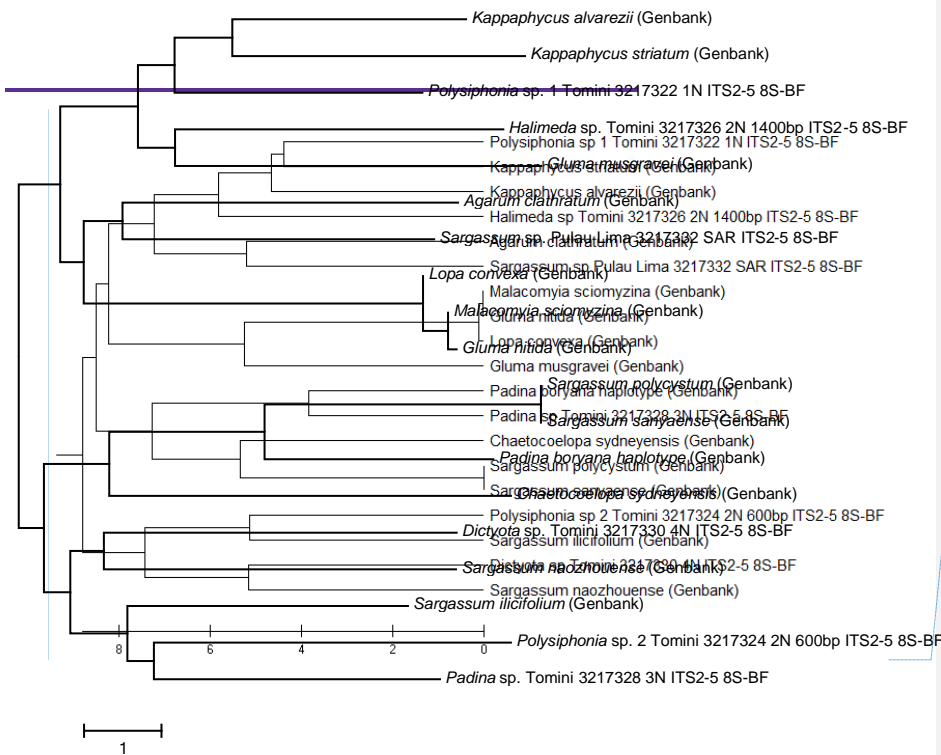
GGTGAACGAAGACTCCGACAAGCATGCTCCCAGGGATATCCCAGGAAAGCGCAAGATGCGT  
TCAAAGTTTTGATGATTTCG

6. SARGASSUM #3217332\_SAR\_ITS2-5\_8S-BF

CATAATCATAATCACCGGCTCTCACCGTACTCTCGAGACTACCTACCGTCCTAAGCCT  
CAAGTCCACCCGCGCATCCCCGGGACCCGTCGTGTCCCCGCCCGCGATAGGGGGC  
GCCGTCAACAACGATCCTCCGGAGGACGCAAGGTGAACTTGCTCCAGCGACGCCTCC  
AGCGCCGGAAGACAACAGAGGGCCAGACAATCGGTAACCTCTAGGCTTGGGTGGACT  
CAGGGGACGAGCAGGGAGCATGTACAAAAATACACCGCACTACCGTCCCCGGAACACT  
CATATTCCGCTCCACCGCCTTGAGGTGAGATCGAACCCTAAAGCTGTGGGCGAGTTTTCG  
CCTCCTCCTCCCCGACAAGCATGCTCCCAGGCATATCCCAGGAGCGCAAGATGCGTTTCA  
AGTTTTCGATGATTACAGAGAT

A total of four sequences for the mt23S Rdna (394 pb) and 15 sequences for the mt intergenic spacer (mt23S-tRNAVal) (333 pb) were successfully amplified and sequenced. The sequences were deposited in GenBank.

Genetic ~~analysis-analysis~~ of the gene as the samples collected from Tomini Bay and Lima Island revealed a unique similarities to other species which is different from estimated sample as in described by their morphological characteristics as well as from their herbarium. Analysis of the rbcL gene in these samples revealed some species as we look on [figure 1.](#) ~~Figure 1.~~



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Figure 1. Neighbor joining consensus trees using partial sequences of GenBank-NCBI.

Blast of the ~~the~~ ITS2 Tomini bay Bay sampel against the GenBank database did not support precise genetic identification for all samples. One sample shown 100% similarity, although come from different clade that is *Sargassum* sp from Lima Island. In the other branch (clade) *Padina* sp from Tomini Bay was located within a very well supported branch (clade) with *Padina boryana*. More morphological and molecular studies have to be carried out before a definitive conclusion can be made. ~~And more molecular markers have to be tested to better understand the taxonomy and evolution of the wild seaweed.~~

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#### 4. CONCLUSION

ITS2 are useful marker for DNA barcoding of wild seaweed, with advantage for ITS2 due to the larger availability of analytical tools and reference barcodes deposited at databases for this marker.

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# Using internal transcribed spacers 2 (ITS2) to identify seaweed species from Tomini Bay and Banten Bay

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**Abstract.** Samples collected from two coastal areas by diving and using a boat. The fresh seaweed morphologically identified while the dried samples collected to be used for DNA testing. Previous research has been shown that there is an influence from environmental parameters on seaweed composition so that the water quality testing was carried out to determine the dominance of wild seaweed water. We conducted genomes extraction, PCR amplification, DNA sequencing testing, alignment with MEGA 7 application and made phylogeny tree, which are distributed at Tomini bay *Dictyota* sp., *Halimeda* sp., *Padina* sp., *Polysiphonia* sp., and Banten bay as *Sargassum* sp. This study evaluated the feasibility of using the ITS2 marker to identify some wild seaweed species, from Tomini Bay and Banten Bay waters. Five wild seaweed species collected from these waters were submitted for DNA barcoding. Currently available universal primers for ITS2 region amplification were sufficient to be successfully amplified and the result of DNA amplification continue to be sequenced. In conclusion, the data presented here indicates that ITS2 are useful markers for DNA barcoding of wild seaweed, with advantage for ITS2 due to the larger availability of analytical tools and reference barcodes deposited at databases for this marker.

**Keywords:** DNA, ITS2 markers, wild seaweed

## 1. Introduction

The identity of five wild seaweed species has been determined by amplification of the Internal Transcribed Spacer 2 of the nuclear rDNA (ITS2) markers. This allows the detection of specificity patterns for each species and provides an alternative method, when morphological or biological species concept's methods fail. Total genomic DNA suitable for amplification was extracted from the dried tip of a leaf's alga following the CTAB method. We then proceeded to the classification and DNA testing result of the collected seaweeds.

Seaweed inhabits rocky substrates of the infralittoral zone where they play an important ecological role in providing habitat, food and shelter as well as spawning and nursery grounds for a wide variety of organisms [1, 2]. However, in recent years, seaweed stands have been significantly reduced, [3-7]. Despite its ecological importance, the taxonomy of species within the genus is still poorly understood and no studies have yet explored the genetic diversity of wild seaweed species in the Tomini and Banten Bay. The ecomorphs differ greatly from the average morphology of the species. That makes it difficult to distinguish which morphological variation is an adaptation to ecological conditions, which





is a characteristic of a different species. Species determination is made even more difficult by the lack of comprehensive identification keys for the genus. The only currently available key for wild seaweed species [8] based on morphology is outdated and was written in a period when sampling possibilities, and thus also determination, were limited. Difficulties arise while identifying the species, as several names may have been applied to the various populations or ecomorphs belonging to a single species, i.e. the morphological variability of the species has been overlooked. The situation is similar for other Sargassaceae genera such as, for example, the genus *Sargassum* [9]. The current method of determining relations within the genus based primarily on morphological characteristics, is shown as being insufficient to unambiguously separate some species of this genus. Because of this, the focus is increasingly shifting to molecular methods of studying marine algae phylogeny, particularly brown algae, and this genus. In order to overcome morphological ambiguities in the identification of species, molecular markers are nowadays used [10].

Several different molecular markers have been used in recent studies of brown algae molecular taxonomy and phylogeny. The most common ones are nuclear ribosomal markers, ITS, SSU and LSU [11-13], ITS2 [10], plastid markers, *rbcL* and *psaA* [14, 15], and mitochondrial markers, *mt 23S* and *mt spacer* [2, 16]. However, most of these markers have been used for delineation among the higher taxonomic units such as genera and families and rarely for distinguishing between the species. This is especially the case in the order Fucales, the family Sargassaceae, and the genus *Cystoseira*, which require highly variable markers to determine relations between the taxa [17]. High genetic variations in the populations of the genus *Sargassum*, and suggest that 2 *tis2* those variations the populations should be considered separately when studying the ecology of the genus [5]. Recently, researchers have underlined the usefulness of the mitochondrial 23S in the delineation of *Sargassaceae* genera and the potential of the *mt23S-tRNAVal* spacer at below genus level [2]. Molecular markers have to be tested to better understand the taxonomy and evolution of the seaweed species research. The purpose of this research is identifying the appropriate ITS2 molecular marker with which species distinction of the wild seaweed could be achieved. We choose to test molecular markers in a preliminary study of four wild seaweed Tomini Bay's species and one wild seaweed Banten Bay's species. The data was then compared to published sequences of Tomini and Banten Bay's species.

## 2. Methods

**Sample collection and DNA preparation;** The individual of each species were sampled from the rocky bottom between 20 and 80 cm of depth. Four wild seaweeds were collected from the Tomini Bay at Avulua Village 10 km north to Parigi Moutong with coordinate 0°39'53.4"S 120°04'25.7"E in April 2018, and wild seaweed *Sargassum* sp from the Banten Bay at Pulau Lima waters (6°0'5.6376"S – 106°9'15.3684 "E) in February 2018. Morphological analysis was guided with characteristics described previously [8]. Immediately after collection, a part of the branch least overgrown by epiphytes was separated from each specimen. Visible epiphytes were then mechanically removed from the sampled part, the tip of talus was washed with distilled water and stored in silica gel. Total DNA was isolated from silica dried algal tissue using Qiagen Plant mini kit and additionally purified using Qiagen Plasmid mini kit. PCR primers, PCR and sequencing Primers published by [2] for the *mt 23S* and the *mt23S-tRNAVal* spacer were used for PCR amplification and sequencing. Primers, PCR conditions and reaction ingredients are listed in table 1. The thermo cycler used in PCR amplification of all regions was Applied Biosystems 2720. The amplified DNA fragments were purified using QIAEX II gel extraction kit 150 (Qiagen). Sequencing was done by Macrogen in Korea using an ABI PRISM 3100 Avant Genetic Analyzer.

**Table 1.** Primers used to isolate molecular markers with annealing temperature (AT) an bibliographic source [18].

No	Markers	AT	Primers	Primer sequences
1	ITS2 Nuclear	55	5.8S-BF 25 BR-2	5'-GATGAAGAACGCAGCGAAATGCGAT-3' 5'-TCCTCCGCTAGTATATGCTTAA-3'
2	COX3 Mitochondria	42	CAF4A: CAR4A:	ATGTTTACTTGGTGRAGRGA CCCCACCARTAWATNGTNAG

Data analysis raw sequences were edited and trimmed manually using the version of Molecular Evolutionary Genetics Analysis v. 7 (MEGA 7). The number of sequences determined by using the GenBank database which is hosted at the NCBI (National Center for Biotechnology Information, USA) [Link: <http://www.ncbi.nlm.nih.gov/>]. The NCBI hosts a number of biological databases for example whole-genome databases for human, mouse, chimp, seaweed or algae and another specific genome of organisms.

The number of polymorphic sites and phylogenetically informative sites were determined using the DnaSP v5 [19]. Alignment of sequences was processed using ClustalX [20] and visualized in GeneDoc [21] for each marker independently. A total of 11 sequences for other Mediterranean *Cystoseira* species available on GenBank and published by [2] were included in the analyses. The most suitable model of nucleotide evolution was determined by the Akaike Information Criterion, AIC, [22] as implemented in JmodelTest [23]: for the 23S Rdna the selected model was TrN+G with gamma=0.013, and for the mt spacer the selected model was HKY, with ti/tv=1.4910. Bayesian analyses were performed using MrBayes 3.1.1 [24]. The parameters of the Markov Chain Monte Carlo (MCMC) analysis comprised two runs (four chains each) for 500000 Species generations, with the sample frequency set to 100 and discarding first 1250 trees as the burn in. Thus, the posterior probabilities of the clades were determined from 3750 trees and the 50% majority-rule consensus tree was built.

### 3. Results and Discussion

Data analysis of sequences after trimmed by using MEGA X, resulting a vary sequences that equals for their pairs. Here the sequences based on their correct pairs.

#### 1. POLYSIPHONIA #3217322\_1N\_ITS2-5\_8S-BF

GGTCACAAGTGACGCTGCTTGCCGCCGAGGCGGCCCGCGTGGCGGTTCGAGCCAGACAAC  
TGACTGACTGACTGACCATCGTGGGTTCGGACGCGCAAAGCCTAATAGCGGGGCTGGAC  
ATCACCCGCACACCTCGCCCCGGTGGGGACAAGGCGGGGCGCCGAGTCTCGATCGCCCG  
TCGCGTACCCACGCCCCCCCCCTGCCAAGAGAAATGGCGGGAGAGAGGAATGGGGAC  
GGGCAAGAAACATTGGCCCTCCACTAGTCGCAATGCCGCAGTCATACTTCTTAGGCCGGC  
TCACGAGACGAAGCTCGCGGCCGGCTCATAGTCCGCGCCCCGAGCGCGCGGAGTCA  
CCATTTCTGGCGTCTCAAGCGGGCCACGCACGGGGGGCGAGTGGGGTGGACAGACACT  
CCGACAAGCATGCTCCAGGAGTATCCCGGAAGCGCAAGATGCGTTCAAAGGTTTGATG  
ATTCAC

#### 2. POLYSIPHONIA #3217324\_2N\_600bp\_ITS2-5\_8S-BF

GAGATCCCGTAGGAAATAAGGACTGCTGCTTTTTTTTCTAGGAAATAAAAAACAGCATT  
GACAGCCTAAAATACCCACATTTCTGTAGATATACTGTCGATCTGAGCGTTGTAATGTAA  
AAATCGAAAGCCATGATCACTCATTTATTTTGAACCTTTGATATCTCTCCACCTCAACA  
AAGCAAGAACAAGTAAACTCTGAATGACAAGTTCAATTCATGCCTGCCGGCTCAAAAGA  
ATCAATTCATTTTTGTAAACAAAACAAAGCGGCGCAAAAAACACTGGAAATACACTTT  
CTACAAGTAAATTTTCAGGTGACCCCGCTTGTAGGTTATTCAAGCCTGGTAGCAAGGACG  
CACCCATCAGCTGCGATTTCCGGTTCGGTTCAGACCGCTAAAATCGCAAAGTTATGTTGTGA  
AATTTTACCTACACATGGGACACTCACACAGGTATGCTCGCAGATTAACCGCGAGCGCC  
ATTTGCGTTCAAATTCGATGATTCA

## 3. HALIMEDA #3217326\_2N\_1400bp\_ITS2-5\_8S-BF

CCAAAAGCAGGACCGCTACCAACGCCACACCTCGCTCCACAAACACACTCAAACT  
CCGACTCAGACGGACCACTGCAAAATGCCAAGCCCTAACAAACCCGCAAGCACGCACACA  
CACACACACGCACACACACCCACCAGTGCAGGACTCAACTTCAGCACTCACACCCGCC  
GTTTTCGCGAACAAGCACAAACACATCCATGAATTCATCTACACCAACAAGCGCGCGCA  
CGCACGCACACACATACACTCACACGCAAAGCTCAAACACAGAAGTTTCGACATACAC  
AGCACCGCCACCAGTTCACACTCCGCACACCAACTGCTCCGATCAAAGATTGCTCTCCTT  
ACCTTCACAGCCAGTGAATTGTAGTAACCGATCCCCAACAAACGAAGCCATGCGCACAGG  
TCGCCCTGCACACCTGCCTCTATTCCACATCCCGTCGCCTCACTAAGTTCACCAGAATA  
AAGAATGCCTCAACTCGCTTCCACAAAGCAGGACTCAGCTTTGGCTTGCGCCTCCACGAA

## 4. PADINA #3217328\_3N\_ITS2-5\_8S-BF

CCACTATCCACAGCAGTCACTGGATCGTAGTTACTTCCCAGAGACTGAGCAAAAAAAAA  
GGGGGAAGGGATGGGATAACGTTTTCCAACCTGTGTCGACCGAAACAACAGAAGTTTCTC  
TTCGGAAACTCTCATACCCCCCTCCCCTTCTCTTTCTTGCCAGGACCCAGAACCGCAA  
AAGACAACCAAGCTAATATAGTACAATACACACACACAAATCCATTTCTCCCTTCTTGTA  
TAATATTCCTTTCCACAGTTCACTGAAAAAGTGTAACCGGTAAGGAACCAAAAAGTGA  
GAAAGTGGGCGCGGCTTTGGGTTCTCAAGTATTCATAAGCCAGATGTTTGTATATTTTA  
GCAAAACACACAACCTTTGCGGGATGCGGTGTCGACACGCTGTACCAACTGGCCGTGTC  
CAGTTGATACTATTAAGGCAAAGAGAATGTCACCTTTCTCCTGGTTTCGCACACTCAC  
GAAAAGTCAAACGCTTGGGGAAAAACAGTAACAACACTGGTTTCT

## 5. DICTYOTA #3217330\_4N\_ITS2-5\_8S-BF

CGGAGGTCCGTAAAGACGACGCGCTGCCCGATAGCAAGCAAGCAAGCAAGCAAGCTAA  
CTAACGGGCAGTCACTTACCTGACCGCGGTCCGAGGGGTCTCGGCGGGCCGGACGGTCCG  
GGTGAAGGGCAGCACCGCAACAGCAGAAATCGATCAATCACTCGATCAATGGATCAAA  
CAATCAACACAACCTCGCCGCCACGGGCCACACGGCCACCCAACCTTCTACTCTCGCTCT  
CTGCTACTCGGCGCGCAACCCGACTTGCGCCGGACTAACGCTGCCGCGTATACGATCCGA  
GACCTTCTCCGGGTTGGACAGTTTTTGTACTCTTCGCGGGGCTCGGCGATGGTCGTTT  
GCACGTCGGTAGAGGAGACGAAGAGACAGCTAGGATAACAACAACAACAACAACA  
ACAACAACAACAACAACAGCACTACACCATCATCGTCATCATCATCGTCATCATCATCAT  
CACCATCATCATCATCAGCATCCCTACTACCACCGGGAACGGCCACCACCGGCGCTCG  
CATAGTCCGCCAAGTACTCACCTTTCCCCGCCGCGGCAAGTCATCTTGGTACCGCGA  
GAAGCGGTGCCGCGATGACGAGGCTAGGCGAAGACCGAGTGTGCACAAGGACGAGTGG  
GGTGAACGAAGACTCCGACAAGCATGCTCCAGGGATATCCCGGAAGCGCAAGATGCGT  
TCAAAGTTTTGATGATTTCG

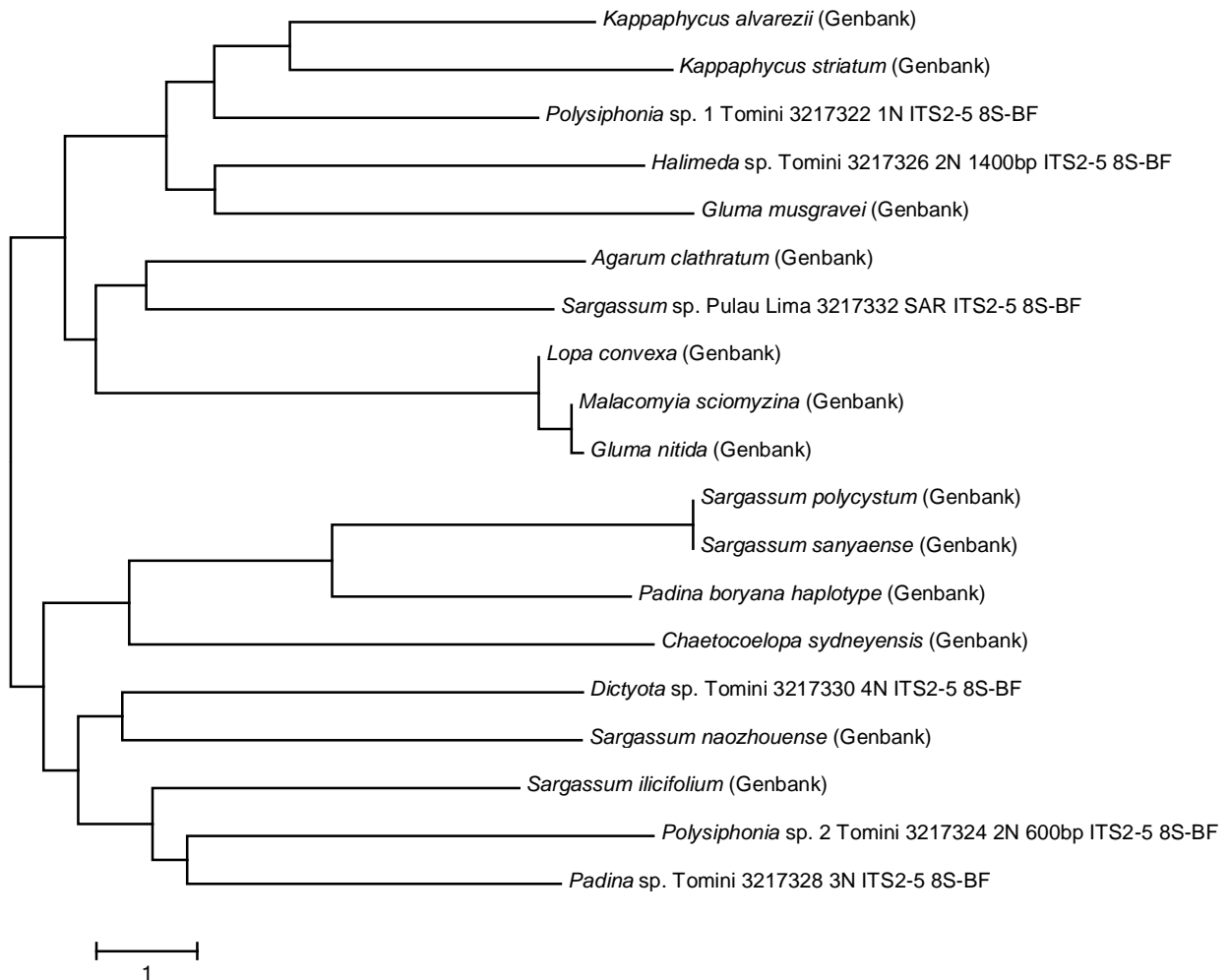
## 6. SARGASSUM #3217332\_SAR\_ITS2-5\_8S-BF

CATAATCATAATCACCGCCTCTCACCGTACTCTCGAGACTACCTACCGTCCTAAGCCT  
CAAGTCCACCCGCGCACATCCCCGGCGACCCGTCGTGTCCCCGCCCGCGATAGGGGGC  
GCCGTCAACAACGGATCCTCCGGAGGACGCAAGGTGAACTTGCCTCCAGCGACGCCTCC  
AGCGCCGCGAAGACAACAGAGGCCAGACAATCGGTAACCTCTTAGGCTTGGGTGGACT  
CAGGGGACGAGCAGGGAGCATGTACAAAATACACCGCACTACCGTCCCCGGAACACT  
CATATTCGCTCCACCGCCTTGAGGTGCGAGATCGAACCCAAAGCTGTGGGCGAGTTTTCG  
CCTCCTCCTCCCCGACAAGCATGCTCCAGGCATATCCCGGGAGCGCAAGATGCGTTCGA  
AGTTTCGATGATTCACGAGAT

A total of four sequences for the mt23S Rdna (394 pb) and 15 sequences for the mt intergenic spacer (mt23S-tRNA<sup>Val</sup>) (333 pb) were successfully amplified and sequenced. The sequences were deposited in the GenBank.

Genetic analysis of the gene as the samples collected from Tomini Bay and Lima Island revealed a unique similarities to other species which is different from estimated sample as in described by their

morphological characteristics as well as from their herbarium. Analysis of the *rbcL* gene in these samples revealed some species as we see in figure 1.



**Figure 1.** Neighbor joining consensus trees using partial sequences of GenBank-NCBI.

Blast of the *rbcL* Tomini bay sample against the GenBank database did not support precise genetic identification for all samples. One sample showed a 100% similarity, although they come from a different clade that is *Sargassum* sp from Lima Island. In the other branch (clade) *Padina* sp from Tomini Bay was located within a very well supported branch (clade) with *Padina boryana*. More morphological and molecular studies have to be carried out before a definitive conclusion can be made.

#### 4. Conclusion

ITS2 are useful marker for DNA barcoding of wild seaweed, with advantage for ITS2 due to the larger availability of analytical tools and reference barcodes deposited at databases for this marker.

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