A new record of kelp *Lessonia spicata* (Suhr) Santelices in the Sub-Antarctic Channels: implications for the conservation of the “huiro negro” in the Chilean coast

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The Katalalixar National Reserve (KNR) lies in an isolated marine protected area of Magellan Sub-Antarctic channels, which represent an important area for marine biodiversity and macroalgal conservation. The present study is the first report of the species *Lessonia spicata*, “huiro negro”, in the Magellan Sub-Antarctic channels. This finding has implications for macroalgal biogeography and conservation concerns in the Chilean coast. In the ecological assessments of the KNR in 2018 we found populations of *L. spicata*, specifically on rocky shores of Torpedo Island and Castillo Channel. The morphological identification and molecular phylogeny based on nuclear (ITS1) sequences revealed that these populations of *Lessonia* are within the lineage of *L. spicata* of central Chile. This report increases the species richness of kelps for the Magellan Sub-Antarctic Channels from 2 to 3 confirmed species (*L. flavicans*, *L. searlesiana* and *L. spicata*), and it also extends the southern distribution range of *L. spicata*. This species has high harvest demand which is moving towards southern Chile, thus these populations should be considered as essential for macroalgal conservation in high latitudes of South America.

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Abstract

The Katalalixar National Reserve (KNR) lies in an isolated marine protected area of Magellan Sub-Antarctic channels, which represent an important area for marine biodiversity and macroalgal conservation. The present study is the first report of the species *Lessonia spicata*, "huiro negro", in the Magellan Sub-Antarctic channels. This finding has implications for macroalgal biogeography and conservation concerns in the Chilean coast. In the ecological assessments of the KNR in 2018 we found populations of *L. spicata*, specifically on rocky shores of Torpedo Island and Castillo Channel. The morphological identification and molecular phylogeny based on nuclear (ITS1) sequences revealed that these populations of *Lessonia* are within the lineage of *L. spicata* of central Chile. This report increases the species richness of kelps for the Magellan Sub-Antarctic Channels from 2 to 3 confirmed species (*L. flavicans*, *L. searlesiana* and *L. spicata*), and it also extends the southern distribution range of *L. spicata*. This species has high harvest demand which is moving towards southern Chile, thus these populations should be considered as essential for macroalgal conservation in high latitudes of South America.

Key words: biogeography, conservation, extension, kelp, Magellan, Sub-Antarctic

Introduction

Lessonia Bory (Laminariales, Phaeophyceae) is one of the most conspicuous brown macroalgal genera that inhabit the littoral to sublittoral zone of rocky coasts (~ 20 m depth) in temperate-cool waters of the South Pacific Ocean (Cho *et al.,* 2006; Martin & Zuccarello, 2012). There are currently records of 11 species of the genus *Lessonia* that are taxonomically accepted, distributed along the coasts of South America, New Zealand, Tasmania, and Sub-Antarctic islands (Cho *et al.,* 2006). These species have major ecological roles in the structure of benthic marine communities (Villouta & Santelices, 1984; Vásquez & Santelices, 1984), and are commercially exploited for the extraction of alginic acid (Steneck *et al.,* 2002). *Lessonia* species are one of the most characteristic and abundant macroalgae (12°S to 56°S) that inhabit the rocky shores of the Chilean coast (17° to 56° S) (Searles, 1978; Avila *et al.,* 1985; Villouta & Santelices, 1986; Vasquez *et al.,* 1998; Tellier *et al.,* 2011; Martin & Zucarello, 2012; Mansilla *et al.,* 2014). Currently, six species have been recorded in Chile: *Lessonia nigrescens* Bory, *Lessonia berteroana* Montagne, *Lessonia. spicata* Suhr, *Lessonia trabeculata* Villouta & Santelices, *Lessonia searlesiana* Asensi & De Reviers and *Lessonia flavicans* Bory (Guiry & Guiry, 2018). A recent morphological and molecular analysis showed that the species distributed from Peru (17°) to Puerto Montt (41°), commonly known as *L. nigrescens*, is actually two cryptic species; the populations distributed from Peru (17°S) to central Chile (30°S) correspond to *L. berteroana* Montagne, and those occurring from central Chile (29°S) to Puerto Montt (41°S) correspond to *L. spicata* (Suhr) Santelices (González *et al.,* 2012; Vega, 2016). However, *L. nigrescens* is still a valid species, because no material of the referred species has been found near its type locality, Cape Horn.

The huiro negro kelps, which include *L. berteroana* and *L. spicata*, are heavily exploited and represent almost 70% of the kelp biomass landed annually (Vega *et al.,* 2014). This economic activity is mainly practiced in northern Chile (18-32°S), through a complex productive chain with high social impact and low added value (Vásquez, 2008). *L. berteroana* and *L. spicata* are exported as a natural commodity to more than 20 countries mainly due to their alginate, which has high economic value (Westermeier *et al.,* 2019). Thus populations of huiro negro have economic interest along Chilean coasts, being essential to generate a stewardship from a local and large scale.

The Katalalixar National Reserve (KNR) is a national reserve area created in 1983. KNR comprises 674,500 ha and is located in a remote zone next to the village of Tortel. This area includes a wilderness temperate rainforest with a complex ecosystem of islands and fjords (Bell *et al.,* 2007). The offshore area (western side) of the Magellan Sub-Antarctic Channels is one of the few places of the Magellan Biogeographic Province (MBP) (43°-56°S; Camus, 2001) that has not been explored systematically by scientific expeditions (Gorny & Zapata, 2018) (Fig. 1a, b). KNR is located at the southern limit of the Humboldt Current System (HCS). The HCS is a key component of the general oceanic circulation in the eastern South Pacific, being one of the most productive marine ecosystems on the earth (Thiel *et al*., 2007). HCS is originated in southern Chile between 42-48°S and is characterized by a northward flow in front of South American coasts with a strong upwelling of cool nutrient-rich waters (Silva *et al.*, 2009). The origin of the HCS induced a large-scale redistribution of biota, and nowadays plays a key role in the biogeography of the South Pacific (Camus, 2001). Thus KNR provides an enormous opportunity to understand the taxonomic composition and biogeography of macroalgae that inhabit the southern boundary of the Humboldt Current (Camus, 2001; Thiel *et al.,* 2007).

The present study contributes the first report of the species *L. spicata* in the Magellan Sub-Antarctic Channels. The distribution of this was thought to be limited to 41°S, but appears to be extended south of the Golfo de Penas (46° 59'-47° 40’S). Continuing survey studies will be necessary to understand the occurrence patterns of populations of *L. spicata* in the MBP.

Materials & Methods

Three individuals of *Lessonia spicata* were collected in the intertidal zone of Torpedo Island and Castillo Channel (Fig. 1a, b) in July, 2018. The specimens were air-dried and then pressed on herbarium sheets for morphological observation and molecular analysis. The Chilean Hydrographic and Oceanographic Service of the Navy (N° 13270/24/337), approved field sampling.

External and internal morphological observations were made. The anatomical observations were performed by sectioning with a razor and staining with 1% aqueous aniline blue acidified with 1% diluted HCl, and mounted in 70% glycerin. Photomicrographs were taken with a Canon Powershot S5 IS camera attached to a BX 51 Olympus microscope (Canon USA, Melville, New York, USA; Olympus Corp., Tokyo, Japan, respectively). A total of 15 replicates from the three

104 individuals were selected for measurement of cortical cell diameter following Gonzalez *et al.,*
105 (2012); means and standard deviations were calculated. Samples of other species occurring in the
106 Sub-Antarctic region (*L. flavicans* and *L. searlesiana*) were also analyzed for comparative
107 purposes. Voucher specimens were deposited in the herbarium of University of Magallanes, Punta
108 Arenas, Chile.
109
110 **Molecular analyses**
111 Genomic DNA was extracted from ~ 5 mg of dried thallus ground in liquid nitrogen using a
112 NucleoSpin Plant II Kit (Macherey-Nagel, Düren, Germany) according to the manufacturer's
113 protocol. The PCR primers for the ITS were ITSP1-ITSRi (Tai *et al.,* 2001; Martin & Zucarello,
114 2012) and KP5- KG4 (Lane *at al.,* 2006). Polymerase chain reaction products were purified using
115 a NucleoSpin Gel and PCR Clean-up (Macherey-Nagel, Düren, Germany) and commercially
116 sequenced (Macrogen, Seoul, South Korea). The electropherograms were edited using the
117 Chromas v1.45 software (McCarthy, 1998) and the new generated sequences were deposited in
118 GenBank (www.ncbi.nlm.nih.gov/genbank/).
119 A total of 34 ITS sequences (731bp) were included in the construction of the phylogeny: 31
120 sequences belonging to the genus *Lessonia* and three outgroups, *Cymathaere triplicata* (Postels &
121 Ruprecht) J. Agardh, *Ecklonia cava* Kjellman and *Macrocystis pyrifera* (Linnaeus) C. Agardh
122 (Table 1). Sequences were aligned using the MUSCLE algorithm in MEGA5 v.6.06 software using
123 the default settings (Tamura *et al.,* 2013).
124 The phylogenic analysis was constructed using Maximum likelihood (ML) and Bayesian inference
125 (BI) analyses. The program PartitionFinder (Lanfear *et al.,* 2012) were used to choose the best-
126 fitting nucleotide substitution model under the Bayesian Information Criterion. The general time
127 reversible nucleotide substitution model with a gamma distribution and a proportion of invariable
128 sites (GTR + Γ+ I) was selected as the best substitution model. ML analysis was performed with
129 the RAxML HPC-AVX program (Stamatakis, 2014) implemented in the raxmlGUI 1.3.1 interface
130 (Silvestro & Michalak, 2012) with the statistical support obtained by 1000 bootstrap replications.
131 BI was performed with the MrBayes v. 3.2.5 software (Ronquist *et al.,* 2012) using Metropolis-
132 coupled Markov Chain Monte Carlo (MC^3). The inference of Bayesian posterior probability (BPP)
133 was inferred following Calderon & Boo (2017).

The neighbor joining analysis was performed in MEGA5 v.6.06 with the default settings software, using 1000 bootstrap replicates.

Results

This is the first confirmed report of *L. spicata* in the Sub-Antarctic region, extending its distribution to the south by seven degrees of latitude (Fig. 2a). The sporophytes collected in the two localities have cylindrical stipes, flattened toward the beginning of the blades, with a regular, almost dichotomous long lanceolate blade with a spike (Fig. 2b-e).

Internal anatomy

Our specimens showed several layers of cortical tissue with cells of smaller diameter compared to *L. searlesiana* (Fig. 3b, e, h) and *L. flavicans* (Fig. 3c, f, i), moreover no lacunas were observed in our samples, unlike *L. flavicans* (Fig. 3c, h). The medulla was composed of elongated medullary cells with filamentous elements (Fig. 3g)**.** The internal anatomy was composed of a narrow cortex (Fig. 3a), with cortical cell diameter of 25.91 ± 2.90 for the individual 1, 28.22 ± 2.10 for individual 2, and 27.02 ± 2.27 for the individual 3 (Table 2).

Phylogenetic analysis

The ITS phylogeny placed our specimens within the lineage of *L. spicata* of central Chile (Fig. 4a). The phylogenetic trees constructed by ML and BI had the same topology except for the phylogenetic position of *L. corrugata* and *L. variegata* from northeastern South Is. The three specimens analyzed consistently formed a strongly supported clade with sequences of *L. spicata* (97% for ML and 0.96 for BPP) collected in Chile; having to *L. berteroana* and *L. trabeculata* as sister taxa. The cladogram was consistent with the phylogenetic tree (Fig 4b). Variable sites occurred at 201 positions (27.5%), and 123 positions (16.8%) were parsimoniously informative. Intraspecific divergence of *L. spicata* from three different populations ranged between 0.0% and 0.2% (0–3 bp). *L. spicata* differed by 0.8%–1.0% from *L. berteroana* and by 1.1%–1.3% from *L. trabeculata*. *L. variegata* is a non-monophyletic species complex of four different species.

Discussion

We confirm here the presence of *L. spicata* both morphologically and genetically, whose individuals correspond to the central Chile lineage described by González *et al.,* (2012). Morphologically these features correspond to those described for *L. spicata* by Suhr (1839) and González *et al.,* (2012). These values also agree with those mentioned by González *et al.,* (2012) for *L spicata*. Genetically our phylogeny is consistent with those of previous studies that show *Lessonia* as a monophyletic lineage (Lane *et al.,* 2006, Martin & Zucarello, 2012).

Lessonia species are a characteristic component of benthic ecosystems in this region (Searles, 1978; Martin & Zucarello, 2011). We highlight two aspects about the importance of this report of *L. spicata* for this area: a) we increase the knowledge of the species richness of kelps for the Sub-Antarctic Channels, and (b) this species has a strong extraction activity which we hypothesize that will move southward in the near future, therefore these populations should be properly preserved in order to prevent high risk of human impact.

The name *L. spicata* was proposed because it was the oldest name available to assign the lineage of central Chile, populations between 29° and 43°S. However, *L. spicata* would be a provisional name mainly because no representative specimens of *L. nigrescens* have been found near the type locality Cape Horn. Therefore, if the true *L. nigrescens* belongs to one of the lineages already described or to a new one, this name would have priority (González *et al.,* 2012). In the MBP *L. nigrescens* has been recorded not only for Cape Horn; Searles (1978) reported a population in the Trinidad Channel (Puerto Alert 49° 53.6 'S), and two others in the Aysén region (Searles, 1978). Puerto Alert is 126 km south of Castillo Channel where we found the population of *L. spicata*. Therefore, it is likely that Searles' records (1978) correspond to populations of *L. spicata*. Finally, it is important to mention that, like González *et al.,* (2012), in recent expeditions to the Diego Ramirez and Cape Horn archipelago–which are related to the characterization of the Diego Ramírez-Drake Passage Marine Park (Rozzi *et al.,* 2017)–we have not found populations of *L. nigrescens*, only individuals of *L. flavicans* (Rozzi *et al.,* 2017). Therefore, in the absence of biological material from the type locality the status of *L. nigrescens* is still in doubt, and the lineage of central Chile that now extends south of 43°S should continue to be named as *L. spicata.*

Several bio-geographical breaks have been described along the coast of Chile (Santelices & Menesses, 2000; Tellier *et al.,* 2009; Fraser *et al.,* 2010); one of the most relevant for many taxa is at 42°S (Brattström & Johansen, 1983; Lancellotti & Vázquez, 1999; Valdovinos *et al.,* 2003). For macroalgae and particularly for kelp species such as *Durvillaea antarctica*, a marked

196 divergence is present south of 43°S, where populations between 49° and 55°S are genetically
197 different from the rest of the populations occurring in the Chilean coast (32°S and 43°S) (Fraser
198 *et al.,* 2010). These authors suggested that although *D. Antarctica* has a high dispersion capacity
199 due to its buoyancy (rafting), it could only colonize free coasts, since it would have limited
200 potential to increase gene flow between established populations. Therefore, it is interesting that
201 although *L. spicata* has a lowdispersal capacity in comparison to *D. antarctica* (Oppliger et *al.,*
202 2012), since it does not have the buoyancy capacity, there is a single genetic unit in the individuals
203 collected in this study and individuals from the central zone of Chile. *L. spicata* must have some
204 physiological adaptations which allowed it to colonize and inhabit areas of high latitudes. In this
205 sense, this species has been described as a perennial seaweed and has not been found in the "bank
206 of microscopic forms" in the Chilean central coast (boulders and water from tidal pools)
207 (Santelices *et al.,* 1995; Santelices *et al.,* 2002). However, it has been observed that microscopic
208 form of *L. spicata* can survive up to 90 days in total darkness and propagules can germinate in
209 total absence of light (Santelices *et al.,* 2002). This high capacity for tolerance to darkness could
210 be a key strategy to colonize new areas with a significant seasonal changes in daylight hours and
211 luminosity (Photosynthetically Active Radiation) during the winter period (Ojeda et *al.,* 2019).
212 Nevertheless, future studies and a greater number of samples along the Chilean coast (mainly the
213 area between 41°- 48°S) will help to elucidate its biogeographic history and how much structure
214 and connectivity the populations of *L. spicata* present throughout their distribution (29°S to 48°S).
215 The harvesting pressure on the genus *Lessonia* has increased alarmingly along the Chilean
216 coast, so we should take a precautionary approach to potential harvesting of *L. spicata* in its austral
217 distribution range. *L. berteroana* (sister species of *L. spicata*) is currently the most exploited
218 seaweed in South America; the main landings are in northern Chile (Westermeier *et al.,* 2019).
219 *Lessonia* is socially important in this region because many artisanal fishers depend directly or
220 indirectly on its harvest (Vega *et al.,* 2014). However, high demand, lack of oversight and harvest
221 methods have created a concerning scenario for kelp forests (Vega *et al.,* 2014; Westermeier *et al.,*
222 2019). The extraction of *L. spicata* in southern Chile began in 2012, and its extractive pressure has
223 been moving southward, mainly between 33° and 41°S (SERNAPESCA, 2019). In the Chilean
224 Los Lagos Region (41°S), between 2014 and 2017 landing increased from 494 to 747 dry tons of
225 *L. spicata* (SERNAPESCA, 2019). This gradual increase should draw attention to kelp forest
226 conservation, since there is evidence on sustainability problems that *Lessonia* populations have

experimented and their biodiversity in northern Chile (Vega *et al.,* 2016). This concern acquires significant relevance if we consider that the Magellan Sub-Antarctic Channels are the austral distribution range of *L. spicata*, -where kelp forest populations are important for sustainability of small-scale fisheries (e.g. king crab; Cárdenas *et al.,* 2007), indigenous traditions (Ojeda *et al.,* 2018) and terrestrial and marine biodiversity (Darwin, 1839; Rosenfeld *et al.,* 2014).

Conclusion

Despite the geographical distance and the presence of important biogeographic breaks (41° and 46°S), our results confirm that the individuals collected in the coastal zone of the Katalalixar Reserve are the species *Lessonia spicata*. The strong morphological and genetic evidence are indicating that the individuals analyzed are associated with the lineage of central Chile, and the populations of *L. spicata* would inhabit the area exposed to the Pacific.

With diverse industrial uses, including providing phycocolloids in the form of alginate *L. spicata* is a potentially important economic resource in the Chilean coast. However, with extractive pressure moving to the south, caution is needed given that this kelp serves not only as a habitat for many animals but also as a spawning ground for some benthic (e.g., gastropods) species.

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Figure 1

Collection points of *Lessonia spicata*. Map showing the location of Katalalixar National Reserve (KNR) in central Patagonia in the oceanic margin of the Campana Archipielago

Collection points of *Lessonia spicata*. a) Map showing the location of Katalalixar National Reserve (KNR) in central Patagonia, (b) Collection sites of *Lessonia spicata*, Torpedo Island (red circle) and Castillo Channel (blue circle) in the oceanic margin of the Campana Archipielago (KNR).

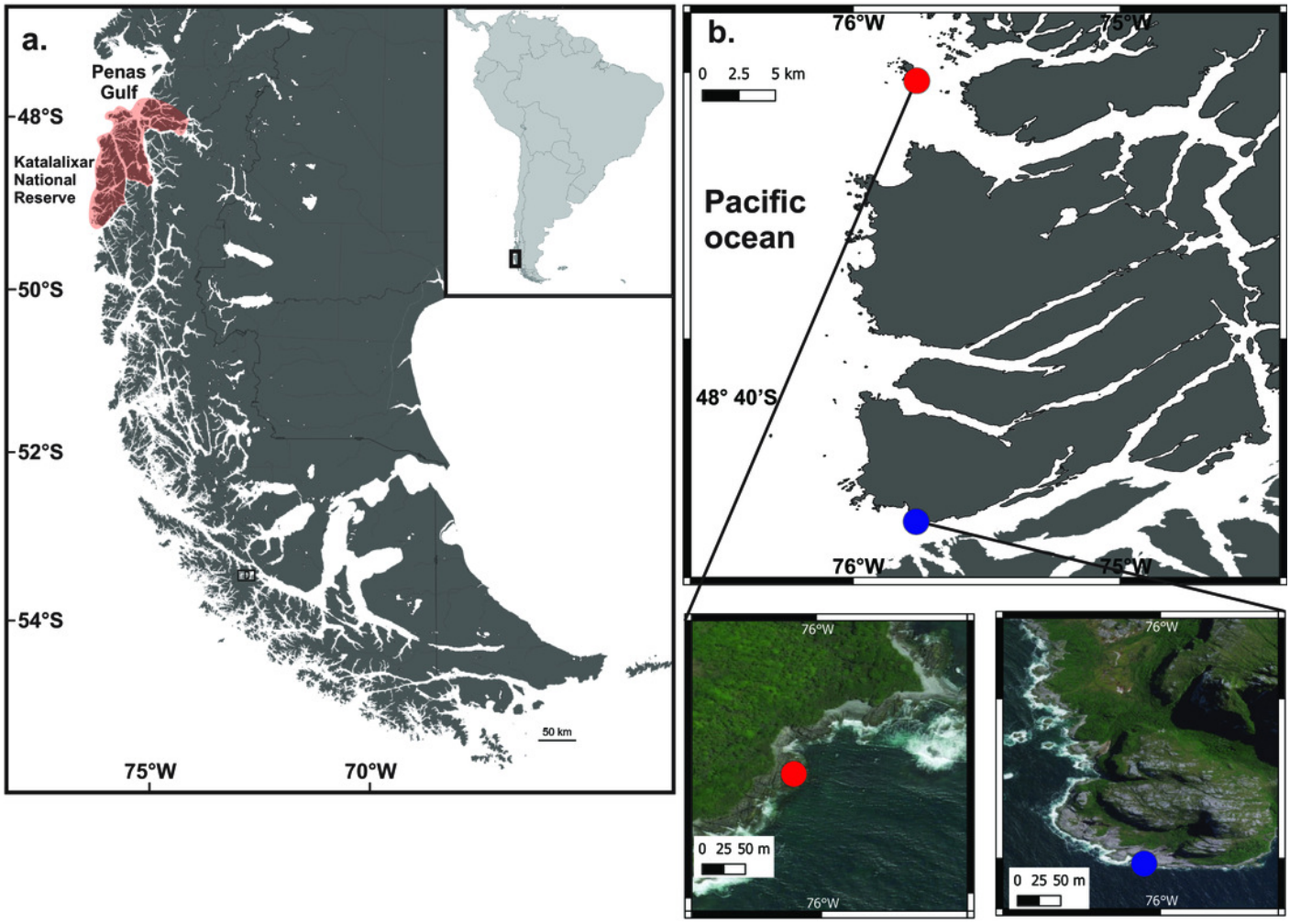

Figure 2

Distribution of *Lessonia spicata* (interspersed bars), showing its previously known distribution (solid bars). Habitat of specimen collected in both sites (Torpedo Island and Castillo Channel)

Distribution of *Lessonia spicata* (interspersed bars), showing its previously known distribution (solid bars). We included the Chilean biogeographical classification of Camus (2001). b) Habitat of specimen collected in Torpedo Island (LMS000001). c) Discoid holdfasts of specimen collected in Torpedo Island (LMS000001), d) Blades of specimen collected in Torpedo Island (LMS000001), e) Habitat of specimen collected in Castillo Channel (LMS000002, LMS000003).

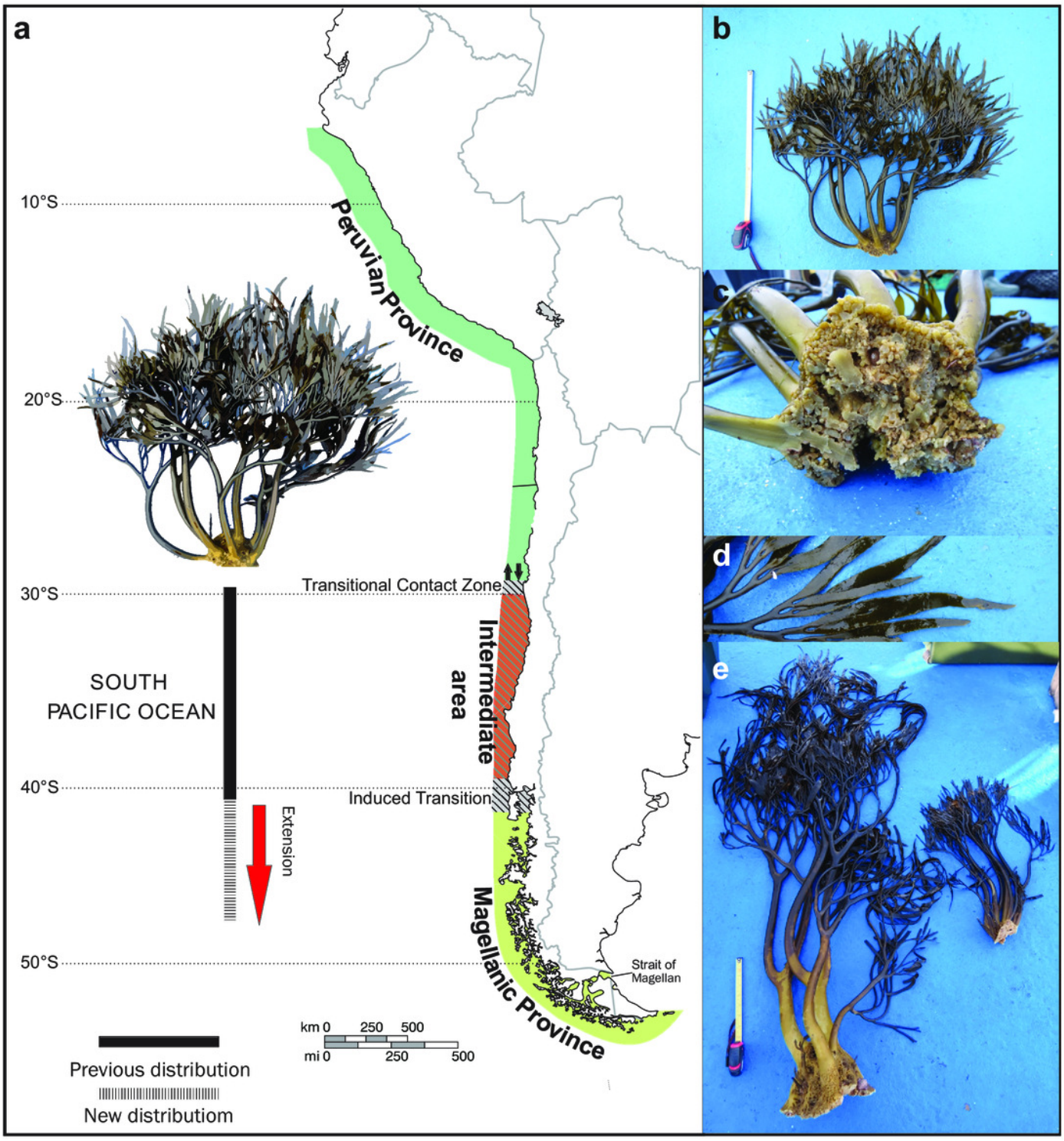
a
b
c
d
e
10°S
20°S
30°S
40°S
50°S
Peruvian Province
Transitional Contact Zone
Intermediate area
Induced Transition
Magellanic Province
Strait of Magellan
SOUTH PACIFIC OCEAN
Extension
km 0 250 500
mi 0 250 500
Previous distribution
New distribution

Figure 3

Cross section of the medial part of mature fronds of Lessonia species who inhabit the Sub-Antarctic channels

Cross section of the medial part of mature fronds of *Lessonia spicata* collected in the Katalalixar Reserve (Fig. 3a, d and g), of *L. searlesiana* from Fuerte Bulnes (Fig. 3b, e and h) and *L. flavicans* from Horn Island (Fig. 3c, f and i); mer = meristoderm, co = cortex and me = medulla, l= lacuna.

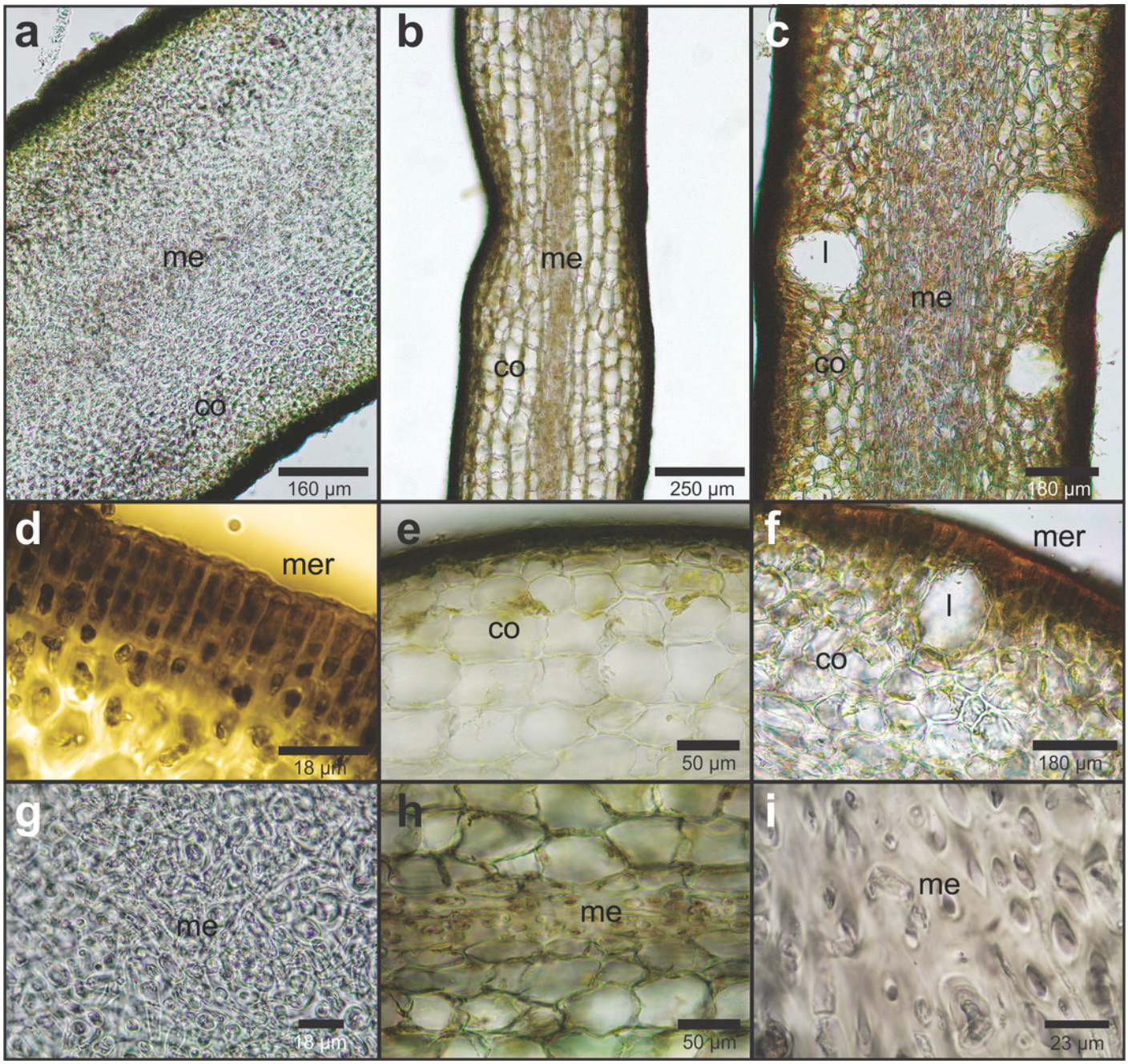
a
me
co
160 µm
b
me
co
250 µm
c
l
me
co
180 µm
d
mer
18 µm
e
co
50 µm
f
mer
l
co
180 µm
g
me
18 µm
h
me
50 µm
i
me
23 µm

Figure 4

Phylogenetic tree of ITS sequences obtained by maximum likelihood (ML) inference.

a) Phylogenetic tree of ITS sequences obtained by maximum likelihood (ML) inference. ML bootstrap values (≥ 50%) and Bayesian posterior probabilities (≥ 0.90) are indicated next to branches. b) Cladograms of ITS sequences obtained by the neighbor joining (NJ) method. Bootstrap values (≥ 50%) are indicated next to branches. The sequence for taxa in bold was generated in this study.

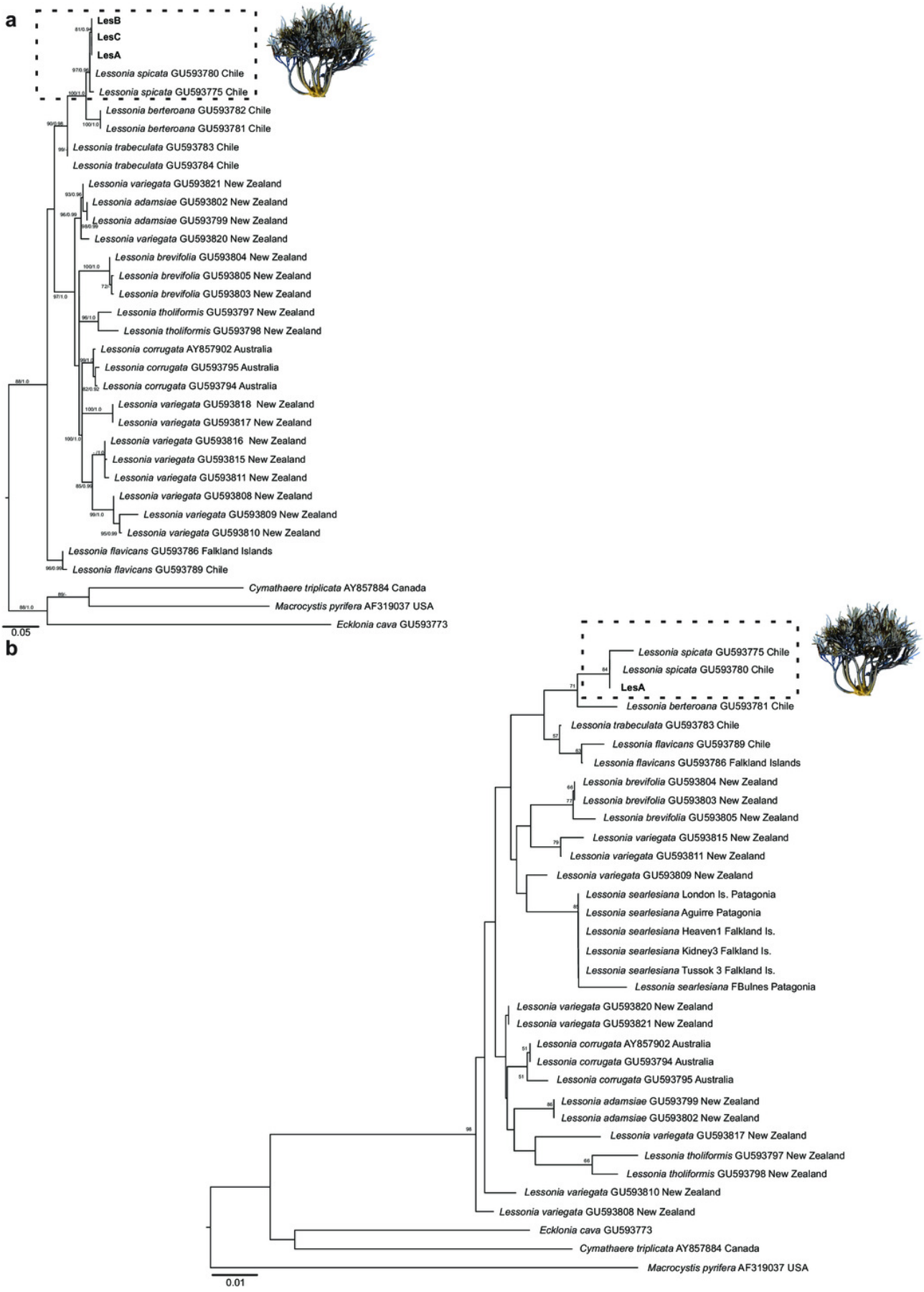
a
LesB
LesC
LesA
Lessonia spicata GU593780 Chile
Lessonia spicata GU593775 Chile
Lessonia berteroana GU593782 Chile
Lessonia berteroana GU593781 Chile
Lessonia trabeculata GU593783 Chile
Lessonia trabeculata GU593784 Chile
Lessonia variegata GU593821 New Zealand
Lessonia adamsiae GU593802 New Zealand
Lessonia adamsiae GU593799 New Zealand
Lessonia variegata GU593820 New Zealand
Lessonia brevifolia GU593804 New Zealand
Lessonia brevifolia GU593805 New Zealand
Lessonia brevifolia GU593803 New Zealand
Lessonia tholiformis GU593797 New Zealand
Lessonia tholiformis GU593798 New Zealand
Lessonia corrugata AY857902 Australia
Lessonia corrugata GU593795 Australia
Lessonia corrugata GU593794 Australia
Lessonia variegata GU593818 New Zealand
Lessonia variegata GU593817 New Zealand
Lessonia variegata GU593816 New Zealand
Lessonia variegata GU593815 New Zealand
Lessonia variegata GU593811 New Zealand
Lessonia variegata GU593808 New Zealand
Lessonia variegata GU593809 New Zealand
Lessonia variegata GU593810 New Zealand
Lessonia flavicans GU593786 Falkland Islands
Lessonia flavicans GU593789 Chile
Cymathaere triplicata AY857884 Canada
Macrocystis pyrifera AF319037 USA
Ecklonia cava GU593773
0.05
b
Lessonia spicata GU593775 Chile
Lessonia spicata GU593780 Chile
LesA
Lessonia berteroana GU593781 Chile
Lessonia trabeculata GU593783 Chile
Lessonia flavicans GU593789 Chile
Lessonia flavicans GU593786 Falkland Islands
Lessonia brevifolia GU593804 New Zealand
Lessonia brevifolia GU593803 New Zealand
Lessonia brevifolia GU593805 New Zealand
Lessonia variegata GU593815 New Zealand
Lessonia variegata GU593811 New Zealand
Lessonia variegata GU593809 New Zealand
Lessonia searlesiana London Is. Patagonia
Lessonia searlesiana Aguirre Patagonia
Lessonia searlesiana Heaven1 Falkland Is.
Lessonia searlesiana Kidney3 Falkland Is.
Lessonia searlesiana Tussok 3 Falkland Is.
Lessonia searlesiana FBulnes Patagonia
Lessonia variegata GU593820 New Zealand
Lessonia variegata GU593821 New Zealand
Lessonia corrugata AY857902 Australia
Lessonia corrugata GU593794 Australia
Lessonia corrugata GU593795 Australia
Lessonia adamsiae GU593799 New Zealand
Lessonia adamsiae GU593802 New Zealand
Lessonia variegata GU593817 New Zealand
Lessonia tholiformis GU593797 New Zealand
Lessonia tholiformis GU593798 New Zealand
Lessonia variegata GU593810 New Zealand
Lessonia variegata GU593808 New Zealand
Ecklonia cava GU593773
Cymathaere triplicata AY857884 Canada
Macrocystis pyrifera AF319037 USA
0.01

Table 1(on next page)

List of species used in DNA analyses, information on collections and accession numbers in GenBank

List of species used in DNA analyses, information on collections and accession numbers in GenBank (sequences generated in the present study are shown in bold). [1] Martin & Zuccarello (2012), [2] Lane et al. (2006), [3] Yoon et al. (2001).

Table 1. List of species used in DNA analyses, information on collections and accession numbers in GenBank (sequences generated in the present study are shown in bold). [1] Martin & Zuccarello (2012), [2] Lane et al. (2006), [3] Yoon et al. (2001).

Species	Collection site	Voucher code	ITS
LesA	Torpedo island, Aysen, Chile		MN061669
LesB	Channel Castillo, Aysen Chile		MN061670
LesC	Channel Castillo, Aysen, Chile		MN061671
Lessonia adamsiae	South Promontory, The Snares, New Zealand	A626	GU593802[1]
Lessonia adamsiae	Tahi, The Snares, New Zealand	A614	GU593799[1]
Lessonia berteroana (as *L. nigrescens* northern lineage)	San Marcos, Tarapaca, Chile	B858	GU593781[1]
Lessonia berteroana (as *L. nigrescens* northern lineage)	San Marcos, Tarapaca, Chile	B859	GU593782[1]
Lessonia brevifolia	Smoothwater Bay, Campbell Is., New Zealand	A548	GU593803[1]
Lessonia brevifolia	Antipodes, New Zealand	A973	GU593804[1]
Lessonia brevifolia	Perseverance Harbour, Campbell Is., New Zealand	B296	GU593805[1]
Lessonia corrugata	Gov. Is. Reserve, Tasmania, Australia		AY857902[2]
Lessonia corrugata	Bicheno, Tasmania, Australia	A985	GU593794[1]
Lessonia corrugata	Skeleton Pt., Tasmania, Australia	C057	GU593795[1]
Lessonia flavicans	Rookery Bay, East Falkland, Falkland Islands	A634	GU593786[1]
Lessonia flavicans (as *Lessonia vadosa*)	Punta Arenas, Patagonia, Chile	B985	GU593789[1]
Lessonia spicata (as *L. nigrescens* IA lineage)	La Pampilla, Coquimbo, Chile	A581	GU593775[1]
Lessonia spicata (as *L. nigrescens* IA lineage)	Bahia Mansa, Osorno, Chile	B719	GU593780[1]
Lessonia tholiformis	Wharf reef, Owenga, Chatham Is, New Zealand	A518	GU593797[1]
Lessonia tholiformis	Wharekauri, Chatham Is, New Zealand	A532	GU593798[1]
Lessonia trabeculata	Punihuil, Chiloe Is, Chile	B715	GU593783[1]
Lessonia trabeculata	Punihuil, Chiloe Is, Chile	B716	GU593784[1]
Lessonia variegata (as *L. variegata* lineage N)	North Cape, Northland, New Zealand	A557	GU593808[1]
Lessonia variegata (as *L. variegata* lineage N)	Maitai Bay, Northland, New Zealand	B129	GU593809[1]
Lessonia variegata (as *L. variegata* lineage N)	The Sailors Grave, Coromandel, New Zealand	B312	GU593810[1]
Lessonia variegata (as *L. variegata* lineage K)	South Bay, Kaikoura, New Zealand	A138	GU593817[1]
Lessonia variegata (as *L. variegata* lineage K)	New Wharf, Kaikoura, New Zealand	A606	GU593818[1]
Lessonia variegata (as *L. variegata* lineage S)	Curio Bay, Catlins, New Zealand	A434	GU593820[1]

Lessonia variegata (as *L. variegata* lineage S)	Causet Cove, Doubtful Sound, New Zealand	C154	GU593821[1]
Lessonia variegata (as *L. variegata* lineage W)	Princess Bay, Wellington, New Zealand	A001	GU593811[1]
Lessonia variegata (as *L. variegata* lineage W)	Cape Palliser, Wairarapa, New Zealand	A613	GU593815[1]
Lessonia variegata (as *L. variegata* lineage W)	Riversdale Beach, Wairarapa, New Zealand	A025	GU593816[1]
Cymathaere triplicata	Whiffen Spit, Sooke, BC, Canada		AY857884[2]
Macrocystis pyrifera	California, USA		AF319037[3]
Ecklonia cava			GU593773[1]

4

5

Table 2(on next page)

Morphological measurements (mean ± SE) of individuals collected in Torpedo Island and Castillo Channel.

External morphological data: TL = Thallus length (cm), DD = Disc diameter, NS = Number of stipes. Internal morphological data: DC = Diameter of cortical cells.

Table 2. Morphological measurements (mean ± SE) of individuals collected in Torpedo Island and Castillo Channel. External morphological data: TL = Thallus length (cm), DD = Disc diameter, NS = Number of stipes. Internal morphological data: DC = Diameter of cortical cells.

		External measurements			Internal measurements	
		TL	DD	NS	DC	
Individual	Site					
1	Torpedo Island	68	10	9	25.91 ± 2.90	This study
2	Castillo Channel	166	21	6	28.22 ± 2.10	This study
3	Castillo Channel	55	5	13	27.02 ± 2.27	This study
Average		96.33 ± 60.68	12 ± 8.19	9.33 ± 3.51	27.05 ± 1.15	This study
L. spicata						
	Maintencillo	150 ± 13.3	-	-	25.7 ± 1.4	(González et al. 2012)
	Matanzas	160 ± 5.0	-	-	27 ± 1.6	(González et al. 2012)
	Calfuco	120 ± 7.2	-	-	30 ± 1.8	(González et al. 2012)