Sponges from the 2010-2014 Paamiut Multispecies Trawl Surveys, Eastern Arctic and Subarctic: Class Demospongiae, Subclass Heteroscleromorpha, Order Poecilosclerida, Family Coelosphaeridae, Genera *Forcepia* and *Lissodendoryx*

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by

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TABLE OF CONTENTS

ABSTRACT

Tompkins, G., Baker, E., Anstey, L., Walkusz, W., Siferd, T. and Kenchington, E. 2017. Sponges from the 2010-2014 Paamiut Multispecies Trawl Surveys, Eastern Arctic and Subarctic: Class Demospongiae, Subclass Heteroscleromorpha, Order Poecilosclerida, Family Coelosphaeridae, Genera *Forcepia* and *Lissodendoryx*. Can. Tech. Rep. Fish. Aquat. Sci. 3224: v + 129.

Sponges (Phylum Porifera) are benthic filter feeding animals that function in nutrient cycling and habitat provision in the deep sea. Sponges collected between 2010 and 2014 during annual multispecies trawl surveys conducted by Fisheries and Oceans Canada (DFO) in Baffin Bay, Davis Strait and portions of Hudson Strait were taxonomically examined. In total ~2500 specimens were identified, comprising over 100 known sponge taxa. Sponges from the Order Poecilosclerida comprised nearly half the identified species. This report summarizes sponges in the Family Coelosphaeridae (Class Demospongiae, Subclass Heteroscleromorpha, Order Poecilosclerida, Family Coelosphaeridae) which is the most specious family of poecilosclerid sponges in the collections. Sixteen species are described from the genera *Forcepia* and *Lissodendoryx*: *Forcepia (Forcepia) fabricans, F. (F.) forcipis, F. (F.) forcipula, F. (F.)* aff. *japonica, F. (F.) thielei, Forcepia (Leptolabis)* cf. *brunnea*, *Forcepia* sp. 1 and *Forcepia* sp. 2, *Lissodendoryx (Lissodendoryx) complicata, L. (L.) indistincta, L. (L.) lundbecki, L. (L.) stipitata, Lissodendoryx (Ectyodoryx)* cf. *diversichela, L. (E.)* cf. *foliata, L. (E.).* cf. *multiformis, Lissodendoryx* sp. 1. Descriptions include morphological and spicule descriptions and dimensions, DNA barcodes and taxonomic discussion.

RÉSUMÉ

Tompkins, G., Baker, E., Anstey, L., Walkusz, W., Siferd, T. et Kenchington, E. 2017. Éponges provenant des relevés plurispécifiques au chalut effectués par le navire scientifique *Paamiut* entre 2010 et 2014 dans l'est de l'Arctique et la région subarctique : classe Demospongiae, sous-classe Heteroscleromorpha, ordre Poecilosclerida, famille Coelosphaeridae, genres *Forcepia* et *Lissodendoryx*. Rapp. tech. can. sci. halieut. aquat. 3224 : v + 129.

Les éponges (Phylum Porifera) sont des animaux filtreurs benthiques qui vivent selon le cycle des éléments nutritifs et la disposition de l'habitat dans les profondeurs de la mer. Les éponges recueillies au cours des relevés plurispécifiques annuels au chalut effectués entre 2010 et 2014 par Pêches et Océans Canada (MPO) dans la baie de Baffin et le détroit de Davis et dans certaines parties du détroit d'Hudson ont été examinées sur le plan taxonomique. Au total, environ 2 500 spécimens ont été identifiés, composés de plus de 100 taxons d'éponges connues. Les éponges faisant partie de l'ordre Poecilosclerida constituent presque la moitié des espèces recensées. Le présent rapport fait état des éponges appartenant à la famille Coelosphaeridae (classe Demospongiae, sous-classe Heteroscleromorpha, ordre Poecilosclerida), qui est la famille la plus caractéristique des éponges de l'ordre des Poecilosclerida dans les collections. Seize espèces sont décrites chez les genres *Forcepia* et *Lissodendoryx* : *Forcepia (Forcepia) fabricans, F. (F.) forcipis, F. (F.) forcipula, F. (F.)* aff. *japonica, F. (F.) thielei, Forcepia (Leptolabis)* cf. *brunnea, Forcepia* sp. 1 et *Forcepia* sp. 2, *Lissodendoryx (Lissodendoryx) complicata, L. (L.) indistincta, L. (L.) lundbecki, L. (L.) stipitata, Lissodendoryx (Ectyodoryx)* cf. *diversichela, L. (E.)* cf. *foliata, L. (E.).* cf. *multiformis, Lissodendoryx* sp. 1. Les descriptions portent également sur les éléments morphologiques et les spicules et comprennent les dimensions, les codes à barres d'ADN et des observations sur les aspects taxinomiques.

INTRODUCTION

Sponges are sessile benthic animals that feed on plankton, particulate and dissolved matter in the water column by pumping water through their bodies, or in rare cases trapping food on filamentous extensions. Aggregations of sponges provide structurally complex habitat, locally increasing the diversity and abundance of epibenthic megafauna (Beazley et al. 2013, 2015), and function as nursery and feeding grounds for demersal fish species (Kenchington et al. 2010, Miller et al. 2012, Kutti et al. 2015). Beyond their role as biogenic habitat, sponges filter large volumes of water (Reiswig 1971, Reiswig 1974, Leys et al. 2011) and impact the overlying water column through their feeding activities (Yahel et al. 2006, Yahel et al. 2007, de Goeij et al. 2013, Kahn et al. 2015, Rix et al. 2016) and nutrient cycling (reviewed in Maldonado et al. 2012) – making them important contributors to benthic pelagic coupling (Gili and Coma 1998). Given their importance in deep ocean ecosystems, sponge-dominated communities are recognized under the 2006 United Nations General Assembly Resolution (UNGA) 61/105 as vulnerable marine ecosystems (VMEs) in international waters.

Identification of sponge species can be particularly challenging. While some sponges have characteristic morphology, sponge identification to species level is typically achieved by dissolving away sponge tissues and examining the microscopic spicule-based skeleton that is left behind. The lengths and types of spicules are then compared to published sponge species descriptions. Taxonomic literature on deep sea sponges is fragmented, spanning cruise or technical reports and taxonomic journals and conference proceedings or embedded within ecological manuscripts. Currently, a comprehensive resource describing sponge species of the Eastern Arctic and Subarctic is not yet available.

In the Eastern Canadian Arctic, particularly western Baffin Bay, Davis Strait, and portions of Hudson Strait and Ungava Bay, invertebrate species, including sponges, are routinely collected during Fisheries and Oceans Canada (DFO) shrimp and Greenland halibut multispecies trawl surveys. Surveys conducted on the Greenland Institute of Natural Resources (GINR) research vessel (RV) *Paamiut* focus on the Northwest Atlantic Fisheries Organization (NAFO) Convention Areas 0A and 0B and in Shrimp Fishing Areas 1 and 3 (SFA1 and SFA3). We examined approximately 2500 sponge specimens collected from 479 trawl sets (see Figure 1) made from 2010 to 2014 during DFO multispecies trawl surveys conducted on RV *Paamuit*. Over 100 different species were identified. All three sponge classes (Demospongiae, Calcarea and Hexactinellida) were represented, with the vast majority of taxa (> 90%) being demosponges. Sponges from the Order Poecilosclerida (Class Demospongiae) comprised nearly half the identified species.

This report presents morphological and spicule descriptions and DNA barcodes, when applicable, for 16 species from genera *Forcepia* and *Lissodendoryx* (Class Demospongiae, Subclass Heteroscleromorpha, Order Poecilosclerida, Family Coelosphaeridae). These represent

the only genera collected from the Family Coelosphaeridae, the most speciose family of Poecilosclerid sponges from the collection. The full list of species described in this report is: *Forcepia (Forcepia) fabricans, F. (F.) forcipula, F. (F.) forcipis, F. (F.) thielei, F. (F.)* aff. *japonica, Forcepia (Leptolabis)* cf. *brunnea, Forcepia* sp. 1 *and Forcepia* sp. 2. *Lissodendoryx (Lissodendoryx) complicata, L. (L.) indistincta, L. (L.) lundbecki, L. (L.). stipitata, L. (Ectyodoryx.)* cf. *diversichela, L. (E.)* cf. *foliata, L. (E.)* cf. *multiformis* and *Lissodendoryx* sp. 1. Our intent is to provide a detailed taxonomic resource to facilitate accurate, consistent and efficient identification of eastern Canadian sponges for the purpose of monitoring and mapping species distributions. While the sponges described here were collected in Baffin Bay, Davis Strait, Ungava Bay or Hudson Strait (Figure 1), many of these species are found throughout the Arctic or North Atlantic Oceans.

Taxonomic Background on the Family Coelosphaeridae

Demosponges (Class Demospongiae) make up 81% of all extant sponges (7000 species), have cellular, not syncytial tissues, and skeletons made from siliceous spicules and/or, more rarely, spongin fibers (Cárdenas et al. 2012, World Porifera Database). At the time the Systema Porifera (Hooper and Van Soest 2002) was published three demosponge subclasses were recognized, mainly based on morphological and spicule characteristics: Homoscleromorpha, Tetractinomorpha, and Ceractinomorpha. Since then, an updated classification based on molecular phylogenetic data has been proposed (Morrow and Cárdenas 2015) and is reflected in the World Porifera Database. It replaces the previous three subclasses with: Keratosa (sponges with spongin fibre skeletons), Verongimorpha (sponges with no skeleton or a skeleton that is fibrous or made of siliceous asters), and Heteroscleromorpha. The latter is named for its diversity of spicule types and includes sponges with skeletons that are made of siliceous spicules that have single or four axes, and when microscleres are present they are typically structurally diverse. It is by far the largest demosponge subclass, including at least 15 sponge orders (refer to updated classification in Morrow and Cárdenas 2015).

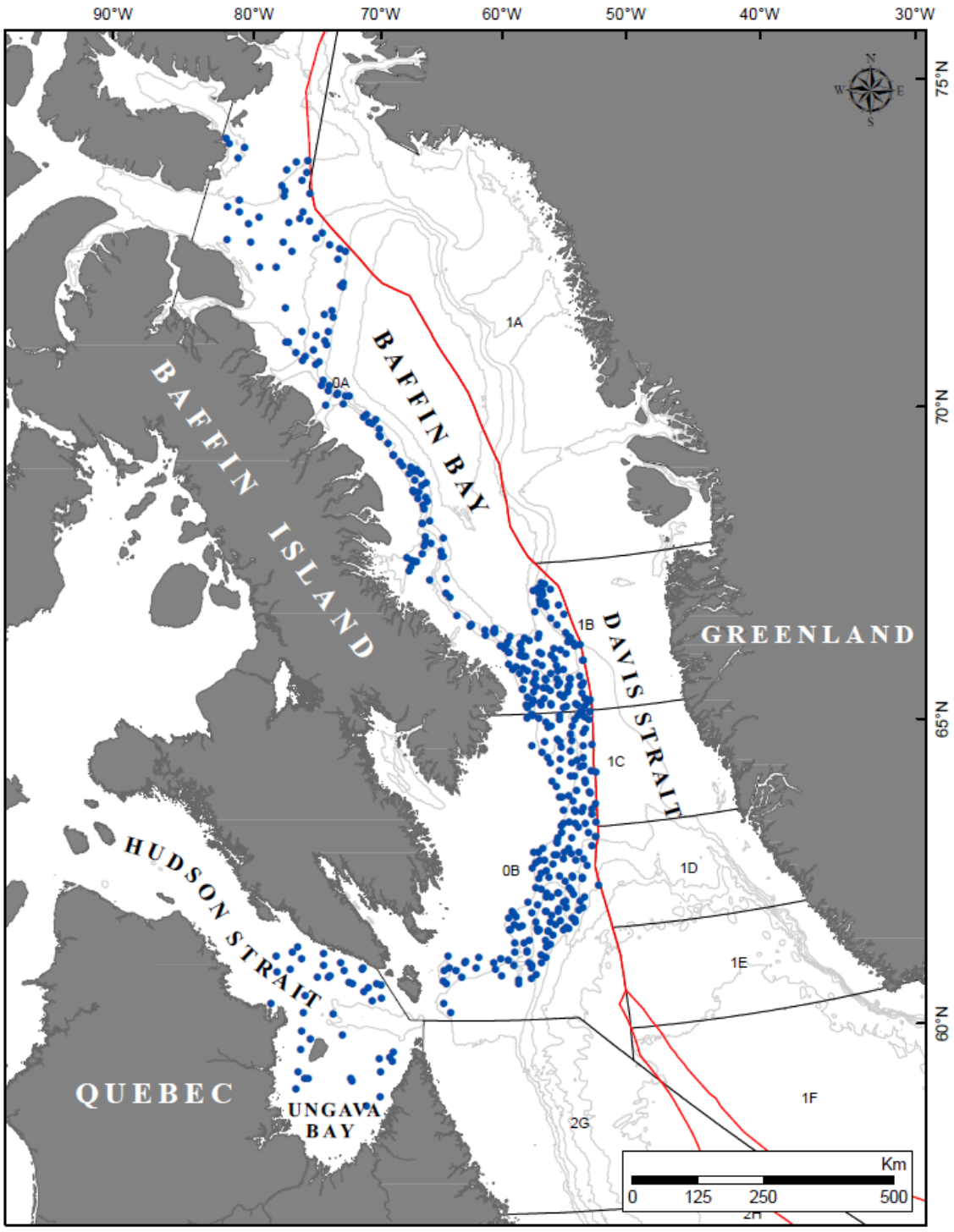

Figure 1. Locations of *Paamiut* 2010-2014 trawl sets (N=479) with sponge catch, spanning Baffin Bay, Davis Strait, Ungava Bay and Hudson Strait. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray. Note that the species listed in this report were found in a subset of these locations.

The Poecilosclerida is the largest order of sponges with over 2209 described species (World Porifera Database, accessed 17th October, 2014 by Morrow and Cárdenas 2015) and 20 families proposed by Morrow and Cárdenas (2015). Sponges in the Order Poecilosclerida are known to be viviparous and can be distinguished by the presence of chelae spicules, a synapomorphy of the group; however chelae are missing in some taxa. Other distinguishing spicules may include sigmas and sigmancistra derivatives, and sometimes toxas, raphides, microoxeas, discorhabds or spinorhabds. Skeletons of poecilosclerids are also known to show differentiation between the outer ectosome and inner choanosome. Poecilosclerida now includes: **Acarnidae**, Chondropsidae, Cladorhizidae, Crambeidae, **Crellidae**, **Coelosphaeridae**, Dendoricellidae, Desmacididae, Esperiopsidae, Guitarridae, **Hymedesmiidae**, Iotrochotidae, Isodictyidae, Latrunculiidae, **Microcionidae, Mycalidae**, Myxillidae, Phellodermidae, Podospongiidae, and Tedaniidae (Morrow and Cárdenas 2015). The families listed in bold, including the Coelosphaeridae, which are described in this report, may be polyphyletic. Thacker et al. (2013) and Redmond et al. (2013) for example both found that sequences from different species of the Coelosphaeridae genus *Lissodendoryx* were spread across different clades. On further examination species within the Family Coelosphaeridae may in the future be reassigned to different taxonomic groupings; however for the purpose of this report and without an alternate proposed classification, we treat the Coelosphaeridae as an intact family.

The Family Coelosphaeridae was originally formed by Dendy (1922) to encompass fistular sponges (with finger-like projections) with parchment-like surfaces - however in the modern Coelosphaeridae some genera, including *Lissodendoryx* and *Forcepia* which are described in this report, do not share this growth form, and many sponges with fistular growth forms have been reassigned to different families (Hooper and Van Soest 2002). The current diagnosis for the Family Coelosphaeridae combines gross morphological and skeletal characteristics. Growth forms may include fistular-hollow, branching, massive, or encrusting. Fistular forms have smooth surfaces. Non-fistular forms have punctate surfaces (marked by small pores). The choanosomal skeleton, when present, is reticulate and differs between the inner choanosome and outer ectosome, and the spicule complement includes: 1) ectosomal tornotes that may be more tylote-like in some cases; 2) choanosomal styles (smooth or acanthose) or oxeas or strongyles, and 3) microscleres that include arcuate isochelae and may include other diverse forms such as sigmas, raphides, oxychaetes, unguiferate chelae, forceps and écailles. The updated classification for the Coelosphaeridae is as follows: Phylum Porifera > Class Demospongiae > Subclass Heteroscleromorpha > Order Poecilosclerida > Family Coelosphaeridae.

The genera currently included in the Coelosphaeridae are: *Chaetodoryx, Coelosphaera, Forcepia, Histodermella, Inflatella, Lepidosphaera, Lissodendoryx,* and two recently added genera *Celtodoryx* (Perez et al. 2006) and *Myxillodoryx* (Aguilar-Camacho and Carballo 2012). The type and only known species for *Celtodoryx* was described by Perez et al. (2006) as a new species and new genus; however it was later discovered by Henkel and Janussen (2011) that this species had been described as *Cornolum ciocalyptoides* (Burton 1935). Henkel and Janussen

(2011) transferred the species from the genus *Cornolum* to *Celtodoryx* and retained Burton's original *Celtodoryx ciocalyptoides*.

Of the above Coelosphaeridae genera only *Forcepia* and *Lissodendoryx* were identified in our collections (*Paamiut* 2010-2014), however we continue to document unique species as we process additional survey collections from that area and cannot rule out the presence of other Coelosphaeridae genera. Moreover, certain taxa may be less frequently collected by the trawl gear. The small carnivorous sponge *Asbestopluma pennatula*, for example, has been recovered using abox core or Van Veen grab, but not with trawl gear. The Systema Porifera (Hooper and Van Soest 2002) gives a general overview of the characteristics of each of the Coelosphaeridae genera, excepting *Celtodoryx* and *Myxillodoryx* which are new genera. A short list of characteristics that may be used to distinguish the *Forcepia* and *Lissodendoryx* genera is given below.

Coelosphaeridae lacking arcuate isochelae

Inflatella: no microscleres; megascleres are tylotes or strongyles

Lepidosphaera: microscleres are unique disc-shaped "écailles"; megascleres are tylotes

Coelosphaeridae with arcuate isochelae

Chaetodoryx: microscleres include oxychaetes (spined microxeas); megascleres are tylotes and choanosomal acanthostyles

Celtodoryx (monospecific): microscleres include oxychaetes; megascleres include anisostrongyles (tylotes) with spined terminals

Myxillodoryx (monospecific): microscleres include unguiferate chelae; megascleres include tylotes and acanthostyles

Histodermella: Spherical base with erect fistules; microscleres include sigmas and raphides (sometimes absent); megascleres include tylotes or strongyles and acanthoxeas or acanthostrongyles

Forcepia: microscleres include forceps; megascleres include tylotes and styles (may be absent)

Coelosphaera: Hollow bodies with fistules; microscleres include sigmas and raphides (may be absent); megascleres include acanthostyles (may be absent) and tylotes or strongyles

Lissodendoryx: microscleres include sigmas and raphides (may be absent); megascleres include smooth styles or acanthostyles and tylotes or strongyles.

Lissodendoryx is very similar in spiculation to *Coelosphaera*, but typically morphologically distinct – with fistular forms typical in *Coelosphaera.* Both may have identical microsclere

complements including arcuate isochelae, sigmas and raphides. Both *Lissodendoryx* and *Coelosphaera* may have acanthostyles, tylotes and strongyles; however additional megascleres may occur in *Lissodendoryx* including smooth styles, oxeas or tornotes. Like *Coelosphaera* a few of the *Lissodendoryx* species collected by the *Paamiut* and treated in this report include arcuate isochelae, sigmas and acanthostyle,s but they are distinguished from *Coelosphaera* by having tornotes as opposed to tylotes or strongyles in combination with acanthostyles. *Lissodendoryx* sp. 1 in our collection is an exception in having acanthostyles in combination with tylotes or tylotostrongyles. Because *Lissodendoryx* sp. 1 does not have a hollow fistular body it is provisionally identified as a *Lissodendoryx* instead of *Coelosphaera* despite having a spicule complement that also matches *Coelosphaera.*

***Forcepia* (Carter, 1874)**

Forcepia species are easily identified by the presence of forcep microscleres in combination with arcuate isochelae. Forceps are U-shaped spicules that resemble pincers. This spicule type likely arose more than once in sponge evolution and can be found in the poecilosclerid family Cladorhizidae in the recently resurrected carnivorous sponge genus *Lycopodina* (formerly included in *Asbestopluma*) (Hestetun et al. 2016). Despite sharing this unique spicule type, *Forcepia,* which have arcuate chelae with equal ends (isochelae), are the only Coelosphaeridae with forceps and readily distinguished from *Lycopodina,* which have chelae with unequal ends (anisochelae). *Forcepia*, as described in the Systema Porifera (Hooper and Van Soest 2002), possess tylotes and styles for megascleres and arcuate isochelae, sigmas and forceps for microscleres. We did not prepare thick sections to examine the arrangement of spicules within the skeleton but *Forcepia* sponges are described as having ectosomal tylotes in a tangential arrangement. Choanosomal spicules, including styles and or tylotes, are reticulately arranged or in encrusting species may have a hymedesmoid arrangement with spicules affixed to a substrate on one end and with their free end projecting straight up through the sponge.

Forcepia is further split into two subgenera: *Leptolabis* (Topsent 1901) and *Forcepia* (Carter 1874). Subgenus *Leptolabis* includes *Forcepia* sponges with basal acanthostyles that project upward into the sponge from the substrate. Subgenus *Forcepia* (Carter, 1874) includes *Forcepia* that lack basal acanthostyles. In this report five of the eight *Forcepia* species lack acanthostyles altogether and are therefore *Forcepia (Forcepia).* These include: *Forcepia (Forcepia) fabricans, F. (F.) forcipis, F. (F.) forcipula, F. (F.)* aff. *japonica* and *F. (F.) thielei.* The three remaining *Forcepia* possess acanthostyles, however the specimens are broken fragments with uncertain orientation and we cannot determine whether they contain basal acanthostyles. These three species include *Forcepia (Leptolabis)* cf. *brunnea* and provisionally *Forcepia* sp. 1 and *Forcepia* sp. 2.

***Lissodendoryx* (Topsent 1892)**

The genus *Lissodendoryx* has a complicated taxonomic history, and molecular phylogenies which show *Lissodendoryx* species spread across multiple clades indicate that the genus may be polyphyletic and in need of revision (Redmond et al. 2013, Thacker et al. 2013). The prefix "Lisso" (smooth) denotes the texture of the styles in the type species – however *Lissodendoryx* with both smooth and spined megascleres are now known. Hofman and Van Soest (1995) reviewed the genus while describing taxa from the Indo-Malayian Archipelago. They observed that only 31 of 80 described *Lissodendoryx* species conformed to the diagnosis of the genus at the time. Some of these species have since been assigned to other genera – however the present *Lissodendoryx* definition is also now widened to encompass more taxa characteristics (Hooper and Van Soest 2002). Current *Lissodendoryx* span a range of body forms (massive, lobate or flabelliform) and have irregular or clathrate (resembling an open lattice) surfaces. The ectosomal spicules are tylotes or strongyles – including forms modified to oxeas or tornotes. The choanosomal spicules are arranged in an isodictyal reticulate pattern (triangular mesh with sides one spicule long) and include smooth or acanthose styles or more rarely oxeas or strongyles. Microscleres may include arcuate isochelae, sigmas and raphides, where raphides may be arranged in trichodragmata. Sigmas or raphides may be missing.

There are five proposed *Lissodendoryx* subgenera: *Anomodoryx, Waldoschmittia, Acanthodoryx, Ectydoryx and Lissodendoryx* (Hooper and Van Soest 2002). *Lissodendoryx (Anomordoryx)* have only a single megasclere type. *Lissodendoryx (Waldoschmittia)* have choanosomal oxeas instead of choanosomal styles. The remaining three subgenera have smooth styles or acanthostyles for choanosomal spicules. *Lissodendoryx (Acanthodoryx)* is currently monospecific and distinguished by having a plumose skeletal arrangement with thick tracts of styles. *Lissodendoryx (Ectyodoryx)* is distinguished from the other remaining subgenus *Lissodendoryx (Lissodendoryx)* by having a second category of smaller acanthostyles. Of the eight *Lissodendoryx* species in this report, three have two size classes of acanthostyles and are categorized here in the subgenus *Ectyodoryx.* They are *Lissodendoryx (Ectyodoryx)* cf. *foliata, Lissodendoryx (Ectyodoryx)* cf. *diversichela* and *Lissodendoryx (Ectyodoryx)* cf. *multiformis.* Note that small acanthostyles were missing in one specimen *Lissodendoryx (Ectyodoryx)* cf. *diversichela* and are not recorded in the original description of *Lissodendoryx diversichela* by Lundbeck (1905). Four collected *Lissodendoryx* species have a single size category of choanosomal styles and are in the subgenus *Lissodendoryx.* They are: *Lissodendoryx (Lissodendoryx) complicata, L. (L.) indistincta, L. (L.) lundbecki,* and *L. (L.) stipitata.* One species with only a single category of acanthostyles is left at the genus level and provisionally identified as *Lissodendoryx* sp. 1, pending future identification.

Using this Report

For each of the 16 species included in this report we provide morphological and spicule descriptions and dimensions, macro photos and spicule figures, DNA barcodes, where possible, and taxonomic discussion. A taxonomic key based on spicule characteristics is provided to allow end users of this report to more efficiently key out sponges for identification. The key should be used with caution, as our spicule characteristics are chosen to distinguish amongst only the 16 species in this report and may not be applicable when considering a broader group of species. The full descriptions should be consulted and spicule measurements or morphological characteristics compared prior to confirming any identification. We note that sponge taxonomy, including taxonomy of the Coelosphaeridae, is in a state of flux and that naming schemes for the sponges in this report could change in the future. We recommend consulting the World Porifera Database at the time of identification to determine whether the taxa names included here are still accepted or have been replaced by alternate names.

METHODOLOGY

Sponge Collection

Sponges described in this report series were collected from 479 trawl sets made during five annual multispecies surveys (2010-2014) conducted by Fisheries and Oceans, Canada, with the Greenland Institute of Natural Resources research vessel *Paamiut*. The missions examined were coded as PA2010-9 (n=97), PA2011-7 (n=100), PA2012-7 (n=92), PA2013-8 (n-=94) and PA2014-7 (n=96). These surveys were conducted to provide fisheries-independent data on the status of Greenland halibut for stock assessments in NAFO Subdivisions 0A and 0B (Baffin Bay/Davis Strait) and with depth coverage 200-1500 m (Figure 1). In 2010 and 2012, a small area of the NAFO 0A referred to as the Shrimp Fishing Area 1 (SFA1) was surveyed in order to assess the stock of Northern shrimp (Figure 1). Also, in 2011 and 2013 samples were collected during DFO Central and Arctic survey of Northern and Striped shrimp in the Shrimp Fishing Area 3 (SFA3) (Hudson Strait/Ungava Bay) with depth coverage of 100-1000 m (Figure 1). The Greenland halibut survey was performed with an Alfredo trawl towed at 3 knots for 30 minutes at each location. The shrimp survey was performed with the Cosmos 2000 shrimp trawl towed at 2.6 knots for 15 minutes. A buffered random sampling approach designed by Kingsley et al. (2004) was employed for all surveys and the areas were divided into the depth strata, *i.e.*, 100-200 m, 200-300 m, 300-400 m, 400-500 m, 500-750 m and > 750 m.

Documentation of Sponge Catches at Sea

For each trawl catch, sponges were separated from other taxa at sea and then further separated by morphology. Each sponge morphotype was photographed with a label containing mission and set number and a tentative sponge name, then weighed and recorded in a database along with geospatial data. If sponge catches were very large, the weight of a subsample was extrapolated to the whole catch. A sample of each sponge was placed into a plastic bag with the original label. These samples were frozen at sea and shipped to the Bedford Institute of Oceanography, Dartmouth, Nova Scotia, for further identification to species level.

Sponge Identification by Spicule Analysis

Species were identified using standard taxonomic approaches for sponges – including analysis of gross morphology and spicule arrangement and microscopic analysis of the sponge spicules. Temporary slides for identification purposes were prepared by applying several drops of bleach to small pieces of sponge on microscope slides to dissolve away tissue, leaving only the spicules. Digestion was aided by teasing the tissue apart with forceps. After tissue was dissolved away and the resulting bubbles dispersed, an additional drop of water was added to the slide and a coverslip added prior to viewing on a compound microscope. Sponge spicule characteristics were documented through photographs by examining the types and appearances of spicules present and measuring each spicule type (usually 10 measurements per spicule type during routine identification).

Terminology for spicule types was taken from Boury-Esnault and Rützler (1997). Sponge morphology and spicule characteristics were then compared to published descriptions and figures. Some of the resources consulted during early identification efforts included: Ridley and Dendy (1887), Lundbeck (1902, 1905, 1909 and 1910), Topsent (1904 and 1913), Koltun (1959 and 1966), Plotkin (2004), Ackers et al. (2007), Cárdenas and Rapp (2012), Cárdenas et al. (2013), Cárdenas and Rapp (2015), Hestetun et al. (2017), and van Soest (Marine Species Identification Portal, Sponges of the NE Atlantic, accessed 29 June 2017, http://species-identification.org/species.php?species_group=sponges&menuentry=inleiding,). While learning sponge taxonomy, Koltun's guides (Koltun 1959, 1966) were often used as a first reference and also when a new type of sponge was encountered. While the sponge fauna described by Koltun were not collected in the same location, many of the species he describes are found in our collections as well. Koltun's documents are simple to use as they contain many sponge macro photos and spicule drawings for comparison. Moreover, they include taxonomic keys for each group of described sponges. We often used Koltun (1959 and 1966) for tentative identifications at the family or genus level. The Systema Porifera (Hooper and Van Soest 2002) was also used for keying out sponges. For any identifications made to species level, the characteristics of the species were compared to those in the original description or to those in more recent

comprehensive reviews. Original references were located by searching for the species in the World Porifera Database – which typically has a PDF link to the original description. The World Porifera Database was also checked to determine whether the species name is currently "accepted" or has been replaced by a new name. Species identifications were recorded in a Microsoft Access database.

To prepare permanent slides for those select specimens to be included in the report, spicules were more thoroughly cleaned and mounted in resin. For permanent sponge spicule slides, several rice-sized pieces of tissue (from the outer surfaces and interior choanosome) were excised, placed in full strength bleach in Eppendorf tubes and left to digest overnight at room temperature. Digested preps were vortexed and then centrifuged at low speed (~3000 rpm) for 1 minute to pellet spicules but not cellular debris. The supernatant was replaced with water, vortexed, left to sit for ~30 minutes and then centrifuged to pellet the spicules again. This process was repeated for a total of two water washes and water was then replaced with 95% ethanol, following the same steps. Cleaned spicules were pipetted on to glass slides and air dried before adding resin. Larger spicules were manually transferred to slides with fine dissecting tools.

Araldite resin was purchased from Electron Microscopy Sciences (Hatfield, PA, USA; catalogue number EMS #13900) and prepared according to manufacturer instructions. In brief, after heating components, Araldite 502 and DDSA, at 60^{o}C to reduce viscosity, 40 ml of Araldite 502 and 44 ml of DDSA were mixed together with a magnetic stir bar (mixing by hand introduces too many bubbles) and 1.2 ml of the accelerator DMP-30 was added and mixed until the liquid was uniform in density. Mixed resin was aliquoted into 10 cc syringes for later use. Resin will harden at room temperature but will remain useable in liquid form for months if stored at -20^{o}C. For mounting, a bead of resin was drawn along a 22 x 40 mm coverslip which was then lowered on to the dried spicules on the slides. If sponges had a very large category of spicules (megascleres) separate slides of large (megascleres) and small spicules (microscleres) were prepared. Araldite cured at room temperature in a ventilated hood over several days or at 60^{o}C overnight. Spicules were visualized on a Nikon E200 microscope and photographed with a Nikon Ds-Ri1 or DS-Fi1 camera operated though a Digital Sight DS-U2 or DS-U3 camera control unit and Nikon NIS Elements Documentation software (versions 4.20-4.5).

Spicule measurements were collected from live or captured microscope images using the NIS Elements Documentation length measurement tool, and measurements were exported to Microsoft Excel files for further analysis and tabulation. Length measurements represented the longest visible length. Width measurements were taken at different points depending on the spicule type. Sigma and chela widths were taken at the mid-point of the spicule (middle of shaft for chela) in the middle of the spicule. Forcep widths were taken at the top of the forcep arch. Tylote and tornote widths were measured at the spicule mid-point as well, and style widths were measured adjacent to the rounded end of the spicule.

For at least one specimen of each species, 30 length and 30 width measurements were collected for each spicule type. For up to five additional specimens only 10 length and 10 width measurements per spicule type were collected. For some species, specimens documented with spicule measurements were selected from a larger collection of available representatives.

For each species, spicule measurements were tabulated and were reported in micrometers (µm) with the following format for each specimen: minimum–(mean)–maximum. Figures showing images of all of the spicule types for each species were prepared with Adobe Photoshop CC or CS2. Maps showing the distribution of each species were prepared in ArcMap 10.2.2AP using the coordinate system NAD 1983 UTM Zone 20N. Depth contours of 200, 500, 1000, 1500, 2000 and 3000 m are included on each map.

Photographs of overall specimen morphology were captured with a Nikon D810 DSLR camera equipped with a Nikkor 60 mm lens. Additional lighting was provided with two angled flood lamps connected to a Dyna-Lite 1000er power supply. Rulers and specimen labels were included for reference and the camera was controlled remotely from a PC computer using Camera Control Pro 2 software (version 2.13).

While photographs of many of the supporting specimens included in the report were collected, a photo of the main specimen, from which 30 spicule measurements were collected, was included in the sponge description in the body of the report, unless otherwise indicated.

DNA Barcoding

Species with similar spicule complements and morphological characteristics were given the same species name during routine taxonomic processing, however there are many examples of cryptic marine species which share a common phenotype but differ enough in genotype to be considered different species (McCusker et al. 2012). Moreover, variability in spicule lengths and morphology can raise questions regarding whether variability represents multiple species or simply variability within species. Short DNA sequences or DNA barcodes are increasingly used in species identification, using the premise that specimens of a given species will have matching DNA sequences for select marker genes. For animals, a standard region of the slow evolving "mitochondrial cytochrome C oxidase I gene" (CO1) is routinely sequenced (Hebert et al. 2003; www.barcodeoflife.org). Newly obtained sequences can be compared to sequences in public databases including BOLD and GenBank when available as a way to confirm or determine species-level identifications. The standard CO1 fragment was amplified from some of the specimens in this report using primers published by Folmer et al. (1994): Forward primer LCO1490 (GGT CAA CAA ATC ATA AAG ATA TTG G) and reverse primer HCO2198 (TAA ACT TCA GGG TGA CCA AAA AAT CA). Note that for sponges an additional region downstream of the standard CO1 fragment is sometimes sequenced to give a larger, more variable sequence for comparison (Duran and Rützler 2006, Wörheide 2006). We did not sequence this CO1 extension for Coelosphaeridae but have done so for other sponges in the

Paamiut collections. Recommendations for additional sponge primers can be found on the Sponge Barcoding Project web page (www.palaeotologie.geo.uni-muenchen.de/SBP/). Protocols for DNA barcoding are described below.

DNA Extraction

Representative sponge specimens were selected for DNA barcoding based on whether the specimen was reasonably intact (for complementing morphological descriptions) and whether the specimens were adequately preserved for DNA work. All *Paamiut* sponges were received frozen at the Bedford Institute of Oceanography but some were transferred to 70% ethanol during routine identification. DNA is sometimes not adequately preserved in 70% ethanol, so where possible, tissue samples preserved in 70% ethanol were avoided.

Prior to DNA extraction several rice-sized pieces of sponge tissue were excised using sterile scalpel blades. Because the outer surface of trawl-caught specimens is often contaminated with tissue from other specimens, tissue from the sponge interior was preferred, and exposed by first trimming away a layer of surface tissue. Tissue was transferred to 100% ethanol in 2 ml cryo-vials and ethanol was replaced after 1 day and again after 2 days. 95% ethanol was also used instead of 100% for some specimens. DNA was extracted from these tissue samples using a QIAGEN DNeasy® Blood & Tissue Kit, following the kit protocol for animal tissues. Prior to DNA extraction from the ethanol-preserved tissue the tissue pieces were dried manually with paper towel. The kit protocol was modified slightly for sponge to remove spicules so that they did not puncture the membrane of the DNeasy® Mini spin columns. After the lysis step (overnight at 56^{o}C) the samples were vortexed and then left to sit for 30 minutes to allow the spicules to settle to the bottom. Before moving on to the next step of the DNA extraction procedure, the lysate, excluding the spicules at the bottom of the tube was transferred to a fresh tube for further processing. In the final step of the DNA extraction protocol DNA was eluted in 100 µl of QIAGEN Buffer AE.

Polymerase Chain Reaction (PCR) and Sequencing

For CO1 amplification, 25 µl PCR reactions containing the following were prepared for each specimen: 2.5 µl 10x buffer, 2 µl 2.5 mM dNTP, 1 µl 10 µM forward primer, 1 µl 10 µM reverse primer, 0.15 µl TaKarA ExTaq Hot Start version and 1 µl extracted DNA. Reactions were run on an Eppendorf Master Cycler with a heated lid using the following program: 95^{o}C 5 min (1x); 94^{o}C 45 s, 45^{o}C 30 s, 72^{o}C 1 min (5x); 94^{o}C 45 s, 50^{o}C 30 s, 72^{o}C 1 min (30x), 72^{o}C 10 min (x1); 6^{o}C hold. To confirm that DNA sequences in the expected size range were amplified, 10 µl of each PCR product was mixed with 1 µl BD Biosciences 6x loading dye and run alongside a 100 bp DNA ladder on 1% agarose gels prepared in buffer 1x TAE with a 1x TAE running buffer. Reactions that yielded a clear band in the expected size range (~650 bp) were sent to GeneWiz (www.genewiz.com) for further processing, including PCR purification

(to remove unincorporated dNTPs and excess primers) and sequencing using standard Sanger sequencing protocols. The forward and reverse sequencing primers were LCO1490 and HCO2198 respectively. For certain species sequences were not successfully obtained – for example if the only available specimen was preserved in 70% ethanol, in which the DNA is not as well preserved. DNA sequence trace files (in ab1 format) were archived in a Barcode of Life Project (BOLD; www.boldsystems.org), Sponges of the Eastern Arctic (Code: EAS) managed by Ellen L. Kenchington, where it was linked to collection data and when possible, specimen photos for each sponge. The sequence editor tool was used to view the trace files, to check the forward against the reverse sequence for each specimen, and to correct any erroneous base calls in the DNA sequence for each specimen. The edited consensus sequence from the forward and reverse reads was saved to generate a DNA text sequence in FASTA format.

Descriptions

The remainder of this report, excluding appendices, is comprised of description for 16 species from the genera *Forcepia* and *Lissodendoryx* collected in the *Paamiut* surveys. A taxonomic key based on spicule characteristics is also included to aid species identification efforts. The characters in the key are used only to distinguish between the species described in this report and may not be appropriate when comparing a broader group of species. Specimens should be compared to the full species descriptions to confirm identification. We have focused our descriptions on spicule characteristics and have not documented skeletal organization since analyzing the spicule complement alone is sufficient for identification for this group of species. Descriptions of skeletal architecture are however typically included when publishing descriptions of all new sponge species, and for some groups of sponges analysis of skeletal architecture is necessary for identification.

Each of the sponge descriptions in this report includes the following:

- ITIS and WORMS reference numbers when available
- Specimen macro photo
- Morphological description
- Habitat information including depth and geographic area
- Map of *Paamiut* 2010-2014 collection locations
- Descriptions of spicule morphology and sizes
- Spicule figure with light micrographs of each spicule type
- Discussion of taxonomic literature
- Distinguishing characteristics
- Reference to DNA barcodes, if available
- Table with spicule measurements

RESULTS

Forcepia Species

A total of eight *Forcepia* species were collected, including *Forcepia (Forcepia) fabricans, F. (F.) forcipis, F. (F.) forcipula, F. (F.)* aff. *japonica, F. (F.) thielei, Forcepia (Leptolabis)* cf. *brunnea, Forcepia* sp. 1 and *Forcepia* sp. 2. These species fit the Systema Porifera (2002) genus description, with the possible exception of *Forcepia* sp. 2. All others possess tylotes and styles for megascleres and arcuate isochelae, sigmas and forceps for microscleres. *Forcepia* sp. 2 is a possible exception to this definition in that it possesses tornote megascleres with mucronate ends in addition to tylotes and styles. To our knowledge this is not a characteristic found in other *Forcepia* species. With only one available specimen we have not ruled out the possibility that the tornotes are contaminating spicules; however these spicules were abundant and do not occur in any of the other sponges collected in the same trawl set.

The species names of two *Forcepia* described here are currently unknown and therefore provisionally listed as *Forcepia* sp. 1, and *Forcepia* sp. 2. These names may be updated in the future after further comparisons with published species descriptions. In addition to *Forcepia (Leptolabis)* cf. *brunnea* these two species are the acanthostyle-containing *Forcepia* in our collections. While subgenus *Leptolabis* is characterized by the presence of basal acanthostyles, subgenus *Forcepia* may also contains acanthostyles, albeit not in a basal hymedesmoid arrangement. Since we did not examine the arrangement of acanthostyles in *Forcepia* sp. 1 and *Forcepia* sp. 2 we leave their identification at the genus, not subgenus, level. Despite not examining the arrangement of acanthostyles in the sponge we identify as *Forcepia (Leptolabis)* cf. *brunnea*, our specimens match the description of *Forcepia (Leptolabis) brunnea* and are therefore assigned to the subgenus *Leptolabis.*

The remaining five species, all with smooth, not acanthose, styles belong to the subgenus *Forcepia.* All but *Forcepia (Forcepia) forcipula* have tylotes in addition to smooth styles. Species can be further distinguished by their forceps: *Forcepia (Forcepia) forcipis* lacks sigmas and has large hairpin shaped forceps longer than 300 μm; *F. (F.)* aff. *japonica* has very small (< 10 μm) forceps; *F. (F.) forcipula* has characteristic small (< 30 μm) forceps with toothy shafts; *F. (F.) thielei* has a single size class of forceps with a characteristic shape where both legs angle outward but with a longer leg that then angles back inward again; and *F. (F.) fabricans* has two size classes of forceps – the larger class with equal legs and the smaller class with unequal legs.

Lissodendoryx Species

A total of eight *Lissodendoryx* species were collected, including *Lissodendoryx (Lissodendoryx) complicata, L. (L.) indistincta, L. (L.) lundbecki, L. (L.) stipitata, Lissodendoryx (Ectyodoryx)* cf. *diversichela, L. (E.)* cf. *foliata, L. (E.)* cf. *multiformis*, and *Lissodendoryx* sp. 1. Placement of the

three latter sponges in the subgenus *Ectyodoryx* is supported by the presence of two size classes of acanthostyles although small acanthostyles were missing in some specimens of both *L. (E.)* cf. *diversichela* and *L. (E.)* cf. *multiformis.* Acanthostyles also occur in the subgenus *Lissodendoryx*, but not in two size classes. Compared to *L. (E.)* cf. *multiformis* and *L. (E.)* cf. *diversichela*, *L. (E.)* cf. *foliata* is readily distinguished by having one size class of chelae instead of three and one size class of sigmas instead of two. *L. (E.)* cf. *multiformis* and *L. (E.)* cf. *diversichela* have very similar spicule complements and are difficult to distinguish. Both species have 3 sizes classes of chelae, two size classes of sigmas and have acanthostyle and tornote megascleres – with two size classes of acanthostyles present in some specimens of each. The size of tornotes in the type specimen for *L. (E.) multiformis* is not reported however the microsclere and large acanthostyle lengths in our specimens are consistent with both *L. (E.) multiformis* (Brønsted 1932) and *L. (E.) diversichela* (Lundbeck 1905). The morphology of the chelae is distinct in these two species and we have used this character to aid in identification of our specimens. *L. (E.) diversichela* has strongly curved C-shaped chelae with short stubby alae, similar to those in *L. (L.) complicata. L. (E.) multiformis* large chelae are less strongly curved. We have retained the cf. designation for *L. (E.)* cf. *diversichela* because of small acanthostyles were present in one of our specimens but are not documented in the type specimen (Lundbeck 1905). We note that if *L. (E.) diversichela* truly lacks small acanthostyles its placement in subgenus *Ectyodoryx* is problematic given that the subgenus is distinguished by small acanthostyle presence. We also retain cf. for *L. (E.)* cf. *multiformis* because tornote measurements for the type specimen are not available for comparison (Brønsted 1932).

Lissodendoryx sp. 1 is very similar to *Lissodendoryx (Ectydoryx)* cf. *diversichela* and *L. (E.)* cf. *multiformis* in spicule complement and spicule measurements. All three have acanthostyles, three size classes of arcuate isochelae and sigmas in a broad size range. Despite these similarities the presence of tylotes instead of tornotes clearly distinguishes *Lissodendoryx* sp. 1. We did not find small acanthostyles in *Lissodendoryx* sp. 1, so it may belong to subgenus *Lissodendoryx,* not *Ectyodoryx.* However, because small acanathostyles are also often missing in *Ectyodoryx* we prefer to identify this species to the genus level only.

The remaining *Lissodendoryx* species in this report belong to the subgenus *Lissodendoryx.* Confirmation of species identification by spicule analysis is always recommended, however *Lissodendoryx (Lissodendoryx) complicata*, *L. (L.) stipitata* and sometimes *L. (L.) indistincta* can often be recognized by their distinct morphology. *L. (L.) complicata* is unique in being bush-like with anastomosing branches that separate and rejoin. *L. (L.) stipitata* is a small thin-stalked sponge with a soft brush-like main body. *L. (L.) indistincta* is lump-like and yellow, orange or brown with a dense finely grooved body that appears shiny out of water. Spicules differ considerably between the four species described here. *L. (L.) stipitata* is unique in lacking sigmas. *L. (L.) indistincta* has a class of modified chelae with reduced alae and toothy or dentate shafts. *L. (L.) complicata* differs from the other *Lissodendoryx* in this report in having tylotes in combination with smooth styles. It also has characteristic highly curved chelae. This leaves *L.*

(L.) lundbecki with a combination of characteristics not found in other taxa: one size of acanthostyles, tornotes with mucronate (sharply pointed) ends, two sizes of chelae and one size of sigmas. It is most similar to *L. (E.)* cf. *foliata* which has two sizes of acanthostyles and one size of chelae and differs in spicule measurements.

Spicule Key for Species of *Forcepia* and *Lissodendoryx*

(1) Contains forcep spicules…..…….....2 (*Forcepia)*
No forcep spicules……..….....9 *(Lissodendoryx)*
(2) Includes forceps longer than 200 µm…….....*Forcepia (Forcepia) forcipis*
All forceps shorter than 200 µm……..3
(3) Styles are smooth……4
Styles are spined (acanthose)……...7
(4) All forceps shorter than 30 µm in length.……5
Contains forceps that are larger than 30 µm……6
(5) Forcep spicules 10um or smaller…….*Forcepia (Forcepia)* aff. *japonica*
Forcep spicules 9-25um with toothy shafts…….…..*Forcepia (Forcepia) forcipula*
(6) Contains single forcep size class…….....*Forcepia (Forcepia) thielei*
Contains more than one forcep size class…….*Forcepia (Forcepia) fabricans*
(7) Contains tornotes in addition to tylotes……..*Forcepia* sp. 2
Contains tylotes but not tornotes…….…… ……...8
(8) Forceps 20 µm long or shorter……..……..……*Forcepia* sp. 1
Forceps 60 µm or longer with outward flared legs…..…*Forcepia (Leptolabis)* cf. *brunnea*
(9) Styles are smooth styles, alone or in combination with acanthostyles…….....10
Styles are acanthostyles only....……....12
10) Sigmas absent……*Lissodendoryx (Lissodendoryx) stipitata*
Sigmas present…….……...11
11) Contains tylotes…….....*Lissodendoryx (Lissodendoryx) complicata*
Contains tornotes; chelae have toothy shafts.… *Lissodendoryx (Lissodendoryx) indistincta*
12) One size class of chelae only…….*Lissodendoryx (Ectyodoryx)* cf. *foliata*
Two or three size classes of chelae……13
13) Only one size class of sigmas ~20-30 µm……*Lissodendoryx (Lissodendoryx) lundbecki*
Sigmas over a broad size range between 20 and 100 µm long……...14
14) Contains tylotes……...*Lissodendoryx* sp. 1
Contains tornotes……15
15) Large isochelae are strongly curved with short stubby teeth and alae……
Lissodendoryx (Ectyodoryx) cf. *diversichela*
Large isochelae not strongly curved……*Lissodendoryx (Ectodoryx)* cf. *multiformis*

Descriptions of *Forcepia*

ITIS TSN 659695 (subgenus)

***Forcepia (Forcepia) fabricans* (Schmidt, 1874)** WORMS AphiaID 168858

Species description

The sponge is beige to yellow or brown in colour, soft in consistency and shiny out of water, as a result of mucus on the surface. The specimens were irregular or lump-shaped and a dermal membrane, when present, gave the specimen a smooth appearance. Canals are visible in the surfaces not covered by membrane. The sponge surface was not noticeably porous, however short papillae (< 0.5 cm long) were visible on some specimens. These may be easily overlooked when the collapsed papillae adhere to the mucous covered surface (Figure 2). Eight specimens or fragments were examined and ranged in size from 2 to 5 cm long and 1 to 2.5 cm thick.

Habitat information

Hudson Strait, Davis Strait and north of Baffin Bay at 353-702 m depth (Figure 3).

Spicules (Table 1, Figure 4)

Megascleres: Smooth gently curved and gradually tapering styles 569-752 x 9-23 μm. Tylotes 322-445 x 8-15 μm with slightly unequal ends.

Microscleres: Arcuate isochelae 26-53 by 4-9 μm. Forceps in two size classes (I and II) with distinct spined knobs and legs covered with dense short spines that angle away from the knobs. Forceps I are 43-79 μm long with a 4-9 μm width at the top of the arch and even legs. Forceps II are 12-38 μm by 2-5 μm, typically with unequal leg lengths. Sigmas are 76-161 by 5-11 μm and planar or near planar.

Distinguishing characteristics

Among the species considered in this report the presence of short papillae is unique to *Forcepia (Forcepia) fabricans*, however these may not be present or visible in fragmented or mucous covered specimens. Spicule characteristics distinguishing this species include smooth styles, two size classes of spined forceps with terminal knobs, and large planar sigmas. Spicule measurements are needed to confirm identification. *Forcepia (Forcepia) topsenti* described from waters off Iceland by Lundbeck (1905) differs from *Forcepia (Forcepia) fabricans* only in the size of its large forceps (86-104 μm).

Taxonomic remarks

Forcepia fabricans was described originally by Schmidt (1874) as *Esperia fabricans* and later transferred to the genus *Forcepia.* Other early descriptions of *Forcepia fabricans* include Vosmaer (1885) as *Forcepina bulbosa,* Thiele (1903) as *Hamigera (Forcipina) fabricans* and then Lundbeck (1905) as *Forcepia fabricans.* Erroneously the text and figures in the original description (Schmidt 1874) do not match *Forcepia fabricans* and instead the spicule figures associated with the description show two anisochelae – spicules not present in the Family Coelosphaeridae. Thiele (1903) examined Schmidt's type specimen and confirmed that it is *Forcepia fabricans* but Thiele overlooked the small class of forceps in his description. Vosmaer also overlooks the small forceps. Lundbeck (1905) describes *Forcepia fabricans* as a massive or possibly erect sponge with papillae on its surface and with a thin surface membrane. The following spicule measurements were reported by Lundbeck and overlap in size with our *Forcepia (Forcepia) fabricans*: Styles 530-725 by 13-21 μm, tylotes 310-450 by 7-12 μm, arcuate isochelae 42-57 by 4-6 μmm, forceps 60-77 by 3 μm and 25-34 by 1 μm, sigmas 120-140 by 5-7 μm. The tylotes in our specimens are similar to those described by Lundbeck – specifically the tylote shaft is thicker on one end than the other and the tylote swelling on the thick end appears very slight resulting in that end of the tylote being more stryongyle like. The swelling on the thinner end is more pronounced. Lundbeck noted irregular thickenings on the tylote shafts, giving them a polytylote appearance. This was not noticeable in our specimens.

CO1 barcodes for specimens PA2010-9 Set 128 (BOLD Specimen ID PA2010009465) and and PA2013-8 Set 16 (BOLD Specimen ID PA2013008047) are included in Appendix A (A-B). Surprisingly the sequences are only 95% similar in a 620 nucleotide overlap. Collecting CO1 barcodes from additional specimens may be necessary to resolve whether these DNA differences reflect variability within a species or are indicative of different species.

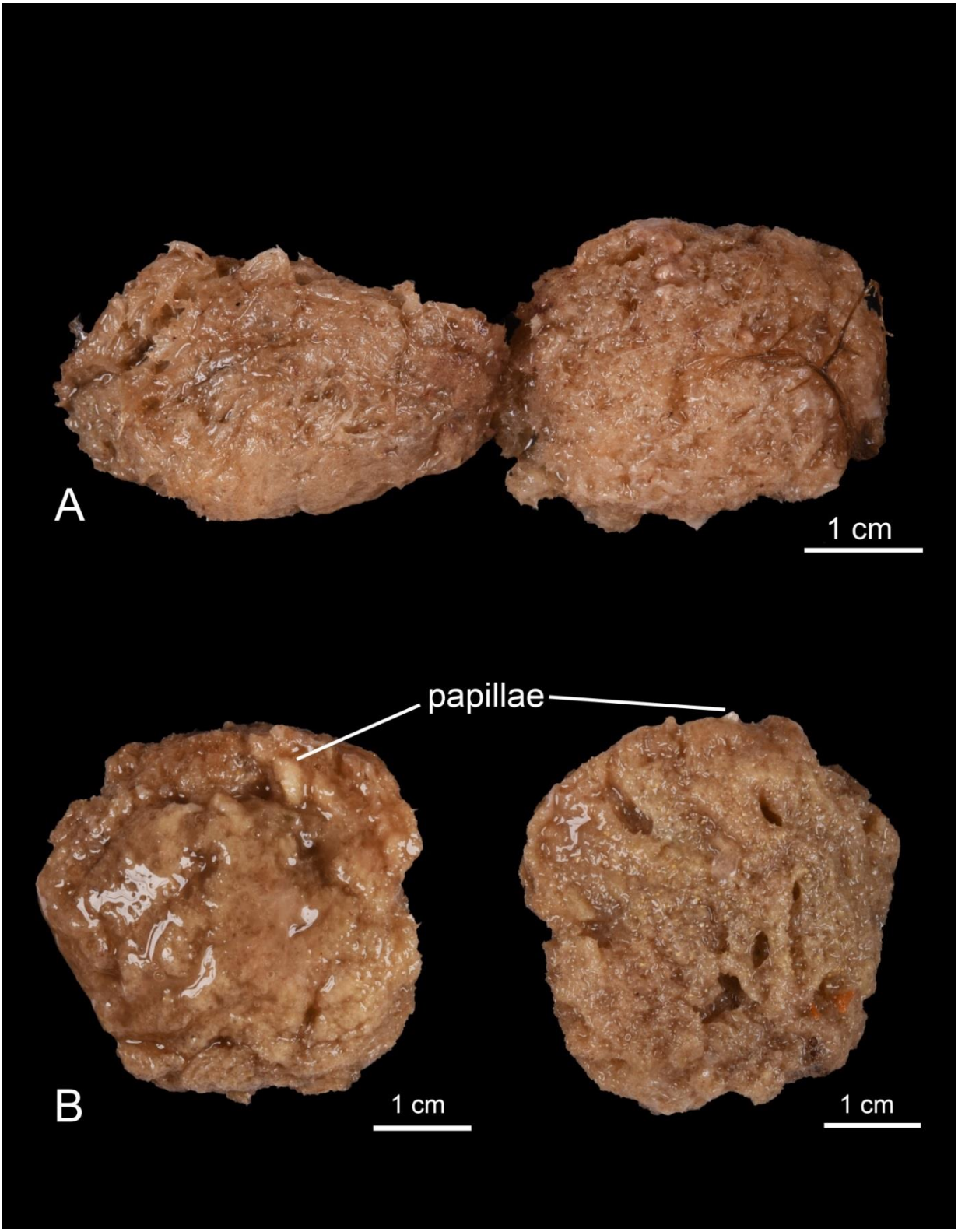

Figure 2. *Forcepia (Forcepia) fabricans* specimens PA2013-8 Set 16 (A) and PA2014-7 Set 147 (B) with both surfaces shown for B.

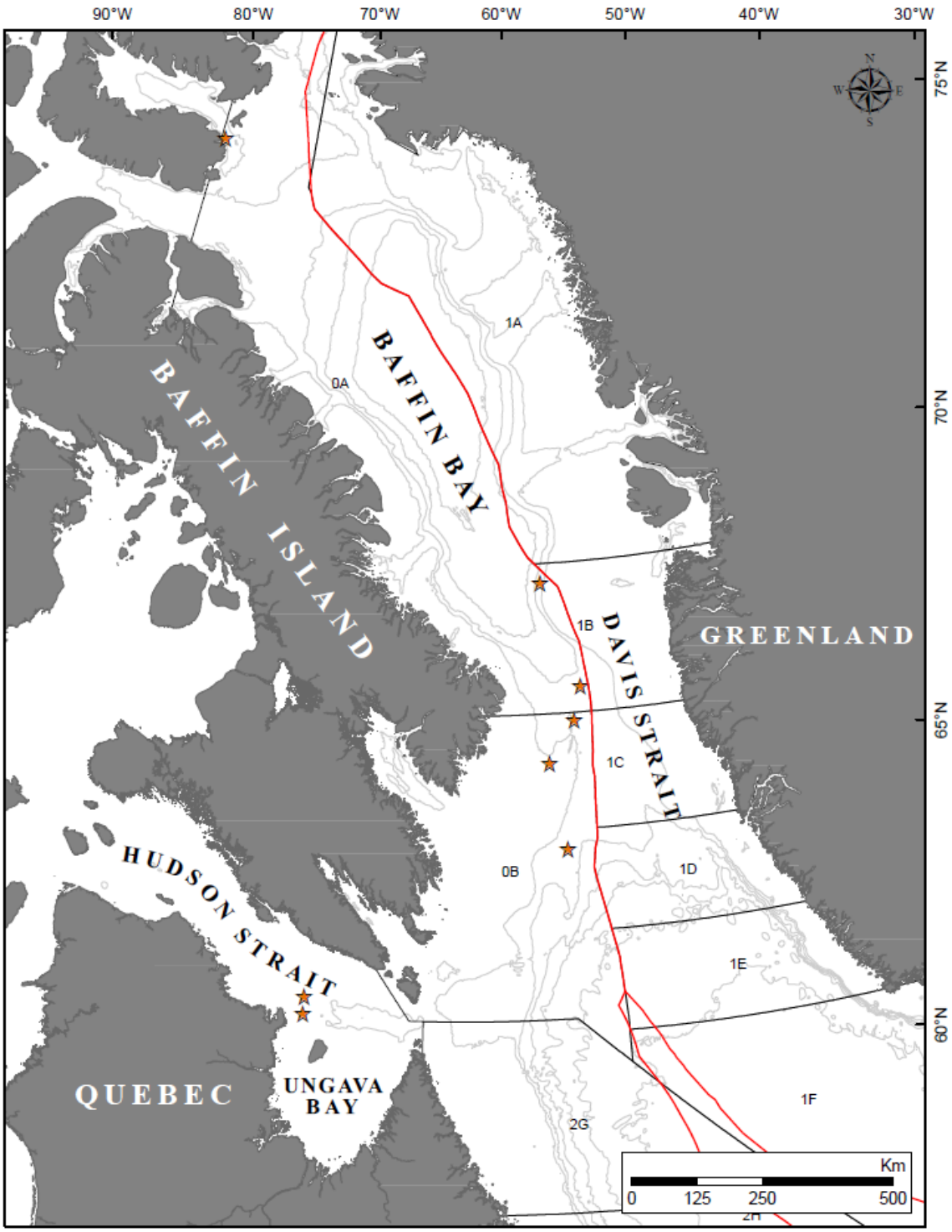

Figure 3. *Forcepia (Forcepia) fabricans* collection locations. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray.

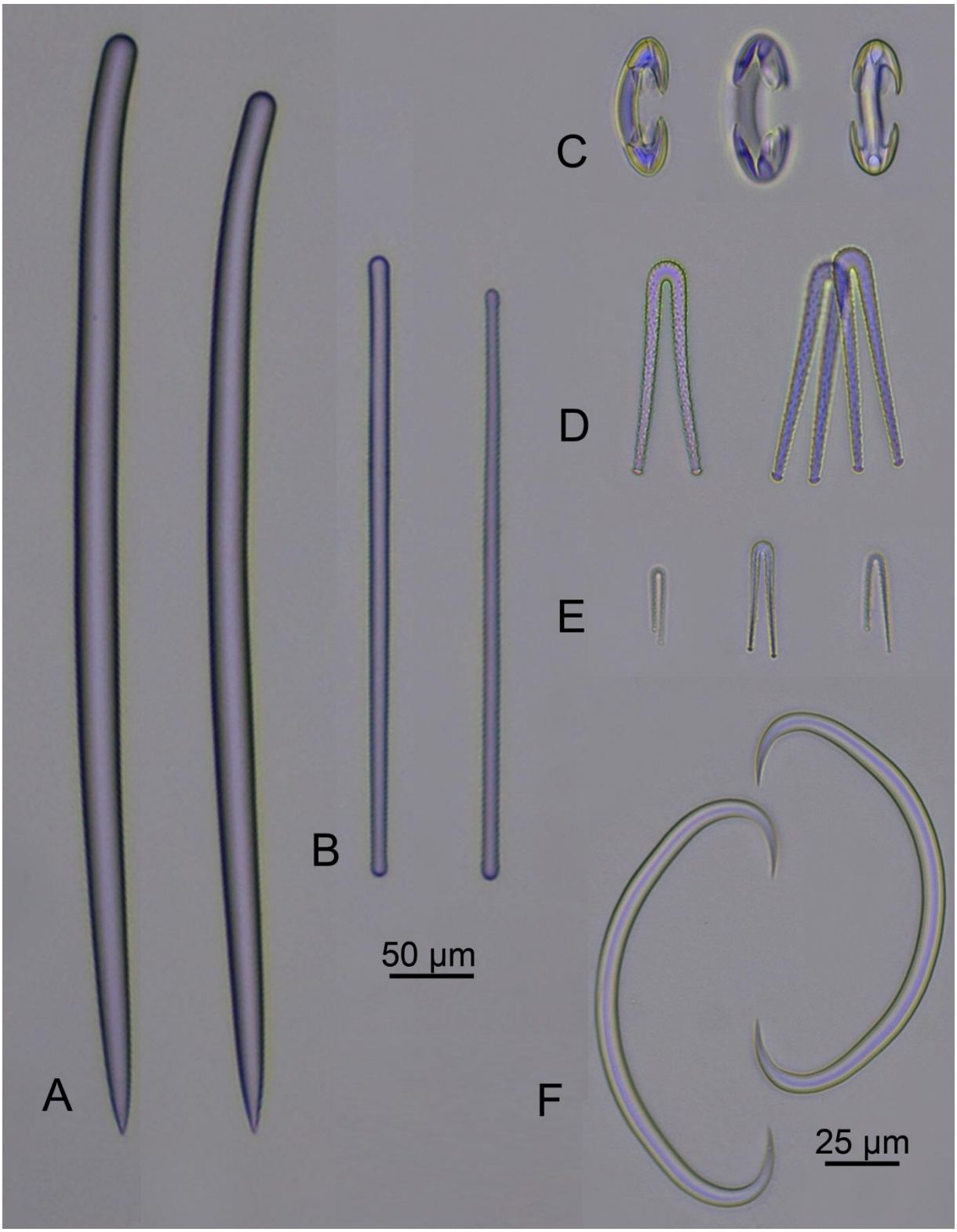

Figure 4. *Forcepia (Forcepia) fabricans* spicules from specimen PA2013-8 Set 16. Styles (A), Tylotes (B), Arcuate isochelae (C), Forceps I (D), Forceps II (E), Sigmas (F). A and B same scale. C-F same scale.

Table 1. Measurements of spicules from specimens of *Forcepia (Forcepia) fabricans* all reported as minimum-(average)-maximum for length (top line) x width (bottom line). N indicates the number of spicule measurements in each specimen.

Collection	n	Styles	Tylotes	Isochelae	Forceps I	Forceps II	Sigmas
PA2013-8 Set16	30	610.2-(680.2)-745.1 x 12.1-(17.7)-23.3	340.7-(380.0)-431.3 x 8.6-(11.7)-14.2	26.5-(42.0)-48.7 x 4.1-(6.2)-8.7	50.6-(69.0)-76.1 x 4.7-(6.4)-7.7	19.6-(25.0)-37.4 x 2.1-(2.9)-4.6	108.5-(126.7)-148.6 x 5.6-(7.5)-9.1
PA2014-7 Set 147	30	625.8-(695.9)-739.4 x 9.4-(15.8)-18.6	388.0-(417.1)-444.6 x 7.6-(10.8)-12.8	29.4-(35.6)-41.4 x 3.6-(4.7)-6.5	56.2-(64.4)-72.6 x 4.2-(6.4)-9.2	23.6-(31.0)-37.7 x 1.6-(2.0)-3.6	129.9-(148.4)-160.4 x 4.6-(6.0)-7.6
PA2010-9 Set 158	30	576.4-(627.3)-699.2 x 14.9-(19.4)-23.1	323.2-(351.6)-386.3 x 7.6-(10.6)-13.0 (n=15)	28.1-(38.4)-43.6 x 3.7-(5.6)-7.3	42.6-(63.1)-72.8 x 4.2-(5.4)-6.7	17.7-(23.7)-30.1 x 1.5-(2.3)-4.0	121.8-(139.3)-150.2 x 7.0-(9.1)-10.8
PA2010-9 Set 128	10	589.2-(648.9)-700.0 x 13.8-(18.5)-21.9	322.8-(357.9)-389.0 x 9.2-(10.7)-12.3	39.7-(46.0)-53.2 x 4.1-(5.0)-5.7	52.5-(65.2)-73.7 x 3.5-(4.3)-5.0	12.1-(19.6)-24.1 x 1.6-(1.8)-2.6	75.6-(121.8)-143.4 x 5.3-(7.0)-9.1
PA2011-7 Set 67	10	568.6-(602.8)-635.8 x 15.0-(18.9)-21.8	329.5-(352.8)-383.1 x 9.8-(12.3)-14.2	37.8-(44.8)-47.7 x 3.9-(5.2)-6.3	57.8-(66.1)-71.7 x 4.2-(5.5)-6.3	20.8-(22.3)-27.3 x 2.1-(2.4)-2.9	125.9-(135.8)-153.2 x 5.6-(6.3)-6.9
PA2011-7 Set 81	10	584.5-(658.4)-742.4 x 14.3-(16.8)-21.0	322.2-(359.7)-385.6 x 8.5-(11.1)-13.5	40.8-(48.1)-52.0 x 4.4-(5.1)-5.9	64.2-(70.9)-79.1 x 4.1-(4.8)-5.6	17.8-(23.2)-25.8 x 2.1-(2.3)-2.5 (n=5)	136.6-(149.6)-161.4 x 7.0-(8.0)-9.6
PA2012-7 Set 31	10	671.1-(711.1)-752.4 x 14.3-(18.7)-22.3	360.0-(380.0)-402.6 x 9.5-(12.5)-15.4	45.1-(47.2)-52.0 x 5.6-(6.5)-7.9	57.0-(62.6)-68.0 x 4.7-(5.8)-6.6	20.6-(22.7)-26.4 x 2.1-(2.5)-3.0	125.8-(139.2)-145.0 x 5.5-(7.8)-9.3

ITIS TSN 203935

Forcepia (Forcepia) forcipis (Bowerbank, 1866)

WORMS AphiaID 168859

Species description

The sponge is massive or thick lamellate lobose, white to beige or pink in color and slightly compressible with a crumbly consistency. When intact, opposite surfaces are distinct. Side 1 (Figure 5 top) is punctate with holes < 0.5 to 3 mm dispersed over the surface. A reticulate spicule mesh (broken or missing in parts) overlays the holes. The edge is irregular and can be finely grooved. Side 2 has large grooves and smooth texture and holes, < 0.5 to 6 mm diameter, are clustered in or around grooves (Figure 5 bottom). Five specimens 4 to 15 cm long and 0.5-3 cm thick were examined.

Habitat information

Southwest of Davis Strait near Hudson Strait at 481-1232 m depth (Figure 6).

Spicules (Table 2, Figure 7)

Megascleres: Smooth curved or sinuous styles 583-818 by 14-26 μm that are relatively even throughout their length with short tornote-like points. Tylotes 247-370 by 4-7 μm with equal or slightly unequal ends. Characteristic long hairpin shaped and spined forceps (Forceps I) with one arm slightly longer than the other 307-466 by 8-13 μm.

Microscleres: Arcuate isochelae in two size categories: 35-65 by 3-9 μm (I) and 18-26 by 2-3 μm (II). Small forceps (II) 12-46 by 2-3 μm and typically with one arm two to four times as long as the other. Spines are faintly visible on high magnification (600x). Since these forceps are very fine we cannot rule out the possibility that broken small forceps were included in measurements.

Distinguishing characteristics

This species is distinguished by its long (up to 500 μm) hairpin forcep spicules, and by the absence of sigmas. Bowerbank drew sigmas in his original figures (Bowerbank 1874), but these have since been shown to be developmental forms of chelae (Lundbeck 1905).

Taxonomic remarks

Bowerbank (1866) describes a massive sponge with small dispersed pores and a spicule complement including styles, tylotes, two size classes of isochelae and characteristic long spined forceps. The small forceps (our Forceps II) were overlooked by Bowerbank (1866) but later described by Carter (1874) and Lundbeck (1905). Bowerbank originally described chelae with two or three alae, however they in fact have three (Lundbeck 1905). For comparison, Lundbeck's measurements are listed: styles 488-620 by 12.8-21 µm, tylotes 238-309 by 4-5.7 µm, arcuate isochelae 43-67 by 4-7 µm and 21-28 by 1.4-2.1 µm, and forceps 440-520 by 28-36 µm. Our measurements partially overlap these.

The CO1 barcode for our specimen PA2013-8 Set 56 is included in Appendix A (C). Currently there are no *F. (F.) forcipis* barcodes in GenBank for comparison.

Figure 5. *Forcepia (Forcepia) forcipis* specimen PA2013-8 Set 56 showing opposite surfaces.

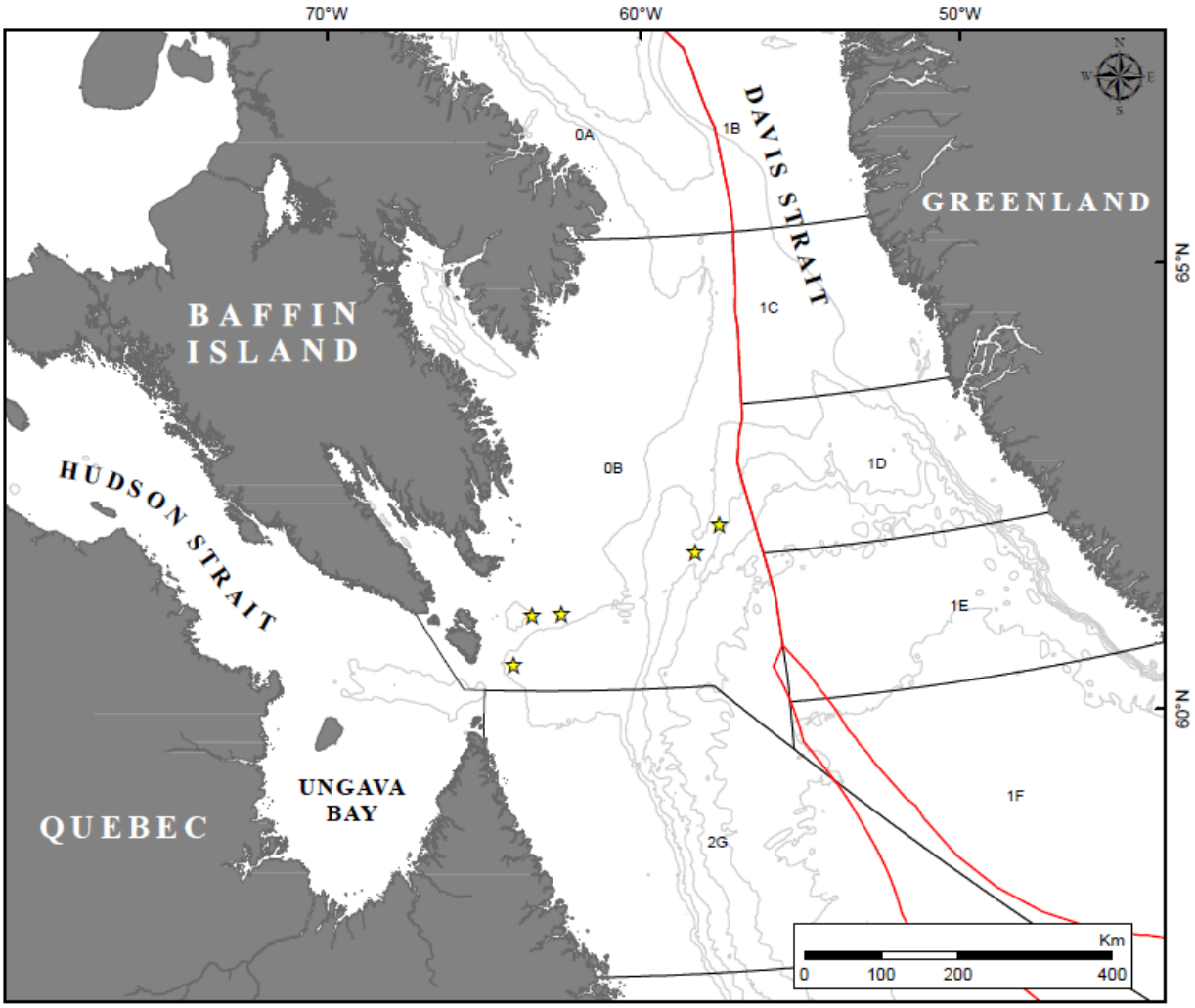

Figure 6. *Forcepia (Forcepia) forcipis* collection locations. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray.

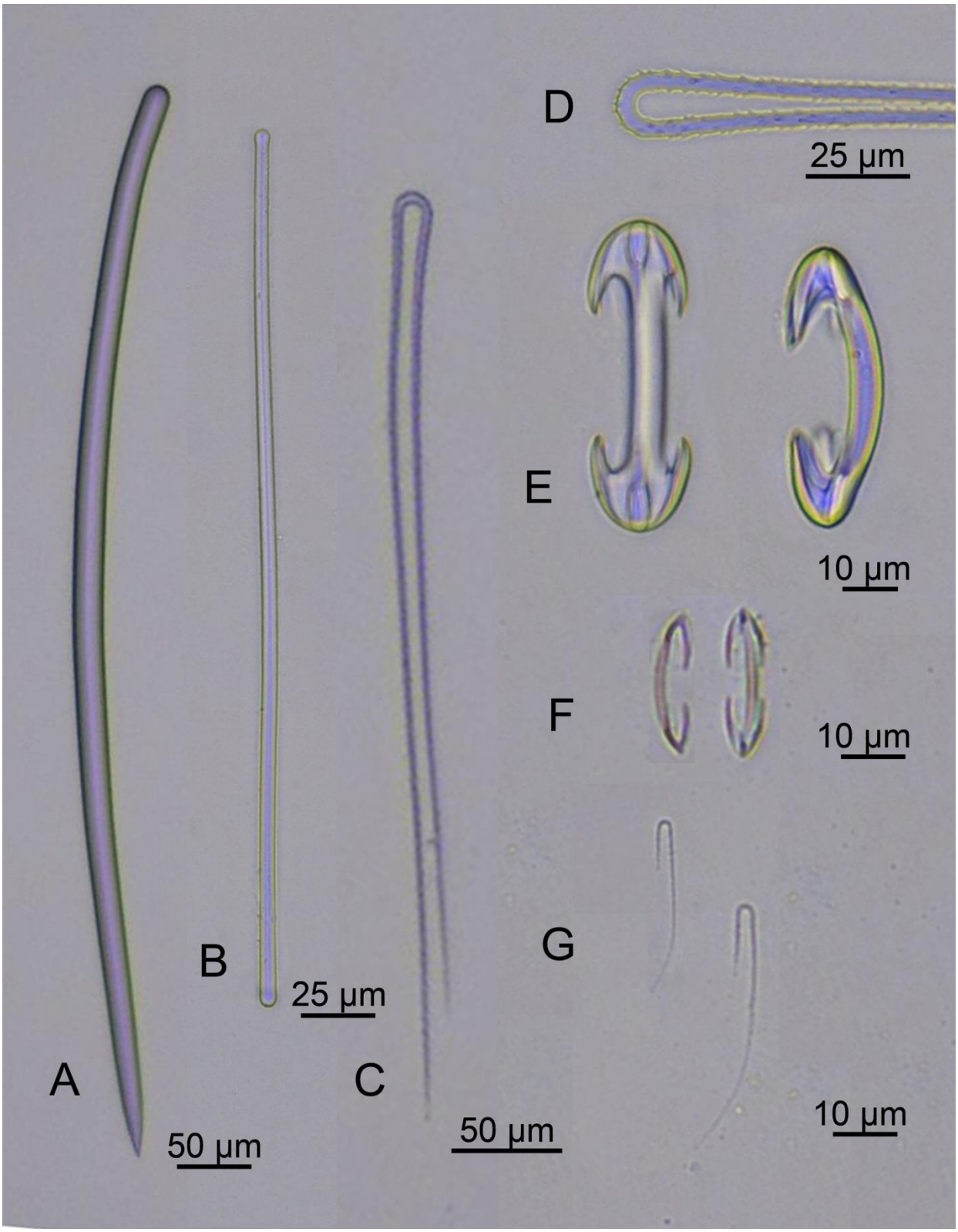

Figure 7. *Forcepia (Forcepia) forcipis* spicules. Style (A), Tylote (B), Forcep I (C), Forcep I Spine detail (D), Arcuate isochelae I (E), Arcuate isochelae II (F), Forceps II (G).

Table 2. Measurements of spicules from specimens of *Forcepia (Forcepia) forcipis*, all reported as minimum-(average)-maximum for length (top line) x width (bottom line). N indicates the number of spicule measurements per specimen.

Collection	n	Styles	Tylotes	Forceps I	Forceps II	Isochelae I	Isochelae II
PA2013-8 Set 56	30	621.2-(700.6)-753.2 x 14.4-(18.6)-26.0	247.1-(290.6)-349.4 x 3.7-(6.0)-7.3 (n=18)	331.0-(415.3)-454.7 x 8.4-(9.9)-11.8	12.3-(24.4)-47.1 x 2.1-(2.3)-2.8 (n=28)	35.4-(54.5)-63.4 x 3.0-(6.4)-8.6	18.4-(21.8)-26.1 x 2.1-(2.6)-3.2
PA2011-7 Set 36	10	670.4-(704.5)-755.9 x 17.8-(22.0)-24.9	306.8-(330.4)-366.1 x 4.5-(5.8)-7.2	375.5-(415.8)-466.2 x 9.5-(10.2)-11.2	25.8-(28.1)-31.3 x 2.1-(2.4)-2.7	41.1-(46.6)-54.5 x 4.1-(5.2)-6.2	18.2-(21.6)-25.1 x 2.1-(2.3)-2.7
PA2011-7 Set 38	10	675.5-(706.2)-745.8 x 16.5-(19.0)-23.5	309.0-(343.2)-370.2 x 5.0-(5.7)-6.4	384.9-(417.6)-439.8 x 9.5-(10.1)-11.2	22.6-(27.0)-32.3 x 2.1-(2.5)-2.7	43.7-(55.4)-64.8 x 5.1-(6.4)-8.0	21.2-(23.0)-26.0 x 2.4-(2.7)-3.2
PA2014-7 Set 117	10	636.8-(735.3)-818.0 x 13.8-(18.0)-22.3	277.3-(316.0)-363.0 x 4.5-(5.7)-6.9	330.3-(367.6)-387.2 x 8.4-(9.8)-12.1	19.3-(27.4)-33.1 x 2.1-(2.4)-2.8	36.9-(45.1)-52.2 x 3.5-(5.1)-6.5	17.9-(21.1)-22.8 x 2.1-(2.5)-3.2
PA2013-8 Set 149	10	583.2-(679.0)-785.8 x 17.5-(19.8)-22.8	307.6-(329.0)-366.7 x 4.6-(5.3)-5.9 (n=3)	307.1-(332.5)-359.3 x 8.5-(10.1)-12.8	19.3-(27.3)-37.2 x 2.1-(2.5)-3.0	45.5-(50.4)-53.9 x 4.6-(5.2)-5.8	17.6-(21.1)-24.6 x 2.1-(2.6)-3.3

ITIS TSN 659695 (subgenus)

Forcepia (Forcepia) forcipula **(Lundbeck, 1905)** WORMS AphiaID: 168860

Species description

Sponge is light beige to yellow to brown in colour, with a compressible consistency. The sponges are irregular and lump-shaped, and often found in fragments. This sponge can sometimes be recognized by the appearance of its dermal membrane which is thin and slightly elastic and shiny out of water. The dermal membrane is loosely connected to the underlying tissue, giving the surface an uneven and almost conulose appearance. The dermal membrane is marked by characteristic, clearly defined circular pores that are < 1 to 2 mm in diameter (Figure 8). Eight of 46 specimens were examined, ranging from 3 to 15 cm long and 1 to 5 cm thick.

Habitat information

Hudson Strait, Ungava Bay, Davis Strait and Baffin Bay at 184-930 m depth (Figure 9).

Spicules (Table 3, Figure 10)

Megascleres: Styles are 464-641 by 9-17 µm and are slightly curved (often irregularly so) to nearly straight. They taper very close to the tip and are therefore short-pointed – however the tips where graded from sharply pointed to rounded – with many appearing closer to strongyles than to styles. The style shaft is often slightly narrower behind the tip, but not enough for the spicule to be considered a subtylostyle.

Microscleres: Arcuate isochelae (Isochelae I) are 28-50 by 3-8 µm. Palmate chelae (Isochelae II) are 13-22 by 1-3 µm. Forceps are 9-21 by 1-3 µm. The forceps are finely-toothed and roundly curved. The legs are even or nearly so, and each leg ends in a terminal knob. Sigmas are 28-82 by 3-6 µm. They range in size, and often one of their terminal ends will appear twisted out of the plane in which the rest of the spicule is found.

Distinguishing characteristics

This sponge is distinguished from other *Forcepia* species in our collections primarily by its small, toothed forceps (visible at 400 x) and the shape of its styles.

Taxonomic Remarks

The external morphology of our specimens matches the descriptions given by Lundbeck (1905) for *Esperiopsis forcipula*, although Lundbeck described the consistency of his specimens as firm, rather than compressible. Lundbeck (1905) recorded styles 540-680 by 10-14 µm, arcuate isochelae 38-50 by 4 µm, palmate isochelae 11-18 by 7 µm, sigmas 30-85 by 2-6 µm, and forceps 17 by 1 um. Koltun's (1959) measurements were comparable to Lundbeck's, with values

for the styles of (500-704 by 10-14 μm). Our measurements partially overlap both Lundbeck's and Koltun's.

The morphology of the styles is somewhat atypical given their reduced or rounded points. As mentioned in the Systema Porifera (Hofmann and Van Soest 2002), tylototornotes up to 470 μm were overlooked in Lundbeck's descriptions but found in *Forcepia forcipula* slides from Lundbeck's collections. Lundbeck describes styles that have long points (likely typical styles) and more commonly short points (possibly tylotornotes); he therefore likely considered tylototornotes to be modified styles. For simplicity we are also considering these megascleres with rounded ends to be styles but note that they are atypical.

CO1 DNA barcode sequences were obtained for specimens PA2011-7 Set 45 (BOLD Specimen ID PA2011007135) and PA2011-7 Set 69 (BOLD Specimen ID PA2011007163) and are presented in Appendix A (D-E).

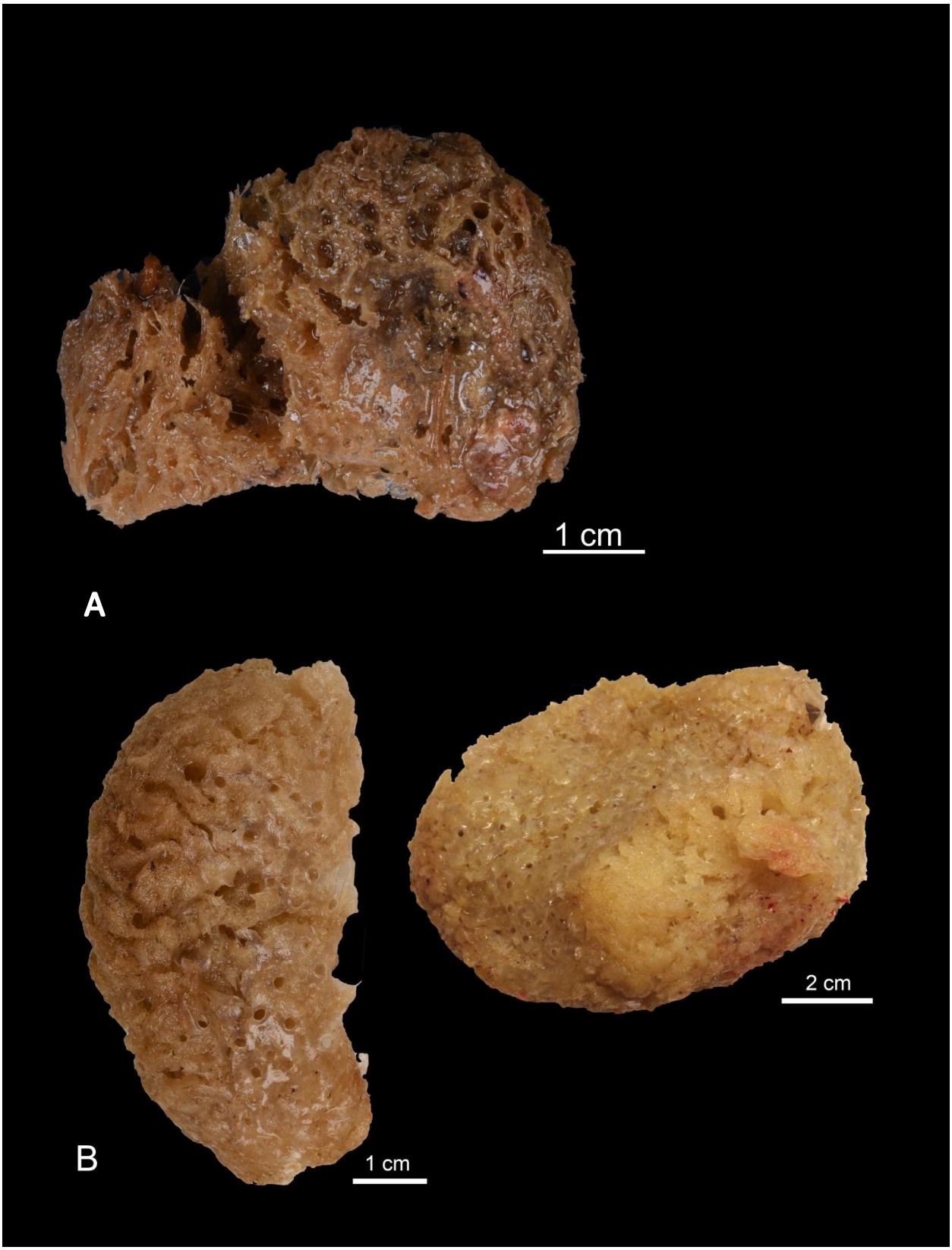

Figure 8. *Forcepia (Forcepia) forcipula* specimens PA2011-7 Set 45 (A) and PA2013-8 Set 55 (B). Note that spicule measurements for specimen PA2013-8 Set 55 are not reported here.

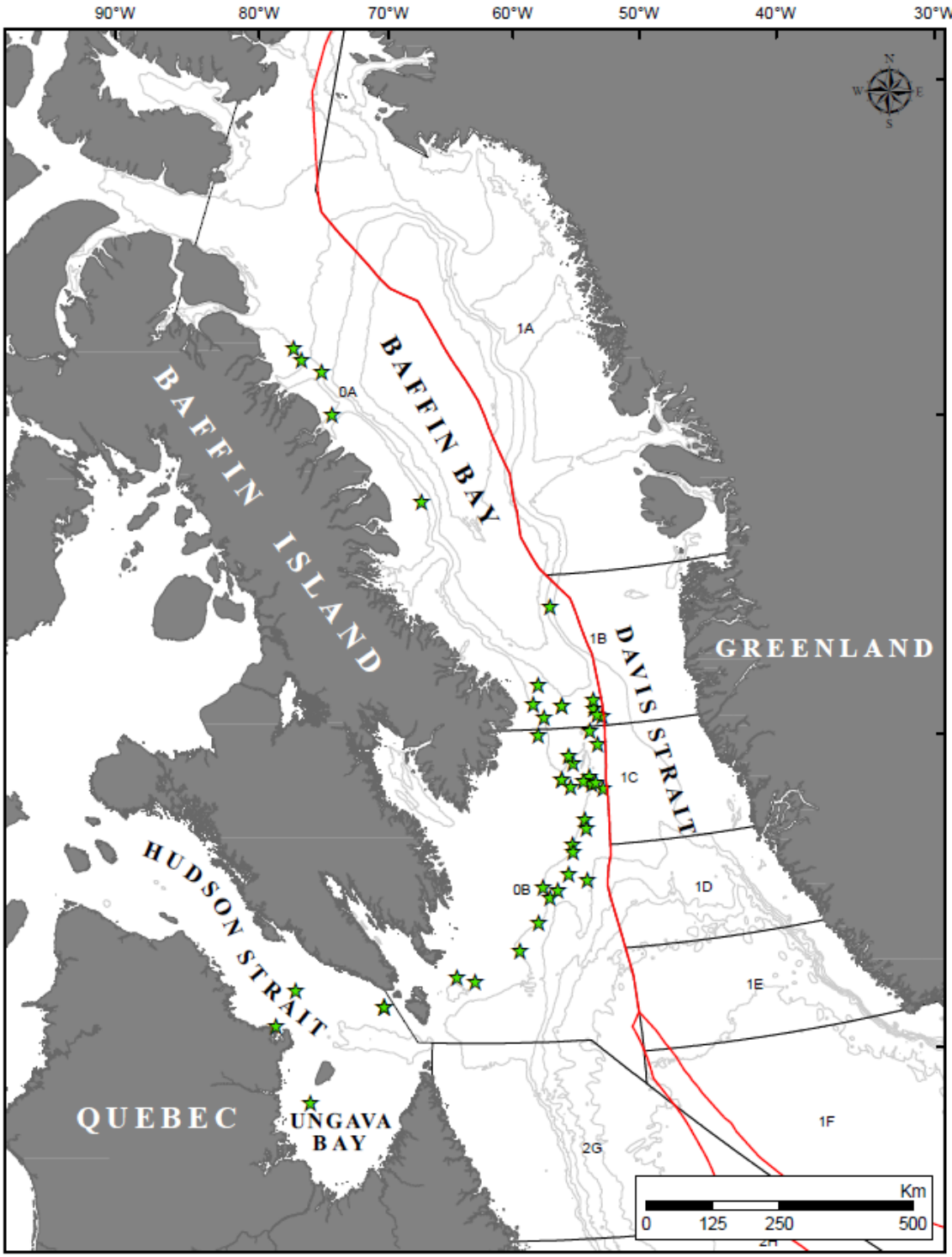

Figure 9. *Forcepia (Forcepia) forcipula* collection locations. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray.

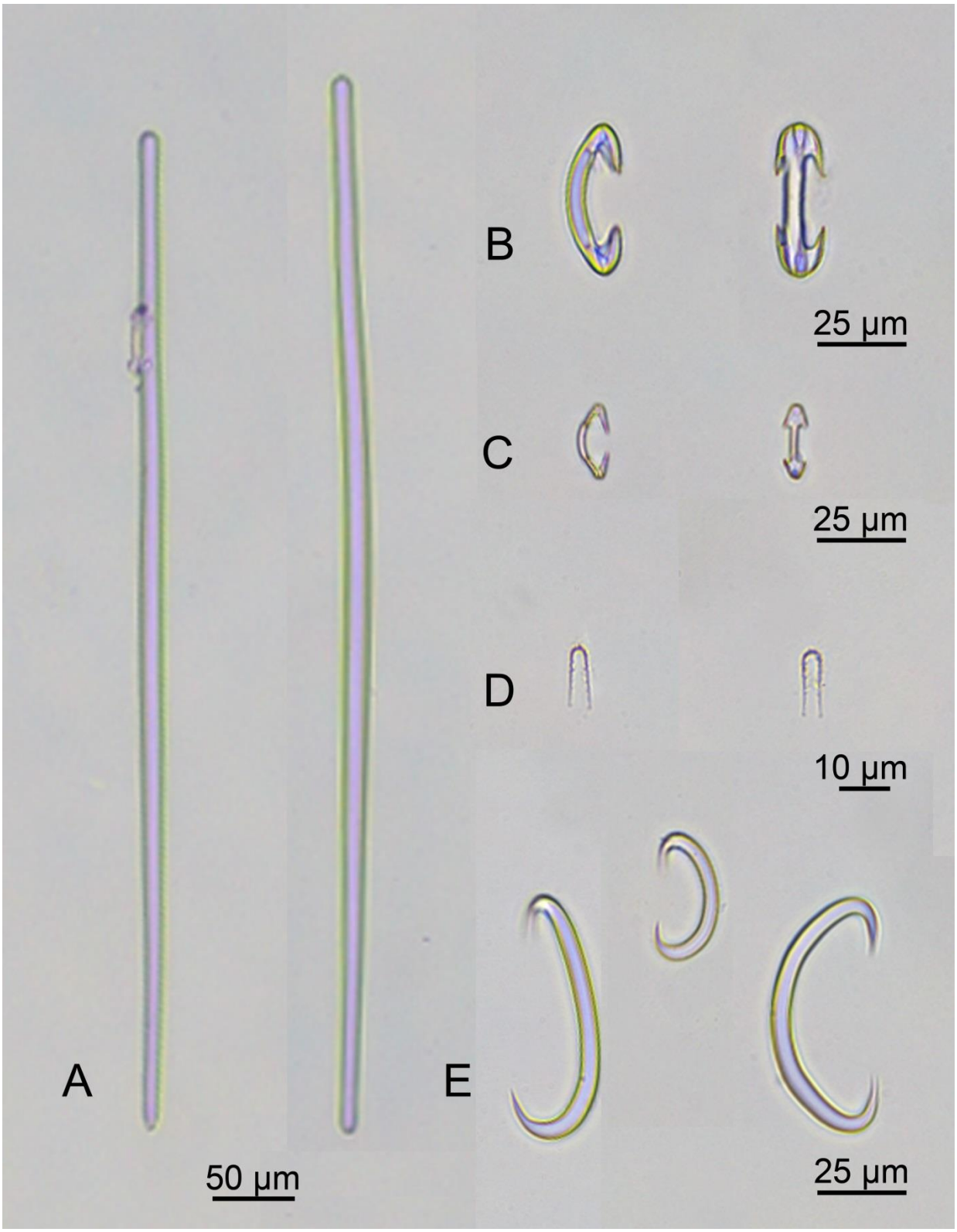

Figure 10. *Forcepia (Forcepia) forcipula* spicules from specimen PA2011-7 Set 69. Styles (A), Arcuate isochelae I (B), Arcuate isochelae II (C), Forceps (D), Sigmas (E).

Table 3. Measurements of spicules from specimens of *Forcepia (Forcepia) forcipula*, all reported as minimum-(average)-maximum for length (top line) x width (bottom line).

Collection	n	Styles	Isochelae I	Isochelae II	Forceps	Sigmas
PA2011-7 Set 45	30	464.2-(531.2)-590.9 x 9.4-(12.5)-15.9	28.4-(39.2)-44.1 x 3.7-(4.6)-6.3	12.9-(18.7)-22.3 x 1.4-(2.0)-2.8	9.4-(14.7)-18.5 x 1.4-(1.7)-2.4	33.6-(43.2)-62.0 x 2.9-(3.9)-5.2
PA2011-7 Set 69	30	544.3-(593.0)-641.1 x 9.7-(12.2)-14.3	29.0-(41.3)-49.5 x 3.9-(5.2)-6.7	16.9-(19.5)-22.0 x 1.6-(2.3)-2.8	12.3-(16.0)-19.2 x 1.4-(1.8)-2.5	27.6-(48.7)-74.7 x 2.5-(4.2)-6.4
PA2010-9 Set20	10	495.0-(528.9)-553.4 x 11.9-(14.4)-16.6	27.8-(36.4)-44.4 x 3.4-(5.8)-6.8	18.1-(19.5)-21.2 x 1.7-(2.0)-2.3	14.2-(14.8)-16.2 x 1.4-(1.9)-2.5	38.5-(45.0)-55.9 x 2.6-(4.0)-5.2
PA2012-7 Set 201	10	533.9-(579.0)-608.0 x 10.8-(12.0)-13.3	37.6-(41.9)-48.6 x 4.8-(6.4)-8.4	15.3-(18.3)-21.6 x 2.0-(2.2)-2.4	12.4-(15.2)-18.2 x 1.4-(1.7)-2.0	31.7-(44.2)-63.9 x 3.1-(4.2)-5.1
PA2010-9 Set 155	10	536.8-(569.0)-616.2 x 10.8-(13.4)-15.5	38.2-(41.1)-47.1 x 4.0-(5.0)-6.8	16.6-(18.4)-20.7 x 1.7-(2.0)-2.4	12.9-(15.7)-17.5 x 1.5-(1.8)-2.0	32.4-(43.2)-68.5 x 2.6-(4.1)-5.9
PA2011-7 Set136	10	524.1-(582.4)-627.2 x 10.5-(12.3)-13.7	42.5-(44.8)-47.7 x 4.6-(5.4)-6.4	16.6-(18.4)-20.0 x 1.6-(2.0)-2.4	11.3-(12.9)-16.3 x 1.2-(1.6)-1.9	33.4-(60.8)-77.0 x 3.3-(4.6)-5.9
PA2014-7 Set 80	10	539.0-(583.3)-625.2 x 12.1-(13.3)-17.0	41.8-(44.5)-48.0 x 3.9-(4.8)-5.6	16.6-(18.6)-21.0 x 1.7-(2.0)-2.6	11.3-(15.3)-17.3 x 1.5-(1.6)-1.8	29.5-(45.8)-82.1 x 2.8-(4.0)-5.6
PA2011-7 Set 86	30	494.1-(552.9)-609.1 x 10.2-(12.7)-15.2	32.1-(37.0)-43.1 x 3.4-(4.2)-5.2	16.6-(19.3)-22.3 x 1.4-(2.0)-2.5	10.5-(16.2)-20.6 x 1.4-(1.6)-2.1	31.1-(41.6)-65.1 x 2.6-(3.6)-4.8

ITIS TSN 659695 (subgenus)

Forcepia (Forcepia)* aff. *japonica WORMS AphiaID 168851 (subgenus)

Species description

Sponge is beige to brown with a soft slightly compressible consistency and partially covered in a thin and slightly convoluted surface membrane. Disperse holes or canals are visible in areas where the surface membrane is missing. Foreign material including dead pieces of coral and foraminiferans may be incorporated into the surface of the specimen (Figure 11). Three specimens were examined ranging from 1.5 to 8 cm in length and 0.5 to 3 cm thick.

Habitat information

Davis Strait and southwest of Davis Strait at 528-759 m depth (Figure 12).

Spicules (Table 4, Figure 13)

Megascleres: Styles 483-824 by 10-19 μm, gently curved with a smooth surface and gradually tapering to a defined point. Tylotes 375-592 by 10-19 μm, slightly inequiended and sometimes more tornote or strongyle like with curved terminals but with poorly defined or no terminal swellings.

Microscleres: Arcuate isochelae in two size categories, 25-39 by 3-6 μm (Isochelae I) and 16-26 by 2-3 μm (Isochelae II), however there may be a continuum in sizes. Forceps very small (5-8 μm) and U-shaped with even legs. Only visible at high magnification (400 x or higher). Contorted (C or S shaped) sigmas in two size classes: 100-165 by 7-15 μm (Sigmas I) and 59-97 by 5-8 μm (Sigmas II).

Distinguishing characteristics

This species is distinguished from other *Forcepia* species by its very small forceps (< 10 μm) visible only at 400 x magnification or higher.

Taxonomic remarks

Forcepia japonica was originally described by Koltun (1959) and has a spicule complement that matches our *Forcepia (Forcepia)* aff. *japonica* in shape; however spicule measurements differ considerably. Both have tylotes and smooth gently curved styles for megascleres; microscleres are arcuate isochelae, sigmas and small forceps. Koltun measured the following: styles 270-353 by 14-19 μm, tylotes 249-312 by 8-10 μm, chelae 21-25 μm, sigmas 33-54 μm and forceps 7-10 μm. *Forcepia (Forcepia)* aff. *japonica* has larger megascleres. For microscleres *F. (F.)* aff. *japonica* has two size classes of sigmas instead of one – with both classes larger than *F. japonica*. Chelae in *F. japonica* match our small size class but are smaller than our large class. Forceps are markedly small and equal in length. Based on spicule size differences and also the different collection locations (off Japan coast for *Forcepia japonica*) we do not believe that *F. japonica* and *F. (F.)* aff. *japonica* are the same species. The latter is a provisional name pending further comparisons with other described species within the same subgenus.

A CO1 barcode for specimen PA2011-7 Set 139 (BOLD Specimen ID PA2011007639) is included in Appendix A (F).

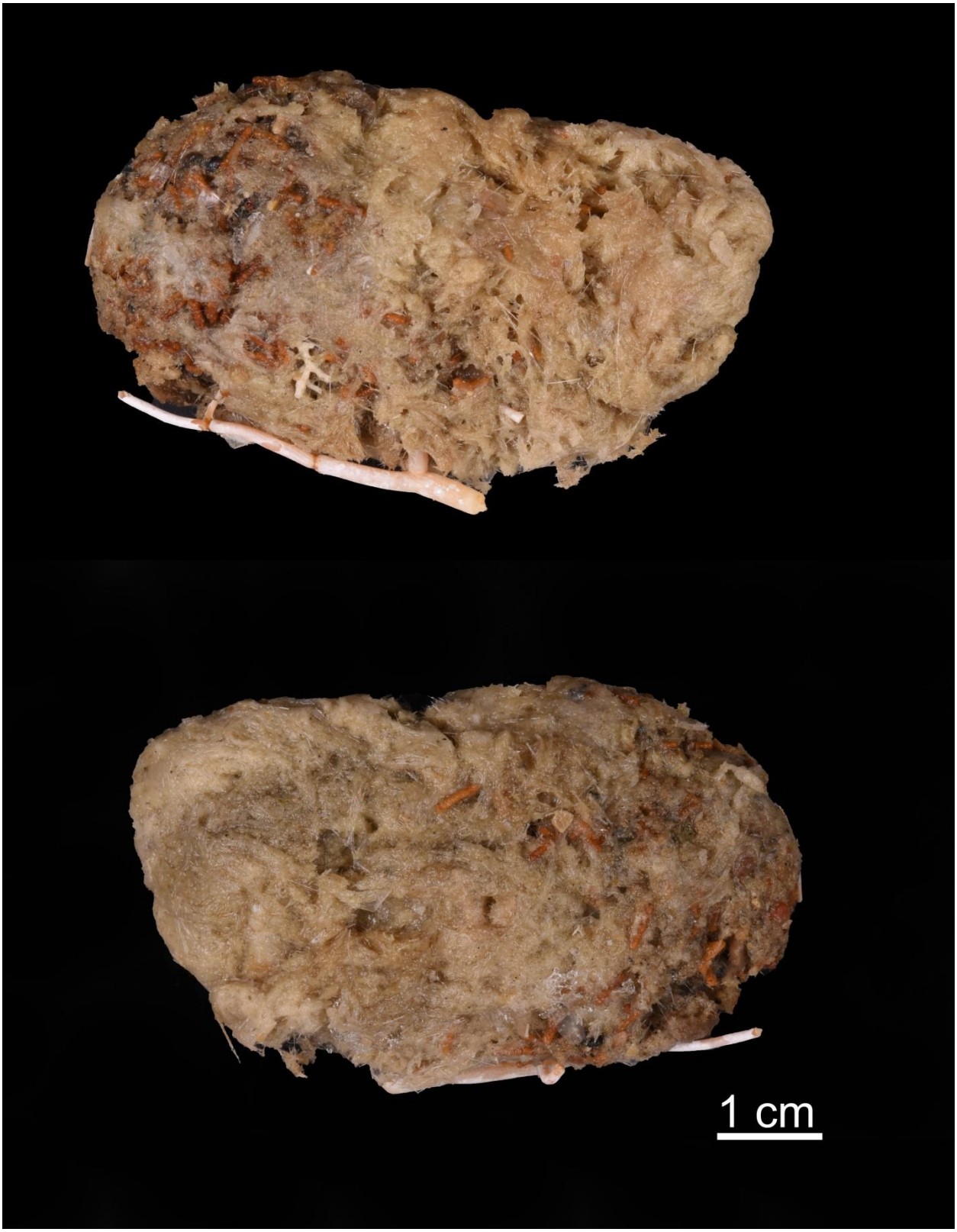

Figure 11. *Forcepia (Forcepia)* aff. *japonica* specimen PA2011-7 Set 139 showing opposite sides.

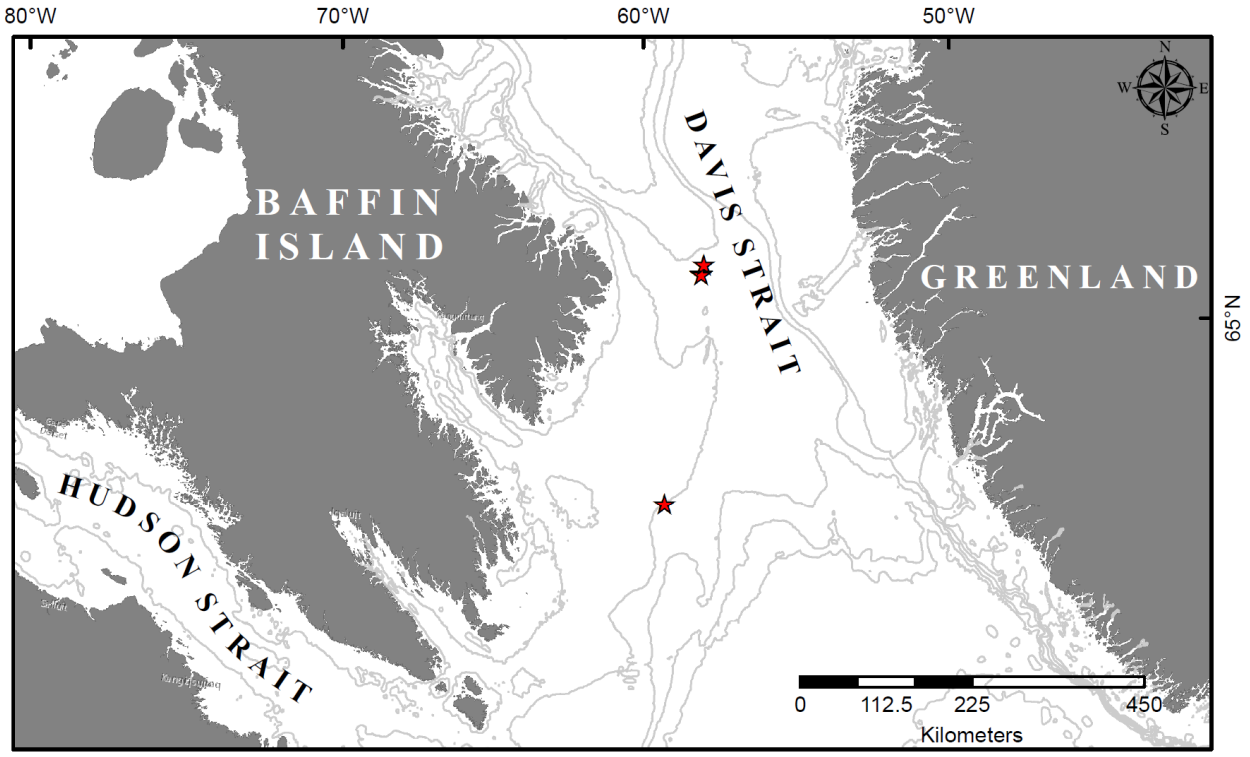

Figure 12. *Forcepia (Forcepia)* aff. *japonica* collection locations.

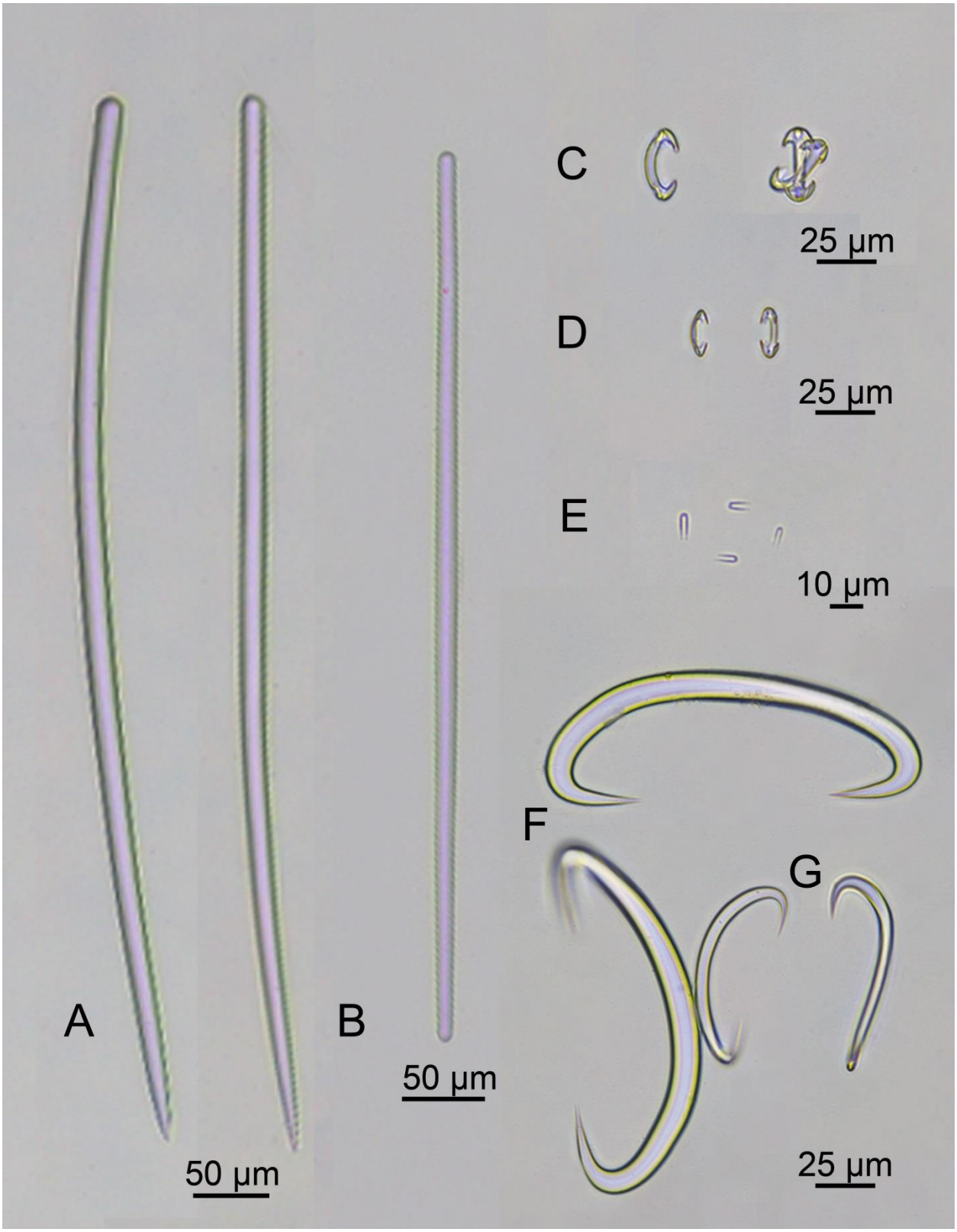

Figure 13. *Forcepia (Forcepia)* aff. *japonica* spicules: Styles (A), Tylote (B), Isochelae I (C), Isochelae II (D), Forceps (E), and Sigmas I (F) and Sigmas II (G).

Table 4. *Forcepia (Forcepia)* aff. *japonica* spicule measurements, all reported as minimum-average)-maximum for length (top line) x width (bottom line) in micrometers (µm).

Collection	n	Styles	Tylotes	Isochelae I	Isochelae II	Forceps	Sigmas I	Sigmas II
PA2011-7 Set139	30	599.4-(697.1)-824.1 x 11.5-(14.8)-18.9	429.9-(525.6)-592.0 x 10.5-(14.1)-18.8	27.4-(30.7)-35.7 x 3.5-(4.4)-5.5	16.3-(19.4)-26.0 x 1.9-(2.7)-3.4	4.8-(6.1)-7.6 x 1.0-(1.2)-1.4	118.4-(148.9)-165.2 x 7.0-(11.9)-15.3	63.8-(79.8)-97.3 x 4.6-(6.0)-8.2
PA2010-9 Set160	10	490.8-(524.8)-570.3 x 9.7-(12.5)-15.5	400.4-(437.9)-467.1 x 10.3-(12.0)-13.9	26.8-(33.1)-39.1 x 3.0-(4.1)-5.4	17.1-(20.1)-24.0 x 2.0-(2.6)-3.1	4.9-(6.2)-7.4 x 1.0-(1.2)-1.6	99.8-(107.8)-115.2 x 8.7-(9.7)-10.5	64.6-(73.7)-85.6 x 4.8-(6.0)-7.9
PA2010-9 Set 159	10	483.4-(514.3)-542.2 x 9.7-(12.2)-13.9	375.4-(414.8)-445.6 x 10.8-(13.2)-17.3	24.6-(33.0)-36.5 x 3.2-(4.9)-6.5	20.1-(21.8)-23.1 x 2.4-(2.9)-3.2	4.8-(6.0)-7.1 x 1.1-(1.3)-1.5	101.6-(107.9)-113.8 x 8.4-(9.6)-10.7	58.9-(71.1)-79.0 x 5.9-(6.3)-6.8

ITIS TSN 659695 (subgenus)

***Forcepia (Forcepia) thielei* (Lundbeck, 1905)** WORMS AphiaID 168877

Species description

Sponge is beige to brown, soft, dense and slightly compressible. The specimens were irregular in shape – presumably pieces of erect lamellate (fan shaped) sponges. The surface is smooth, sometimes with a thin membrane partially intact, but punctate with disperse holes ranging from < 0.5 to 3 mm. As in Lundbeck's original description, one side is more grooved with larger visible holes and channels (Figure 14). Six of ten specimens were examined, ranging from 3 to 12 cm in length and with an even thickness of 0.5 to 2 cm.

Habitat information

Southwest of Davis Strait at 481-1429 m depth (Figure 15).

Spicules (Table 5, Figure 16)

Megascleres: Styles 563-796 by 12-20 µm are straight, curved or sinuous with a smooth surface and even thickness along most of the length. The point is relatively short. Tylotes are 330-473 by 5-9 µm, with a straight shaft and pronounced and near-equal swollen ends.

Microscleres: Arcuate isochelae are 17-35 by 2-5 µm. Forceps are 32-60 by 2-4 µm and acanthose with terminal knobs and a characteristic shape. As described by Lundbeck (1905) one leg is noticeably longer. Near the forcep curve the two legs diverge. The shorter leg ends bending outward. The longer leg continues to turn outward but then angles back in, forming an even curve. Variations in which the legs are even in length or crossed over each other are also seen. Sigmas are 111-168 by 5-8 µm and planar or nearly planar.

Distinguishing characteristics

This species is distinguished from other *Forcepia* species in our collections by its characteristic forcep shape and by having a single size class for each of the microscleres. The planar sigmas are also noticeably large.

Taxonomic remarks

Our specimens match those in Lundbeck's original description, both in morphology, including having two distinct surfaces with one more grooved and uneven, and in spicule measurements and composition. Lundbeck (1905) reported styles 570-720 µm, tylotes 340-400 µm, arcuate isochelae 21-33 µm, forceps 37-60 µm and planar or near planar sigmas 110-130 µm. Our measurements overlap these but span a greater size range for each spicule type (Table 13).

A CO1 DNA barcode sequence for specimen PA2011-7 Set 36 (BOLD Specimen ID PA2011007115) is included in Appendix A (G).

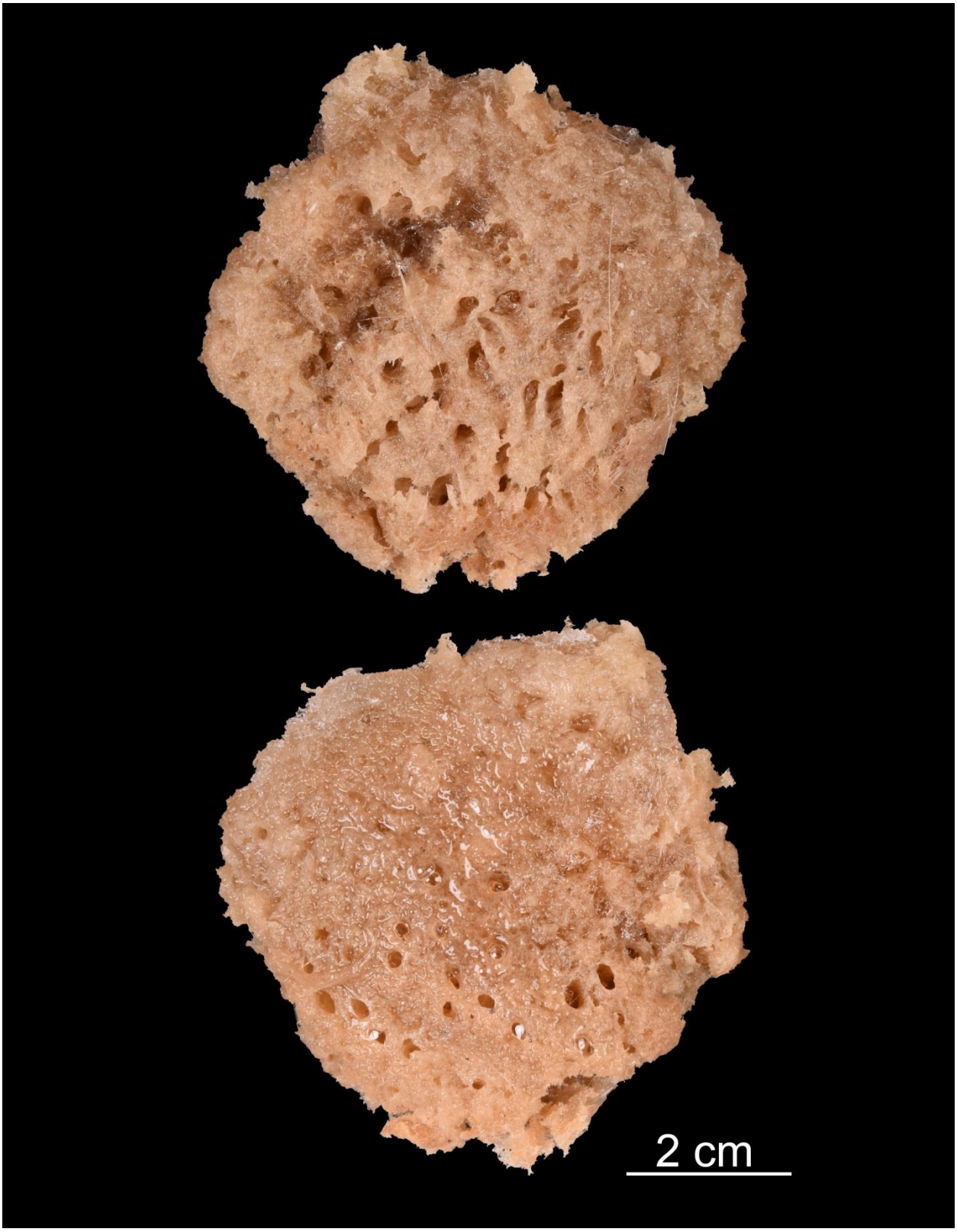

Figure 14. *Forcepia (Forcepia) thielei* specimen PA2011-7 Set 36 showing grooved and smooth surfaces.

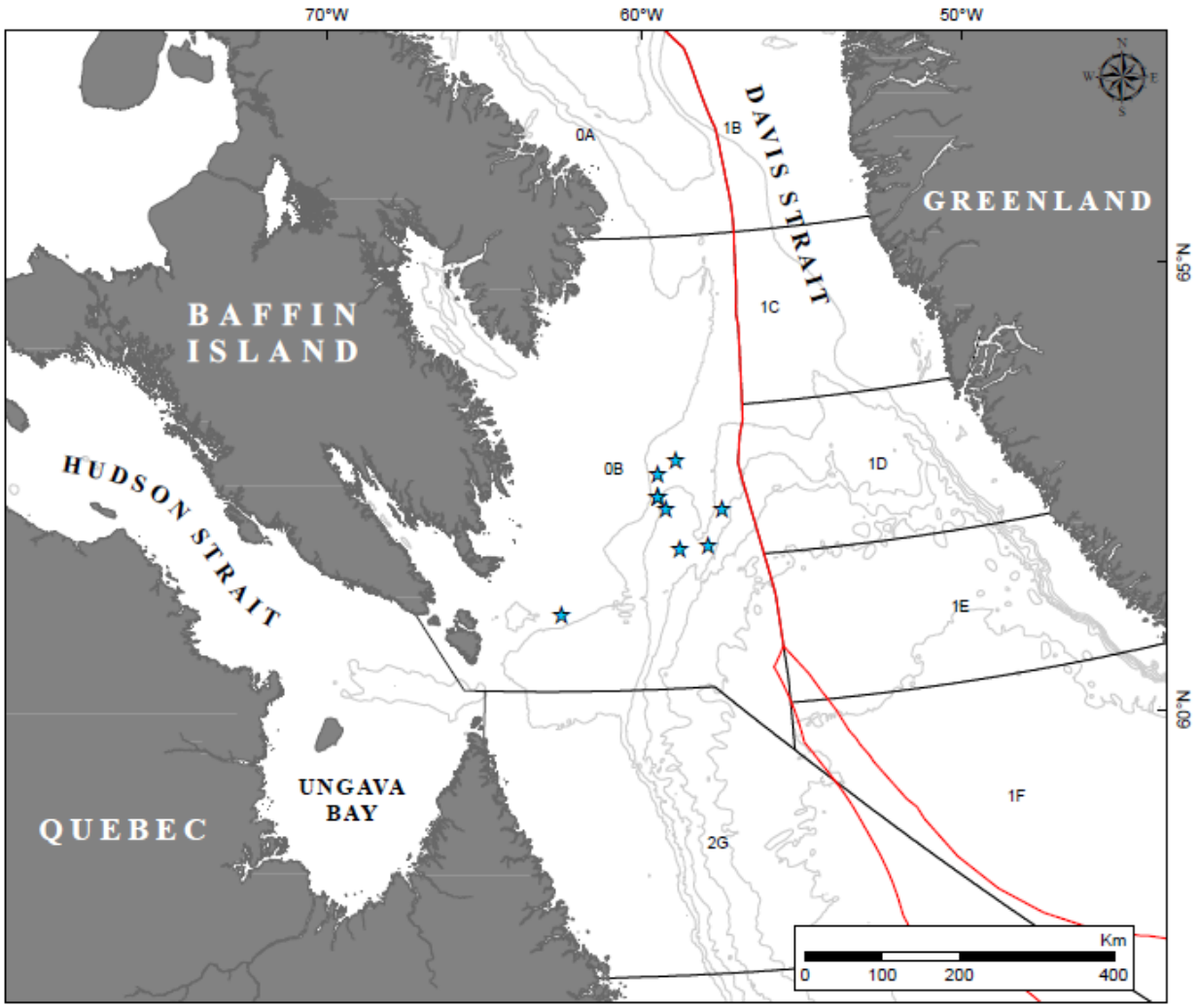

Figure 15. *Forcepia (Forcepia) thielei* collection locations. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray.

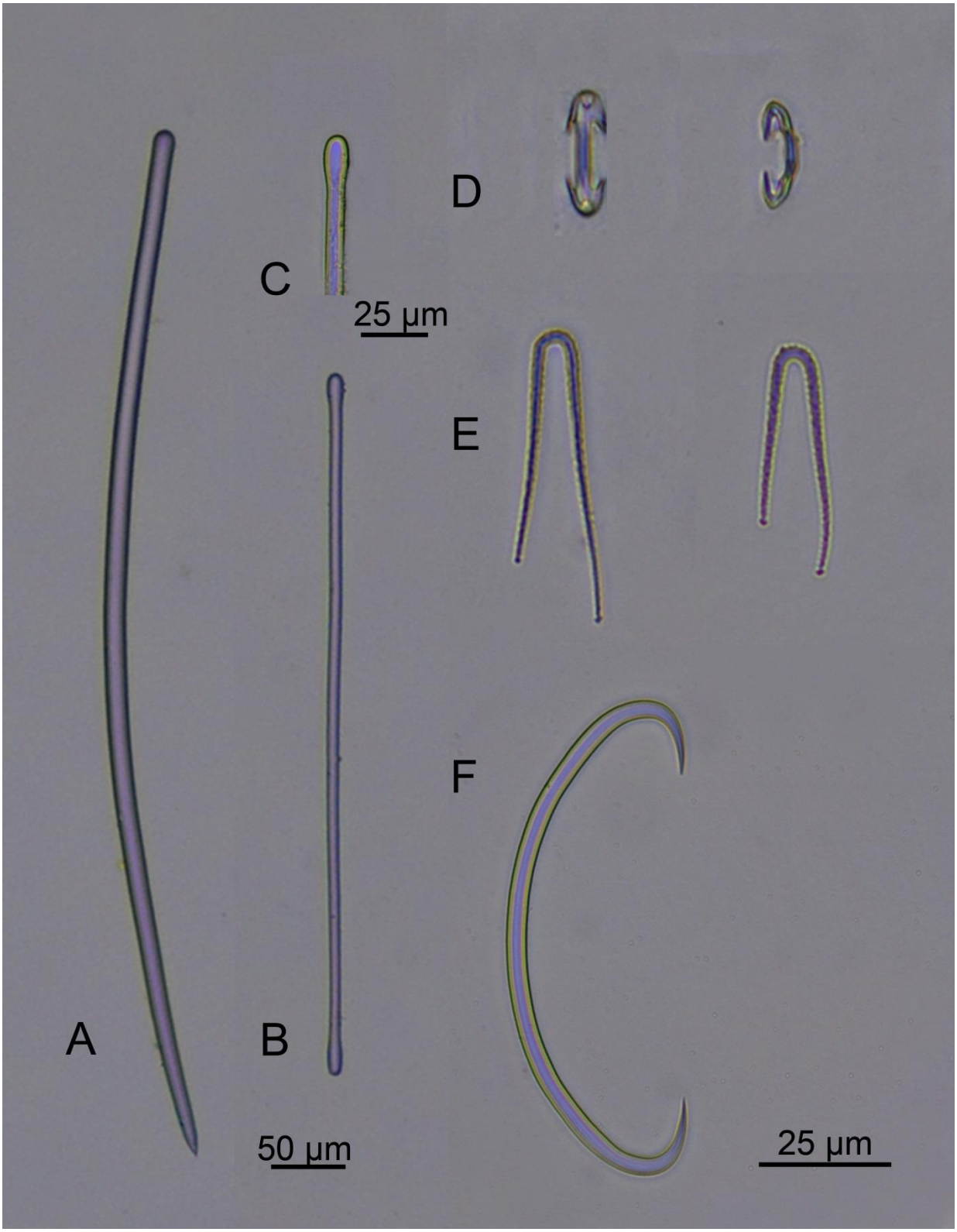

Figure 16. *Forcepia (Forcepia) thielei* spicules: Style (A), Tylote (B), Ttylote end detail (C), Arcuate isochelae (D), Forceps (E), Sigma (F). A and B same scale. D-F same scale.

Table 5. *Forcepia (Forcepia) thielei* spicule measurements, all reported as minimum-(average)-maximum for length (top line) x width (bottom line) in micrometers (µm).

Collection	n	Styles	Tylotes	Isochelae	Forceps	Sigmas
PA2011-7 Set36	30	579.4-(699.6)-795.6 x 11.8-(15.5)-19.6	391.2-(440.1)-473.2 x 4.7-(6.8)-8.9	20.1-(25.5)-35.1 x 2.4-(3.1)-4.7	35.4-(45.1)-59.2 x 2.1-(2.6)-3.6	129.5-(153.1)-168.0 x 4.5-(6.2)-7.5
PA2011-7 Set 132	10	630.7-(680.2)-725.7 x 11.8-(15.8)-18.4	338.6-(376.6)-395.4 x 5.1-(6.8)-8.6	22.0-(26.2)-28.6 x 2.5-(3.0)-3.5	39.1-(45.2)-50.4 x 2.4-(2.7)-3.0	129.3-(139.8)-149.6 x 5.2-(5.8)-6.3
PA2013-7 Set 152	10	563.7-(608.1)-661.7 x 11.8-(14.2)-16.7	329.9-(370.4)-424.6 x 5.3-(6.1)-7.5	23.8-(26.9)-29.2 x 2.4-(2.8)-3.3	31.5-(42.6)-47.9 x 2.1-(2.6)-3.3	118.6-(130.8)-156.5 x 5.0-(5.8)-6.3
PA2013-8 Set 147	10	661.9-(709.0)-756.4 x 14.3-(16.3)-18.7	376.1-(400.4)-441.2 x 4.6-(6.1)-7.3	24.4-(27.7)-29.9 x 2.5-(2.8)-3.3	44.3-(47.0)-49.3 x 2.1-(2.6)-3.2	130.9-(142.3)-160.2 x 5.1-(6.2)-7.1
PA2014-7 Set 145	10	638.7-(671.9)-707.7 x 11.8-(15.6)-17.2	347.9-(382.6)-398.3 x 5.3-(6.0)-6.9	16.9-(22.9)-28.3 x 2.2-(2.8)-3.5	36.4-(42.4)-46.7 x 2.1-(2.4)-3.0	111.0-(129.6)-140.2 x 5.8-(6.6)-7.3
PA2013-8 Set 41	10	617.3-(669.6)-737.1 x 12.2-(16.3)-20.4	379.5-(402.5)-425.2 x 5.6-(6.6)-7.4	21.0-(24.6)-28.5 x 2.1-(2.5)-2.9	42.8-(48.8)-57.8 x 2.1-(2.5)-3.2	129.3-(135.5)-141.6 x 5.6-(6.8)-7.6

ITIS TSN 659696 (subgenus)

***Forcepia (Leptolabis)* cf. *brunnea* (Topsent, 1904)** WORMS AphiaID 238706

Species description

A single lump-like fragment 3.5 cm long and 1.5 cm thick was recovered. It is light brown in colour with a thin and easily detachable membrane covering part of the sponge (Figure 17 top). The membrane covered surface is shiny out of water and pores are not clearly visible. The consistency is soft and compressible (Figure 17).

Habitat information

Specimen collected in Davis Strait at 678 m depth (Figure 18).

Spicules (Table 6, Figure 19)

Megascleres: Acanthostyles 362-452 by 15-26 µm are slightly curved with disperse spines angled away from the tip. Tylotes are 317-401 by 8-15 µm with one end typically wider and tapering toward the other. Like in *Forcepia* (*Forcepia) fabricans* the terminal swelling is more visible at the narrow end of the tylote. In some instances, the tylote shaft is widest at its midpoint.

Microscleres: Arcuate isochelae are 42-62 by 6-11 µm with highly curved shafts and short alae with distinct pointed or nearly pointed tips. Forceps are 68-92 by 3-6 µm and morphologically distinct when compared to the other *Forcepia* species in this report. As in other species the legs are spined and have terminal knobs; however the thin forcep legs approach each other before evenly flaring outward at their ends. Forceps with no clear spines were present but rare and may be developmental forms. Sigmas are 75-106 by 4-8 µm and typically contorted.

Distinguishing characteristics

Among the three species in this report that have acanthostyles this species is distinguished by the characteristic shapes of the chelae and forceps – both of which are represented by a single size class. The chelae have strongly curved shafts, similar to that observed in *Lissodendoryx (Lissodendoryx) complicata.* The alae of the chelae in *Forcepia (Leptolabis)* cf. *brunnea* are distinct in having pointed or near pointed tips. The microscope focal plane should be adjusted during viewing to confirm this difference. The forceps are relatively large, comparable in size to the large forceps with even legs in *Forcepia (Forcepia) fabricans* and *Forcepia* sp. 2. The forceps in *F. (L.)* cf. *brunnea* are unique in having narrower legs that sharply taper toward the terminal knobs. The legs also flare outward near their ends.

Taxonomic remarks

This sponge has a spicule complement that is very similar to that described for *Forcepia (Leptolabis) brunnea* (Topsent, 1904) – an encrusting sponge originally described as two varieties: *Leptolabis forcipula* and *Leptolabis forcipula* var. *brunnea.* The two varieties described by Topsent differed in color and in forcep length (85-100 μm in the grey variety *Leptolabis forcipula* and 40 μm in the brown variety *Leptolabis forcipula* var. *brunnea*). These sponges have now been synonymized and transferred to the genus *Forcepia* with *Leptolabis* taking a subgenus rank. The species epithet *brunnea* is applied to both, distinguishing it from *Forcepia forcipula.* The growth form of our specimen *Forcepia (Leptolabis)* cf. *brunnea* cannot be determined from the fragment in our collection, however like Topsent's specimens the ectosome is well defined with a thick membrane with no distinct holes in the membrane. Topsent (1904) reports the following spicule measurements, listed for *Leptolabis forcipula/Leptolabis forcipula* var. *brunnea*: acanthostyles 175-550 by 13 μm/200-475 by 15 μm, tylotes 430 x 7 μm/360-400 by 5 μm, tridendate isochelae with a highly curved shaft 40-50 μm (rarely 30 μm)/33 μm, forceps 85-100 μm/40 μm, contorted sigmas 87-95 x 6-7 μm/110 x 7 μm. The spicules in our specimens overlap with the spicule lengths reported for *Leptolabis forcipula* and the widths are very close or overlapping – however the smallest measured acanthostyles in our specimens were 362 μm long. *Leptolabis forcipula* var. *brunnea* megascleres overlap in size with our specimens and the sigma measurements nearly overlap; but both the isochelae and forceps in *Leptolabis forcipula* var. *brunnea* are smaller than in our specimens. Topsent (1904) also notes and illustrates acanthostyles with heavily spined heads. While some acanthostyles in our specimen were more heavily spined at the style head, others were more evenly spined along the full spicule length. Note that although we have not examined the arrangement of acanthostyles to confirm that our specimen belongs to the subgenus *Leptolabis* we have assigned it to this subgenus based on its similarity to published descriptions of *Forcepia (Leptolabis) brunnea.*

Comparisons of DNA barcodes between our specimen and the two varieties originally described by Topsent (1904) would be needed to confirm that they are the same species. The CO1 sequence obtained for specimen PA2014-7 Set 78 (BOLD Specimen ID PA2014007550) is included in Appendix A (H).

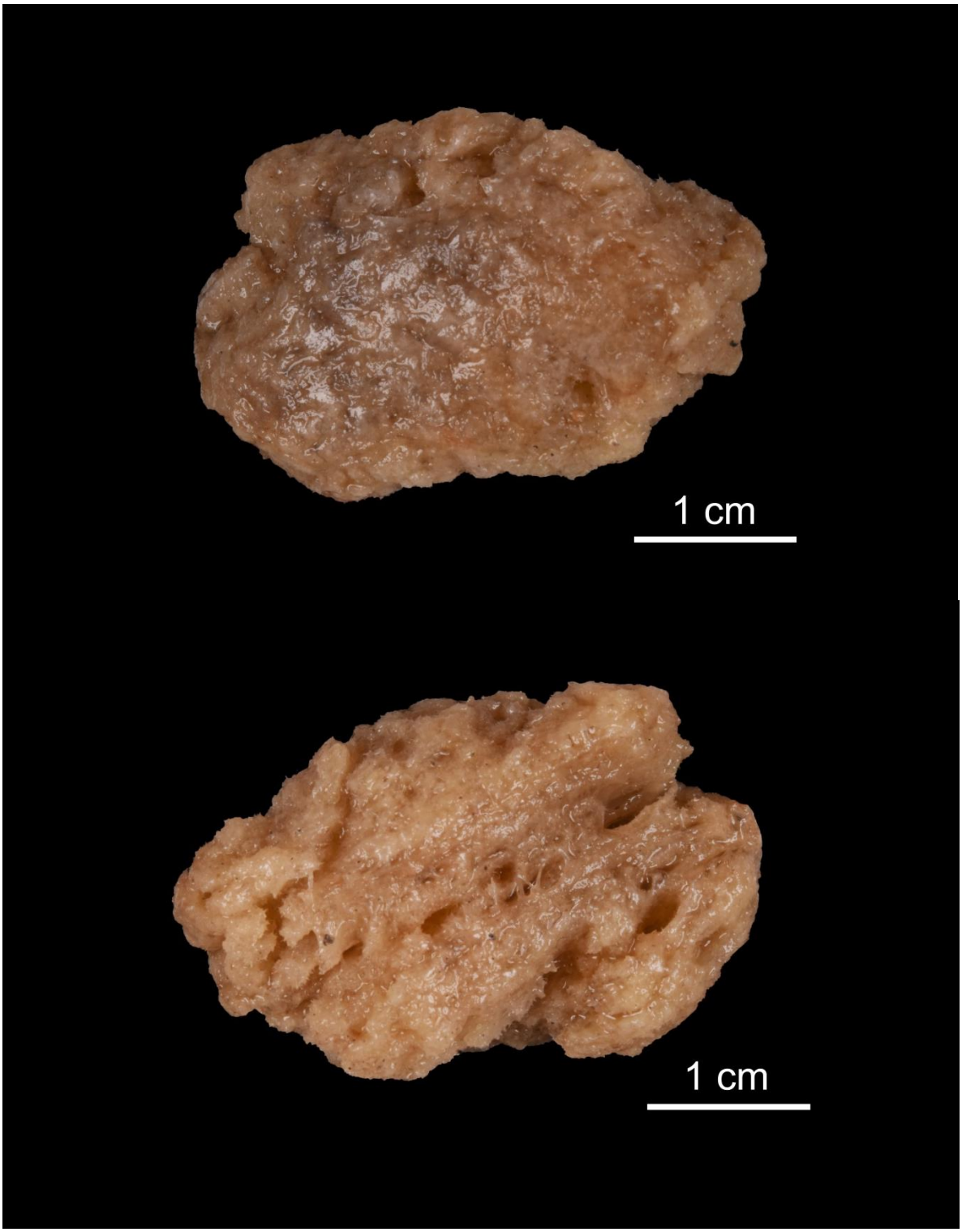

Figure 17. *Forcepia (Leptolabis)* cf. *brunnea* specimen PA2014-7 Set 78 showing opposite surfaces.

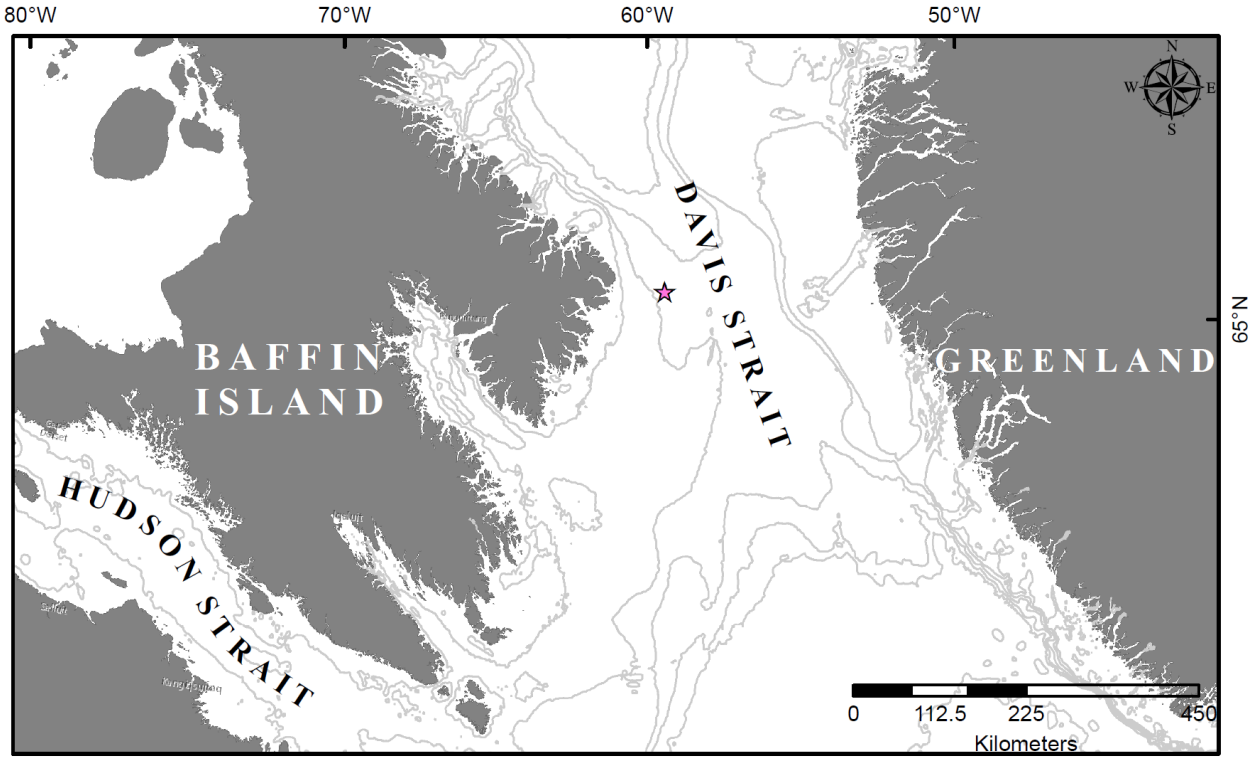

Figure 18. *Forcepia (Leptolabis)* cf. *brunnea* collection location.

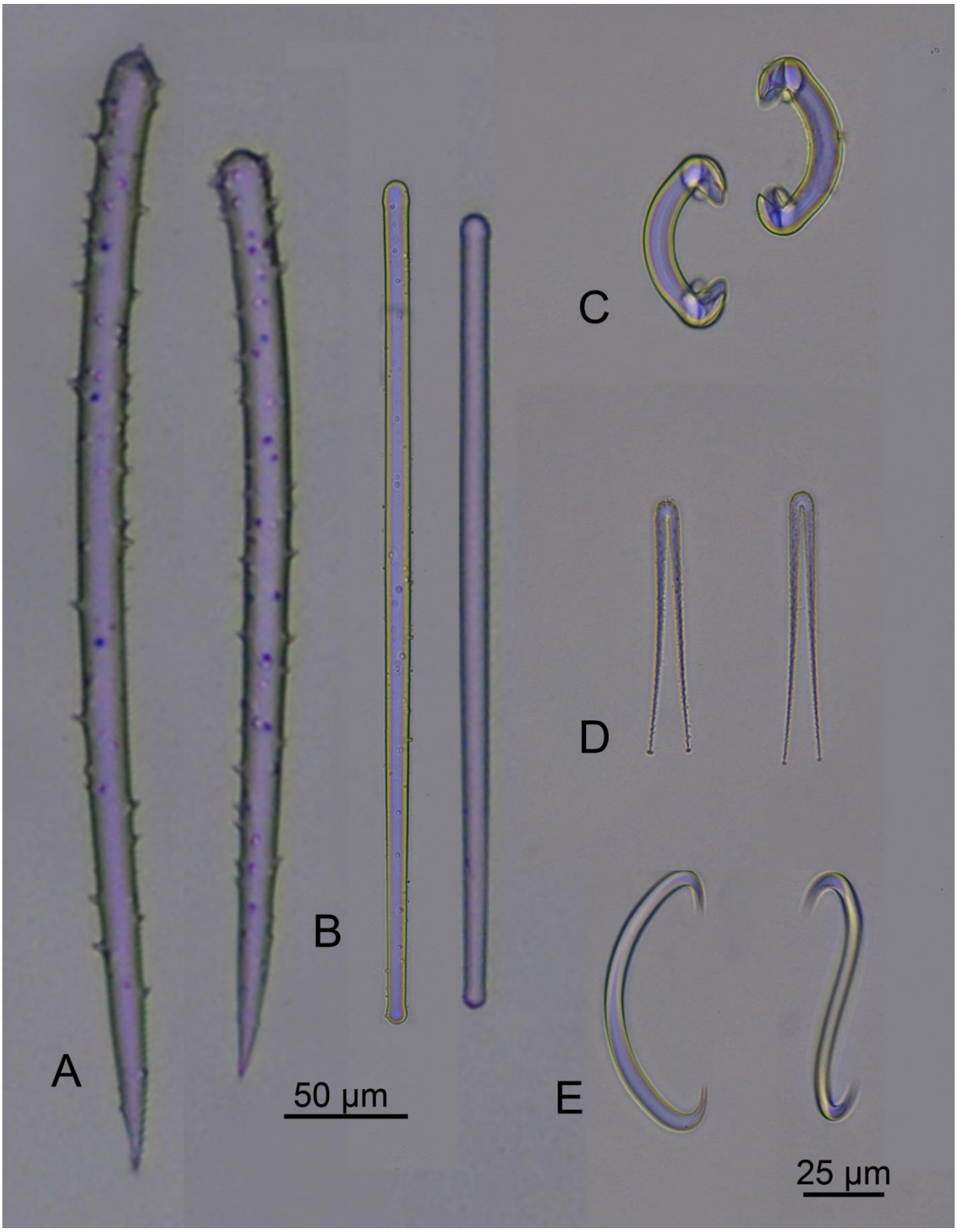

Figure 19. Spicules from *Forcepia (Leptolabis)* cf. *brunnea* specimen PA2014-7 Set 78. Acanthostyles (A), Tylotes (B), Arcuate isochelae (C), Forceps (D), Sigmas (E). A and B same scale. C-E same scale.

Table 6. Measurements of spicules from specimens of *Forcepia (Leptolabis)* cf. *brunnea* all reported as minimum-(average)-maximum for length (top line) x width (bottom line).

Collection	n	Acanthostyles	Tylotes	Isochelae	Forceps	Sigmas
PA2014-7 Set 78	30	361.8-(396.6)-451.6 x 15.1-(20.1)-26.5	316.8-(348.8)-400.6 x 8.5-(11.5)-15.4	41.5-(53.6)-61.8 x 6.1-(9.3)-11.3	68.1-(84.4)-92.3 x 2.9-(4.6)-6.3	75.4-(89.1)-105.8 x 3.8-(6.0)-7.6

ITIS TSN 48049 (genus)

***Forcepia* sp. 1** WORMS AphiaID 131921 (genus)

Species description

The sponge is compact and cushion-shaped, with tan or light brown colouration. It is soft and slightly compressible. The texture is mostly smooth, and an outer membrane seems to be present on at least one face of the sponge. Numerous pores can be found on each side. Two specimens were found, one 2 cm long and 2 cm wide, and the other a small piece approximately 1 cm long and 0.5 cm wide. Due to the small size of the second specimen, only the first one is examined here (Figure 20).

Habitat information

Davis Strait at 667 and 721 m depth (Figure 21).

Spicules (Table 7, Figure 22)

Megascleres: Acanthostyles are 348-440 by 14-29 µm, and are slightly curved along their length. They are heavily spined, with slightly more prominent spines found near their heads. Tylotes are 340-441 by 6-11 µm.

Microscleres: Arcuate isochelae in two size classes: 33-41 by 4-6 µm, and 19-23 by 2-3 µm. Some chelae from the smaller class may have a slightly crooked shaft. Forceps are 9-15 by 2-3 µm. They are faintly acanthose, with legs that flare outward slightly before curving back inward. Forceps with even and uneven legs can be found. Sigmas are 66-151 by 5-12 µm.

Distinguishing characteristics

This species is distinguishable more by its spicule complement than by its external morphology. The presence of two size classes of isochelae, as well as the abnormally large sigmas, makes this species unique in our collections.

Taxonomic remarks

This species has been placed within the genus *Forcepia* due to the presence of forceps. Further classification to the subgenus level is not possible, as the arrangement of the acanthostyles could not be determined from the fragments we examined.

Figure 20. *Forcepia* sp. 1 specimen PA2010-9 Set 162 showing opposite surfaces.

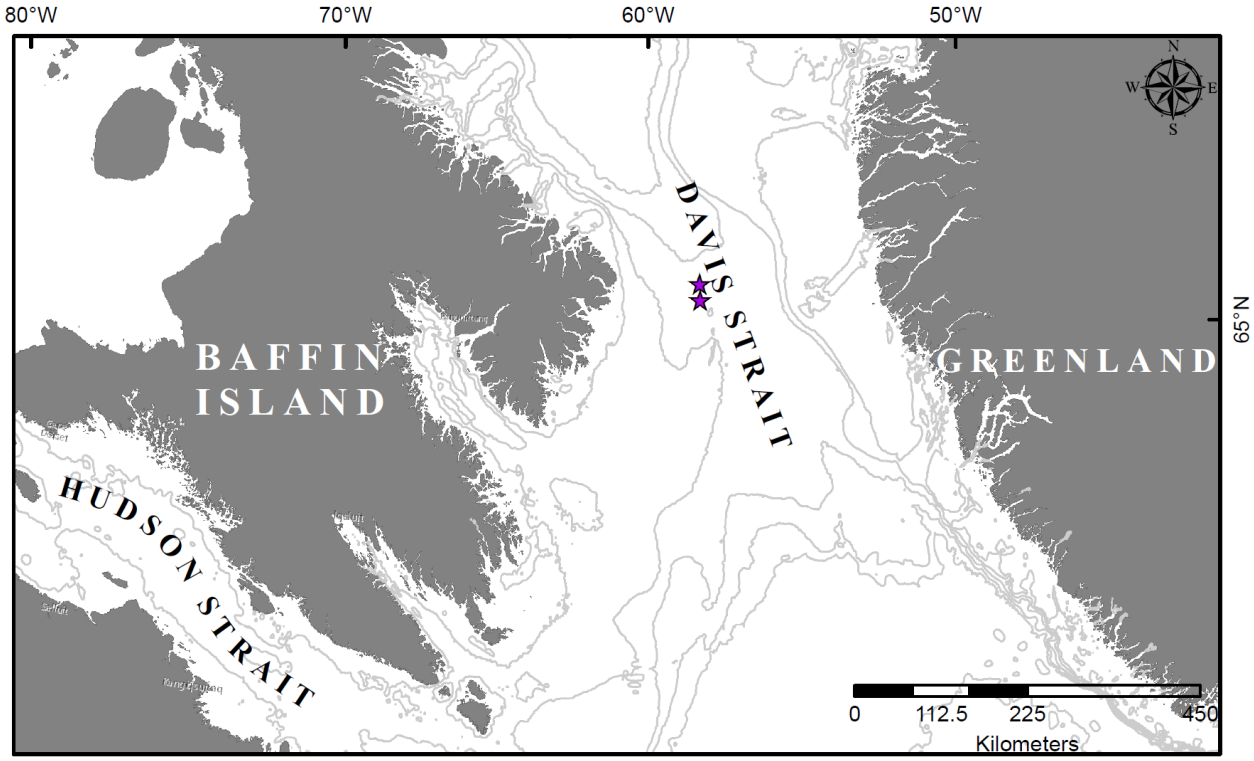

Figure 21. *Forcepia* sp. 1 collection locations.

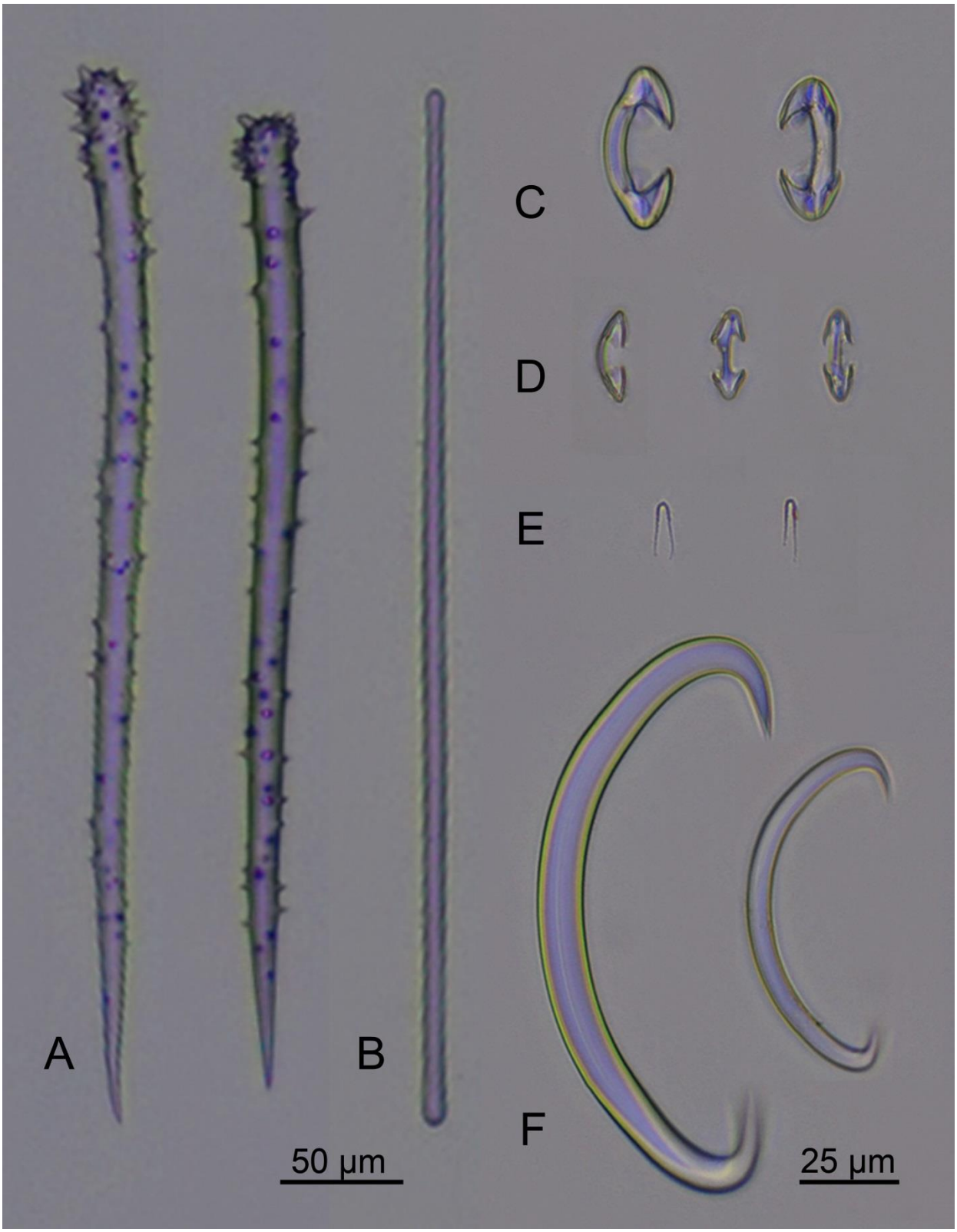

Figure 22. *Forcepia* sp. 1 spicules. Acanthostyles (A), Tylotes (B), Arcuate isochelae I (C), Arcuate isochelae II (D), Forceps (E), Sigmas (F). A and B same scale. C-F same scale.

Table 7. Measurements of spicules from specimens of *Forcepia* sp. 1 all reported as minimum-(average)-maximum for length (top line) x width (bottom line).

Collection	n	Acanthostyles	Tylotes	Isochelae I	Isochelae II	Forceps	Sigmas
PA2010-9 Set 162	30	347.9-(393.9)-439.5 x 14.2-(22.8)-28.5 (n=16)	340.0-(406.0)-440.8 x 6.4-(7.9)-10.6	33.2-(36.1)-41.0 x 4.4-(5.4)-6.4	19.4-(21.6)-23.4 x 2.1-(2.6)-3.4	8.6-(13.0)-15.4 x 2.1-(2.4)-2.8	66.1-(96.9)-150.8 x 4.6-(7.6)-12.1

ITIS TSN 48049 (genus)

***Forcepia* sp. 2** WORMS AphiaID 131921 (genus)

Species description

The specimen consists of several irregularly-shaped fragments that are brown in colour. Their consistency is fibrous and somewhat friable. Numerous pores and/or oscules are visible on the surface, as are lines of prominent spicule tracts. One specimen was found, consisting of three pieces. These measure 1.25-2 cm long by 0.75-1.25 cm wide (Figure 23).

Habitat information

Specimen found in Davis Strait at 513 m depth (Figure 24).

Spicules (Table 8, Figure 25)

Megascleres: Acanthostyles are 252-324 by 14-24 µm, with spines occurring on the head and along the entire shaft of the spicule. The acanthostyles may be slightly bent toward the head. Tylotes are 337-400 by 9-17 µm, with poorly-defined heads. Tornotes 174-206 by 4-7 µm are present, and these have mucronate ends. Typically, one endpoint is more pronounced than the other.

Microscleres: Isochelae are arcuate and 20-37 by 2-5 µm. There are two size classes of forceps. Forceps I are large and acanthose, 54-80 by 3-6 µm. Their legs flare outward toward their ends, and they terminate in knobs. Forceps II are thinner and much smaller, 19-33 by 2-3 µm, and are finely toothed. The legs can be either even or uneven in length. Sigmas are small and thin, 20-30 by 2-3 µm.

Distinguishing characteristics

This species can be distinguished by its spicule complement rather than by its external morphology. The presence of both tylotes and mucronate tornotes in this specimen makes it unique among the species of *Forcepia* that we have examined.

Taxonomic remarks

Due to the presence of two size classes of forceps, this species was assigned to the genus *Forcepia*. However, the presence of mucronate tornotes makes it unique among our *Forcepia* specimens and, to the best of our knowledge, atypical of that genus. While it is possible that one or more spicule types are contaminants, we note that each spicule type detailed here is well-represented in the spicule complement. As with *Forcepia* sp. 1, the species cannot be taxonomically identified below the genus level, as the specimens we obtained were fragmented and the position of the acanthostyles cannot be determined.

Figure 23. *Forcepia* sp. 2 specimen PA2010-9 Set 109 fragments showing opposite surfaces.

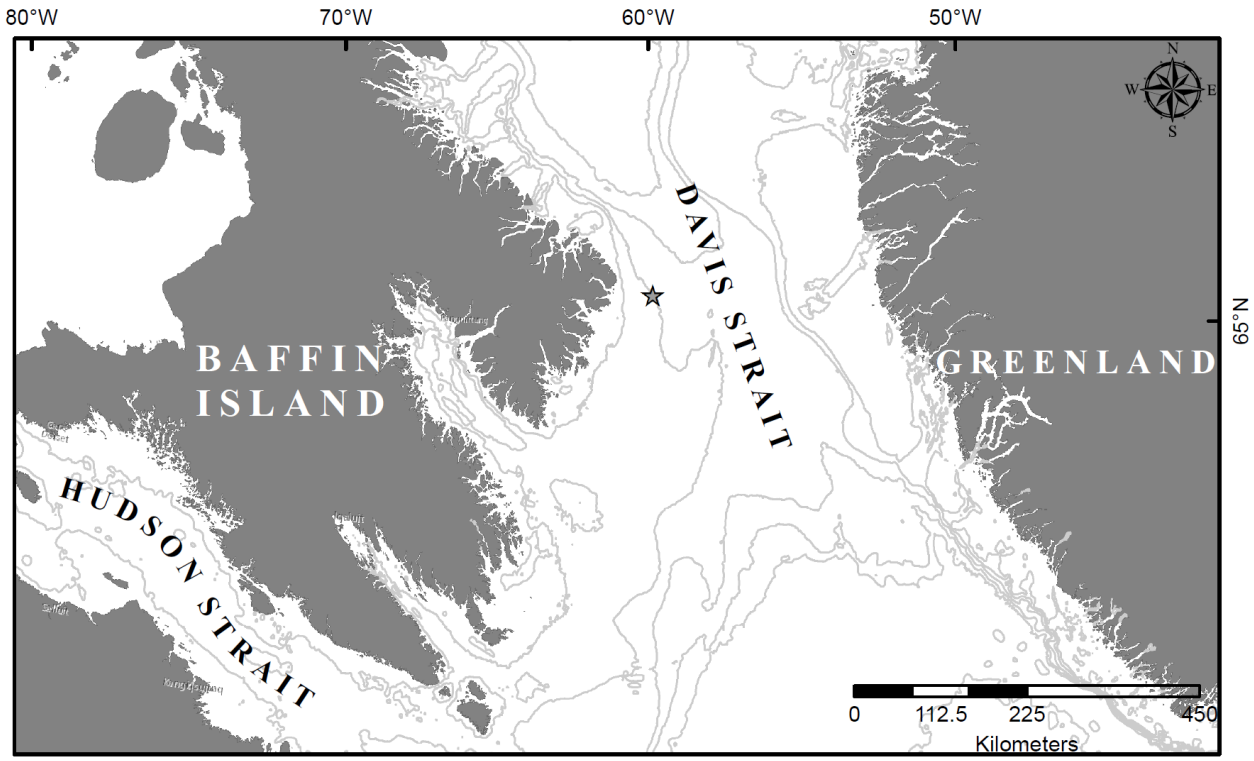

Figure 24. *Forcepia* sp. 2 collection location.

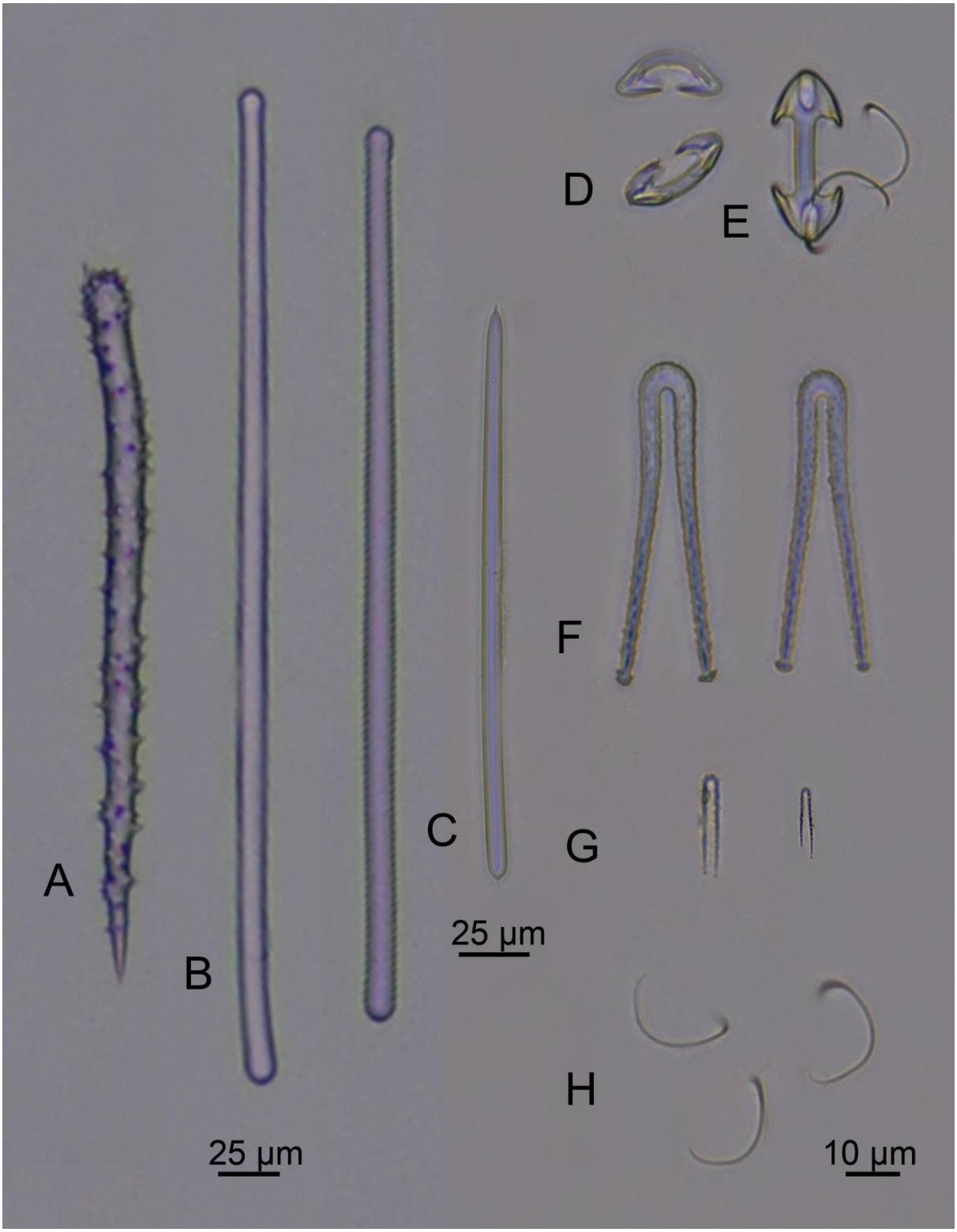

Figure 25. *Forcepia* sp. 2 spicules. Acanthostyles (A), Tylotes (B), Tornote (C), Arcuate isochelae II (D), Arcuate isochelae I with surrounding sigmas (E), Forceps I (F), Forceps II (G), Sigmas (H). A and B same scale. D-H same scale.

Table 8. Measurements of spicules from specimens of *Forcepia* sp. 2 all reported as minimum-(average)-maximum for length (top line) x width (bottom line).

Collection	n	Acanthostyles	Tylotes	Tornotes	Isochelae	Forceps I	Forceps II	Sigmas
PA2010-9 Set 109	30	252.0-(290.0)-323.8 x 13.5-(17.6)-23.7 (n=29)	336.7-(366.1)-399.9 x 8.5-(12.1)-16.7	173.6-(190.0)-206.2 x 4.2-(5.3)-7.04	20.1-(23.6)-37.2 x 2.4-(3.4)-4.6	53.9-(64.1)-71.9 x 3.2-(5.6)-6.4 (n=17)	18.9-(25.4)-33.4 x 1.5-(2.4)-3.3 (n=13)	19.8-(23.4)-30.9 x 2.1-(2.4)-3.0

Descriptions of *Lissodendoryx*

ITIS TSN 659697 (subgenus)

***Lissodendoryx* (*Lissodendoryx*) *complicata* (Hansen, 1885)** WORMS AphiaID 168950

Species description

White to beige or brown bush-like sponge with flexible, somewhat elastic compressed (non-cylindrical) branches 0.5-1 cm wide that separate and rejoin in a net-like pattern, and terminate dichotomously with short, rounded ends (Figure 26). A firm and thicker basal stalk gives rise to the branches but is often missing in our specimens. The surface is slightly hispid and marked by very small (< 1 mm) openings. Six of 24 specimens ranging in size from 8-20 cm long were examined.

Habitat information

Davis Strait, south of Davis Strait and southern Baffin Bay shelf at 471-1478 m depth (Figure 27).

Spicules (Table 9, Figure 28)

Megascleres**:** Smooth and slightly curved styles 448-690 by 9-26 μm which gradually taper along their full length. Tylotes 209-360 by 4-8 μm with nearly equal or equal swellings at the ends.

Microscleres**:** Arcuate isochelae 27-69 by 5-13 μm that are highly curved with a thick shaft and well separated stubby alae. Sigmas in two size classes (I and II): Sigmas I are contorted with one end typically out of plane with the other and 31-60 by 2-4 μm. Sigmas II on the other hand are planar with inward curved ends and measure 15-23 by 2-3 μm.

Distinguishing characteristics

This species can usually be distinguished by its morphology, including its bush-like body form with anastomosing branches, and its slightly hispid perforated surface. Spicules are used for confirmation – ensuring that the complement and measurements match those presented here. The highly curved isochelae are distinct in combination with the smooth, tapering styles.

Taxonomic remarks

Hansen's original description (1885) as *Reneira complicata* lacks spicule measurements and overlooks the characteristic curved arcuate isochelae, and instead describes only the overall sponge external morphology, the specimen's megascleres and possible sigmas. Surprisingly Hansen describes and draws spicules which do not belong to *Lissodendoryx complicata*, including oxeas and toxas – suggesting that he either examined the wrong spicule preparation or his preparation was contaminated with foreign spicules. Fristedt (1887) newly described a Baffin Bay specimen as a new species *Clathria corallorhizoides* n. sp. presenting measurements 0.5 mm for styles, 0.32 mm for tylotes, 0.06 mm for arcuate isochelae and 0.04 and 0.02 for sigmas (measured as distance between the two points), noting that the larger sigmas may be contorted (C or S curved). These are consistent with our specimens, also collected from the same area. Lundbeck (1905) examined both Hansen and Fristedt's type specimens and concluded that Hansen must have examined foreign spicules for his *Reneira complicata* description, but that his specimen was in fact *Lissodendoryx complicata*. Lundbeck (1905) upheld the species epithet as *complicata* while formalizing the genus transfer from *Reneira* to *Lissodendoryx*. Lundbeck reported the following spicule measurements for *Lissodendoryx complicata*: styles 0.42-0.68 mm, strongyla to subtylota (our tylotes) 0.22-0.40 mm, arcuate chelae 0.04-0.058 mm, sigmas 0.042-0.055 mm and 0.017-0.023 mm. Our measurements overlap Lundbeck's as well. Amplification of a CO1 barcode was attempted on 100% ethanol preserved tissue from specimen PA2012-7 Set 141, but was not sucessful.

Figure 26. *Lissodendoryx complicata* specimen PA2012-7 Set 141; close up (top) and overview (bottom).

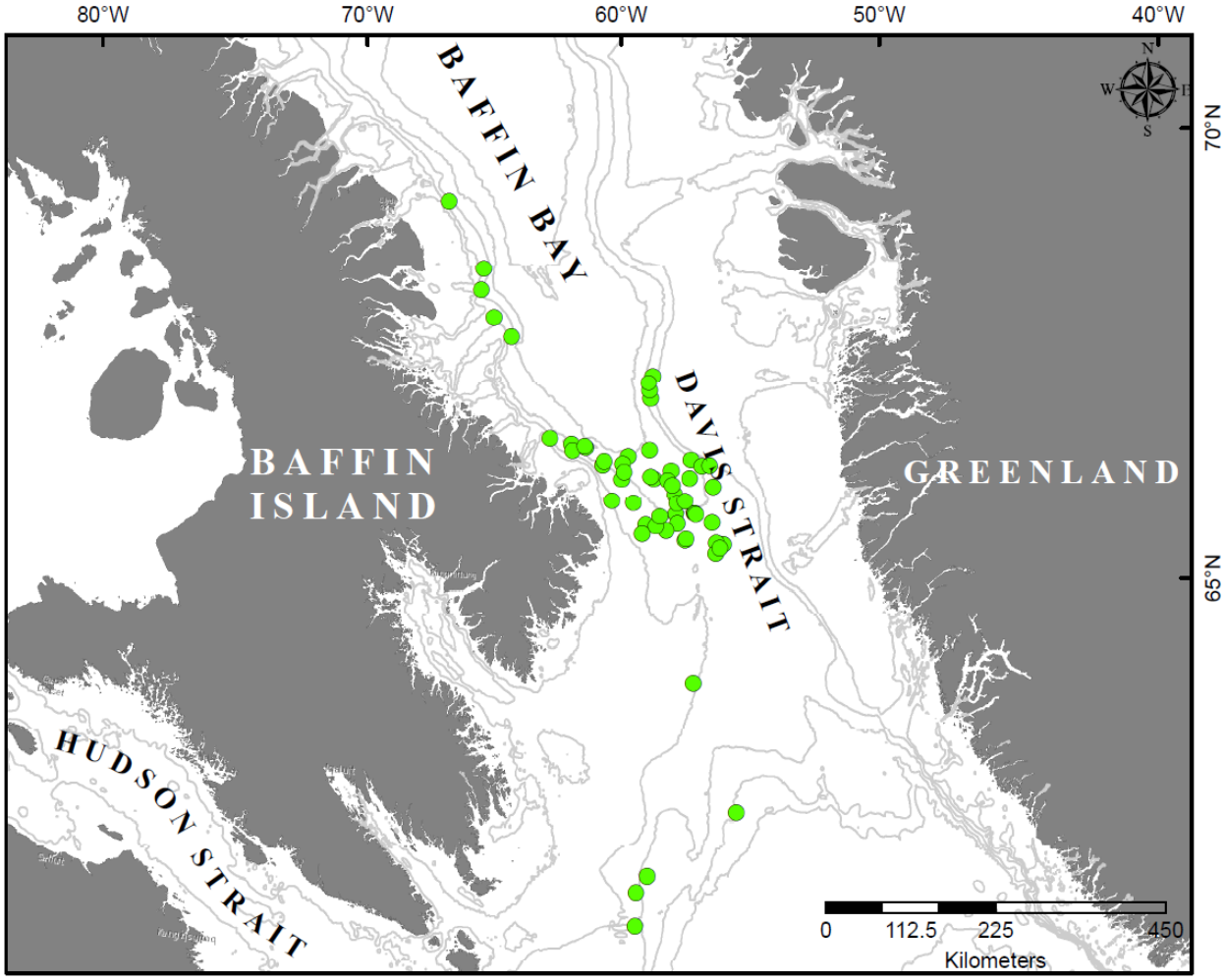

Figure 27. Location of collected specimens of *Lissodendoryx (Lissodendoryx) complicata*.

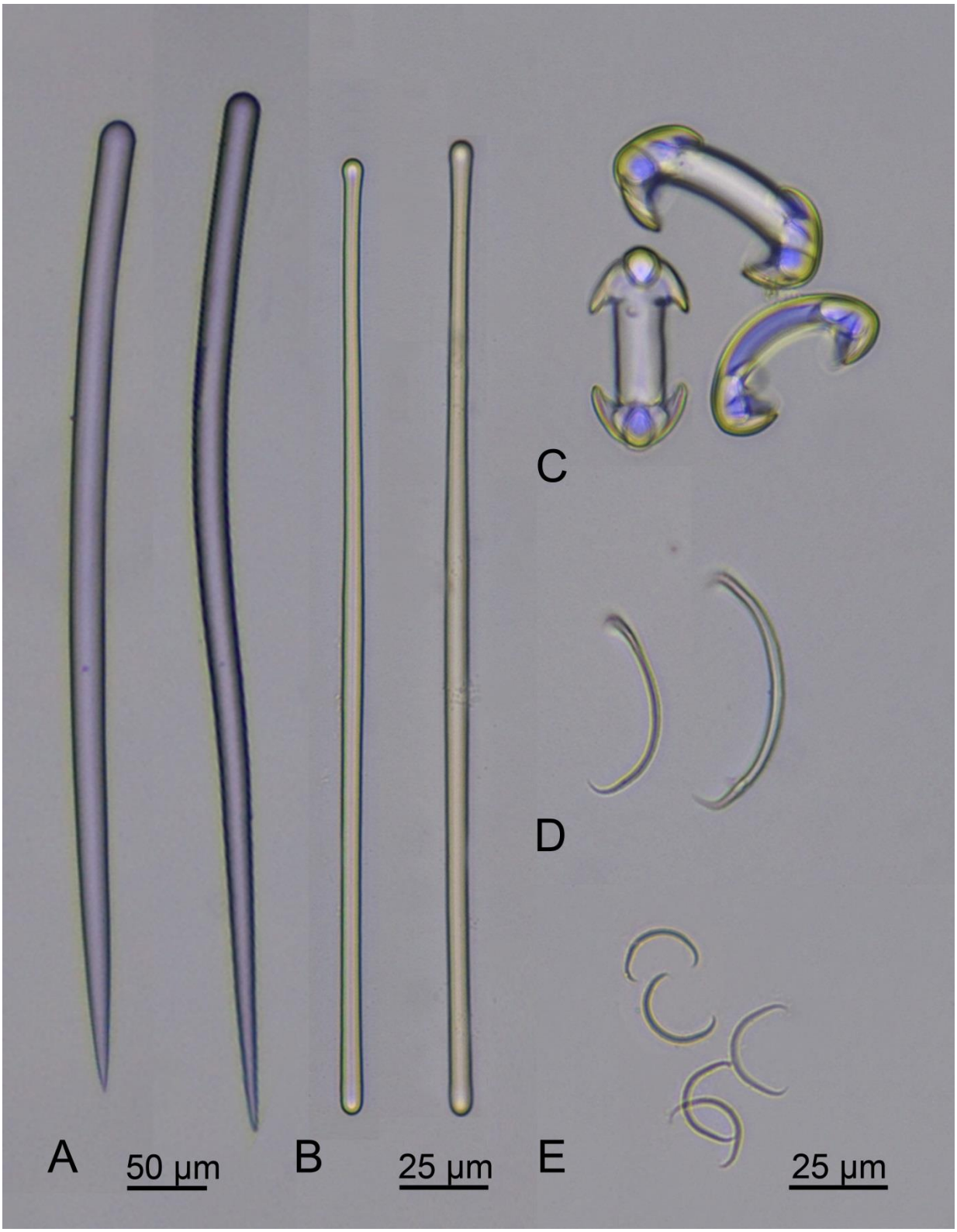

Figure 28. *Lissodendoryx (Lissodendoryx) complicata* spicules from specimen PA2012-7 Set 141. Styles (A), Tylotes (B), Arcuate isochelae (C), Sigmas I (D), Sigmas II (E). C-E same scale.

Table 9. *Lissodendoryx (Lissodendoryx) complicata* spicule measurements, all reported as minimum-(average)-maximum for length (top line) x width (bottom line) in micrometers (µm). N denotes the number of spicule measurements per specimen.

Collection	n	Styles	Tylotes	Sigmas I	Sigmas II	Isochelae
PA2012-7 Set 141	30	456.0-(513.8)-576.1	208.6-(256.7)-294.6	38.1-(40.9)-43.8	17.8-(19.7)-22.0	27.8-(47.0)-57.6
		x 11.3-(17.9)-22.3	x 3.7-(5.0)-6.6	x 1.5-(1.9)-2.8 (n=5)	x 2.1-(2.3)-2.6	x 6.5-(9.4)-13.1
PA2010-9 Set 149	10	508.5-(545.4)-585.5	261.8-(309.2)-346.4	44.4-(53.0)-60.0	17.1-(19.8)-23.2	44.6-(53.7)-61.9
		x 10.0-(19.5)-25.5	x 6.1-(7.3)-8.5	x 1.9-(2.4)-2.7 (n=5)	x 2.1-2.3-2.6	x 5.0-(8.0)-10.9
PA2014-7 Set 86	10	547.8-(588.8)-642.0	267.0-(305.6)-338.3	41.0-(49.9)-60.3	17.5-(19.4)-20.9	35.0-(46.8)-53.1
		x 16.7-(19.8)-21.8	x 4.2-(6.4)-7.5	x 2.1-(3.1)-3.9	x 1.9-(2.2)-2.7	x 7.2-(8.6)-11.5
PA2010-9 Set 167	10	448.4-(558.4)-638.8	271.7-(292.4)-328.7	31.4-(42.4)-49.5	16.2-(17.9)-20.6	27.3-(45.0)-55.0
		x 9.3-(18.5)-23.5	x 3.9-(4.9)-6.0	x 2.1-(2.4)-3.3	x 2.1-(2.3)-3.0	x 5.3-(7.4)-9.1
PA2012-7 Set 105	10	591.2-(640.1)-690.3	290.1-(338.1)-359.9	41.3-(48.0)-56.9	15.0-(18.1)-19.8	45.8-(53.3)-64.3
		x 19.6-(22.0)-24.9	x 5.2-(5.8)-6.8	x 2.1-(25.2)-2.9	x 2.1-(2.3)-2.5	x 6.3-(9.2)-13.2
PA2014-7 Set 88	10	524.3-(599.9)-644.9	278.1-(300.9)-318.4	41.4-(48.1)-55.4	18.7-(20.6)-22.1	42.3-(52.5)-68.9
		14.31-(19.74)-25.5	6.1-(6.8)-7.5	2.5-(2.8)-3.2	2.1-(2.2)-2.4	6.9-(9.2)-10.1

ITIS TSN 659697 (subgenus)

Lissodendoryx (Lissodendoryx) indistincta **(Fristedt, 1887)** WORMS AphiaID 168965

Species description

Yellow to brown sponge with a soft, slightly compressible consistency and smooth and sometimes slimy surface that appears shiny out of water. The surface is marked by very fine folds or canals giving it a grooved appearance. Lump like, sometimes with a few visible openings on one end (Figure 29). Six of 24 specimens ranging in size from 3-8 cm long and 0.5-3 cm thick were examined.

Habitat information

Hudson Strait, Ungava Bay, Davis Strait, Baffin Bay and northeast of Baffin Bay at 161-663 m depth (Figure 30).

Spicules (Table 10, Figure 31)

Megascleres: Gently curved smooth styles or sparsely spined acanthostyles 337-470 by 10-19 μm. Tornotes or tylotornotes 213-278 by 3-8 μm with slightly swollen ends that terminate in sharp points (mucronate) and sometimes have additional swellings along their length. Tornotes ends may or may not be equal.

Microscleres: Arcuate isochelae (Isochelae I) 19-42 by 2-5 μm and small isochelae (Isochelae II) 8-15 by 2-3 μm that appear sigma-like under 100x magnification but have reduced alae and a toothy shaft (visible at 400x or above). Contorted sigmas are 33-60 by 2-5 μm.

Distinguishing characteristics

This species is distinguished by its smooth yet finely grooved surface (shiny out of water) and lump-like appearance and by its characteristic small toothy chelae (observed at 400x magnification), which are not observed in other species within our collections.

Taxonomic remarks

Morphology and spicules in our specimens match the original description (Fristedt, 1887). Fristedt reported smooth or sparsely spined styles 0.35 mm (0.35-0.417 mm on type re-examination by Lundbeck, 1905), tornotes 0.2 mm, isochelae 0.025 mm and sigmas 0.05 mm. Our measurements overlap but with a larger range for each spicule type. In contrast to Fristedt, who measured sigmas by the distance between the two pointed ends, we recorded the longest length from the two outermost curved edges. The small bihamate spicules (sigmas) 0.0065 mm reported by Fristedt (1887) equate to small isochelae (isochelae II) in our specimens and to those reported by Lundbeck (1905), Hentschel (1929) and Koltun (1959). The isochelae II have a characteristic toothy shaft and very reduced alae only visible under high magnification (400x or above). The *L. (L.) indistincta* small isochela drawing in the Systema Porifera (Hooper and Van Soest 2002) does not show the toothy or lobed shaft that is characteristic of this spicule type. We did not obtain a CO1 barcode for this species.

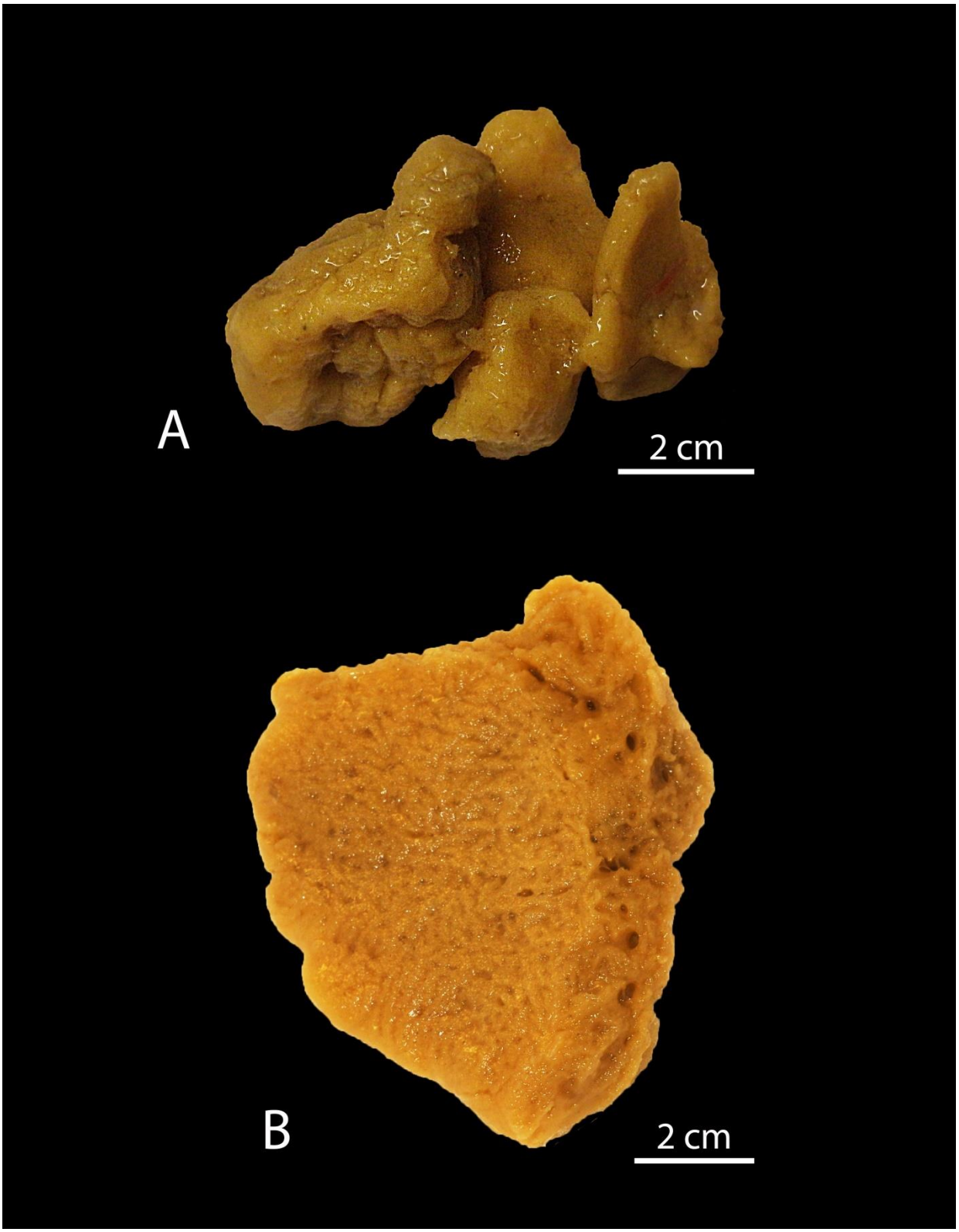

Figure 29. *Lissodendoryx (Lissodendoryx) indistincta* specimens PA2013-8 Set 128 (A) and PA2011 Set 86 (B).

Figure 30. *Lissodendoryx (Lissodendoryx) indistincta* collection locations. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray.

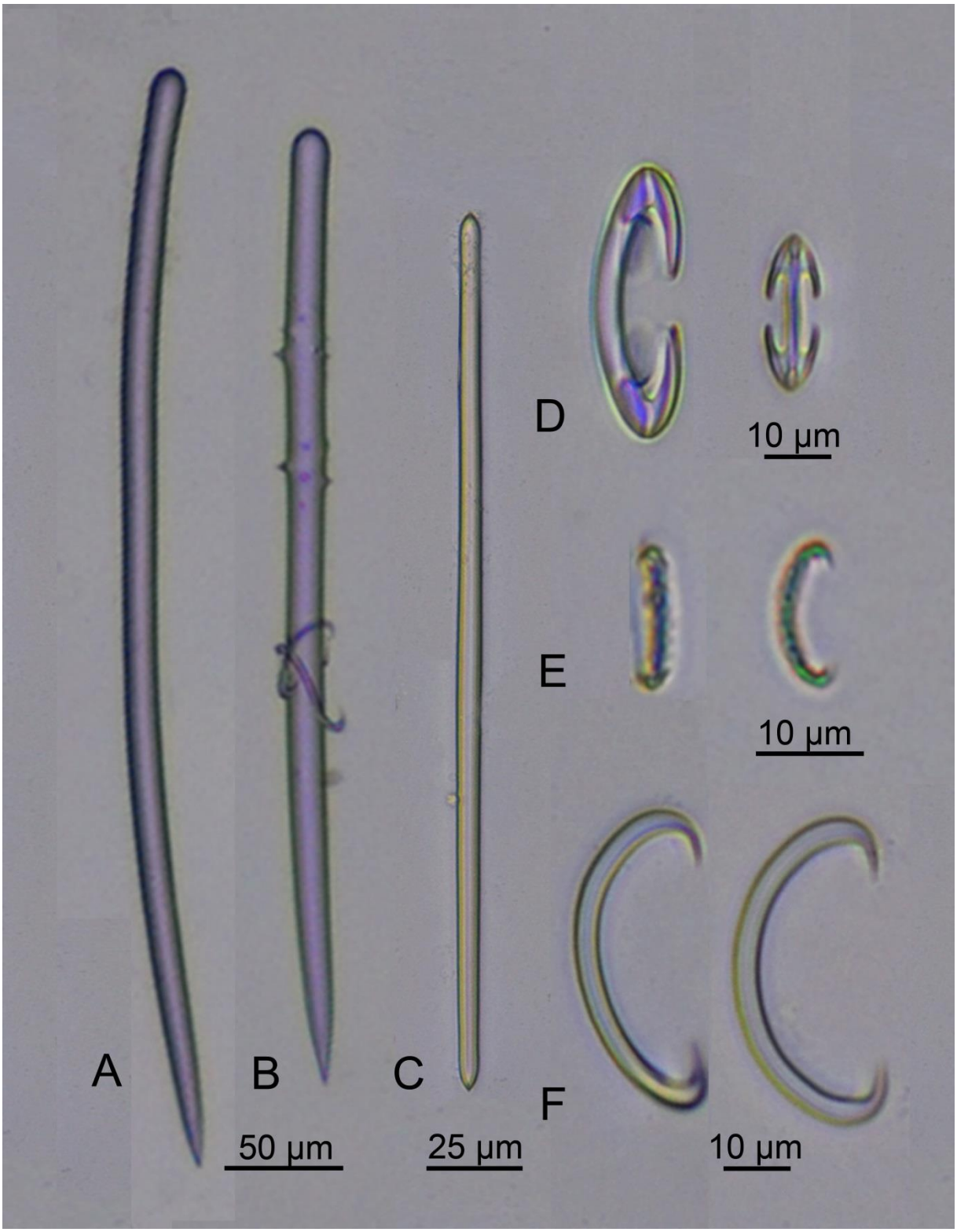

Figure 31. *Lissodendoryx (Lissodendoryx) indistincta* spicules from specimen PA2013-8 Set 128. Smooth style (A), Acanthostyle (B), Tornote (C), Arcuate isochelae I (D), Isochelae II (E), Sigmas (F). A and B same scale.

Table 10. *Lissodendoryx (Lissodendoryx) indistincta* spicule measurements, all reported as minimum-(average)-maximum for length (top line) x width (bottom line) in micrometers (µm).

Collection	n	Styles	Tornotes	Isochelae I	Isochelae II	Sigmas
PA2013-8 Set 128	30	367.8-(424.5)-469.5 x 10.0-(14.8)-19.1	219.3-(244.5)-262.7 x 4.5-(6.2)-7.8	20.3-(26.7)-42.2 x 2.1-(2.9)-4.8	9.6-(11.9)-18.3 x 2.1-(2.3)-3.0	32.6-(41.8)-47.5 x 2.5-(3.5)-4.2
PA2011-7 Set 45	10	373.6-(390.7)-409.0 x 12.8-(14.6)-17.1	237.3-(245.8)-264.0 x 5.5-(6.4)-8.4	23.5-(29.9)-40.7 x 2.2-(3.1)-4.4	7.5-(12.4)-14.3 x 2.1-(2.3)-2.9	32.6-(46.9)-51.2 x 2.9-(3.6)-4.3
PA2011-7 Set 47	10	359.8-(384.1)-411.0 x 11.8-(13.6)-15.0	215.0-(233.0)-244.9 x 2.8-(4.9)-6.7	21.4-(27.1)-35.5 x 2.4-(3.4)-4.8	9.6-(12.2)-13.4 x 2.1-(2.3)-2.6	45.4-(49.8)-56.1 x 3.2-(4.0)-4.6
PA2013-8 Set 129	10	363.8-(387.1)-404.6 x 12.1-14.6-18.5	212.6-(235.8)-278.1 x 4.2-(5.3)-6.2	19.8-(23.5)-38.6 x 2.1-(2.8)-4.6	10.8-(12.3)-13.2 x 2.1-(2.3)-2.8	38.2-(44.7)-59.3 x 2.7-(3.3)-3.8
PA2011-7 Set 95	10	336.6-(388.6)-427.4 x 9.8-(15.1)-17.8	217.2-(240.4)-264.2 x 5.1-(6.4)-7.2	19.2-(22.6)-25.6 x 2.4-(2.8)-3.3	9.0-(11.5)-13.1 x 2.1-(2.4)-2.7	38.6-(42.8)-47.4 x 3.0-(3.6)-3.9
PA2011-7 Set 110	10	373.0-(402.0)-430.8 x 11.7-(14.9)-17.1	217.8-(236.4)-264.3 x 4.3-(6.9)-8.0	18.9-(26.3)-40.2 x 2.2-(2.9)-3.8	10.4-(12.8)-14.7 x 2.1-(2.3)-2.9	39.1-(44.6)-50.5 x 2.3-(3.8)-5.0

ITIS TSN 203973

***Lissodendoryx (Lissodendoryx) lundbecki* (Topsent, 1913)** WORMS AphiaID 168975

Species description

Specimens were beige to yellow in color with a slightly firm, non-compressible and fragile consistency and were often collected as fragments. Fragments were leaf shaped with distinct sides that differ in appearance. The surface of one side is sometimes wavy or thrown into folds that can give rise to anastomosing branches (Figure 32 bottom). The body is porous with elongate holes ranging in size from < 0.5 to 2 mm and fanning out radially. The surface shown in the top panel of Figure 32 appears to have smaller more numerous holes. Surfaces are slightly hispid with spicules projecting from the periphery of each pore (Figure 32). Eight of 21 specimens were examined and fragments ranged in size from 2 to 6 cm long and 0.5-1 cm thick. Some specimens had a slimy whitish coating (possibly eggs) on parts of their surface.

Habitat information

Baffin Bay, Davis Strait and Hudson Strait at 472-909 m depth (Figure 33).

Spicules (Table 11, Figure 34)

Megascleres: Acanthostyles 179-349 by 11-26 µm have thorn-like spines typically more dense on the style head and angled toward it. The acanthostyles are more sharply tapered than the large class of acanthostyles in *Lissodendoryx (Ectyodoryx)* cf. *foliata*. Tornotes (163-227 by 3-7 µm) have slightly unequal and sharply pointed (mucronate) ends.

Microscleres: Arcuate isochelae in two size categories, I and II: 41-72 by 5-12 µm (I) and 19-39 by 2-3 µm (II). Contorted sigmas 20-32 by 2-3 µm.

Distinguishing characteristics

Spicule types in this species also occur in *Lissodendoryx (Ectyodoryx)* cf. *foliata* and *L. (E.)* cf. *multiformis.* These include acanthostyles, mucronate tornotes, arcuate isochelae and small contorted sigmas. These sponges also have a second smaller class of acanthostyles that can be used to distinguish them from *L. (L.) lundbecki*; however the small acanthostyles are not consistently found and therefore may not be a reliable distinguishing character. *L. (L.) lundbecki* can additionally be distinguished from *Lissodendoryx (E.)* cf. *foliata* by having two size classes of chelae instead of one. It is distinguished from *L. (E.)* cf. *diversichela* and *L. (E.)* cf. *multiformis* by having two classes of chelae instead of three and one size class of sigmas instead of two.

Taxonomic remarks

Topsent (1913) recovered the original specimens of *Lissodendoryx (Lissodendoryx) lundbecki* as multiple broken fragments – consistent with the fragility observed in our collected specimens. Topsent suggested that the multiple fragments were pieces of a single larger sponge with a flabelliform body form. The morphological description of Topsent's type specimen matched what we observed in our specimens. The type specimen is leaf or plate shaped but instead of being perfectly flat the sponge has a wavy or folded appearance with two distinct sides – one with smaller more numerous holes than the other. The spicule complement of the type specimen also matches our specimens. Topsent obtained the following spicule measurements, all of which overlapped with our spicule measurements: acanthostyles 290-330 by 14-15 μm, tornotes 200-210 by 5 μm, large isochelae 60 by 6 μm, small isochelae 22-25 μm and sigmas 23 μm. Topsent notes that beyond the two chela size categories, intermediate chela sizes were not uncommon and this is consistent with our broader measured size ranges for chelae: 41-72 μm and 19-29 μm.

CO1 sequences for specimens PA2014-7 Set 69 (BOLD Specimen ID PA2014007107) and PA2010-9 Set 60 (BOLD Specimen ID PA2010009513) are given in Appendix A (I-J) and are identical in 563 bp of overlap with the exception of a single unresolved base.

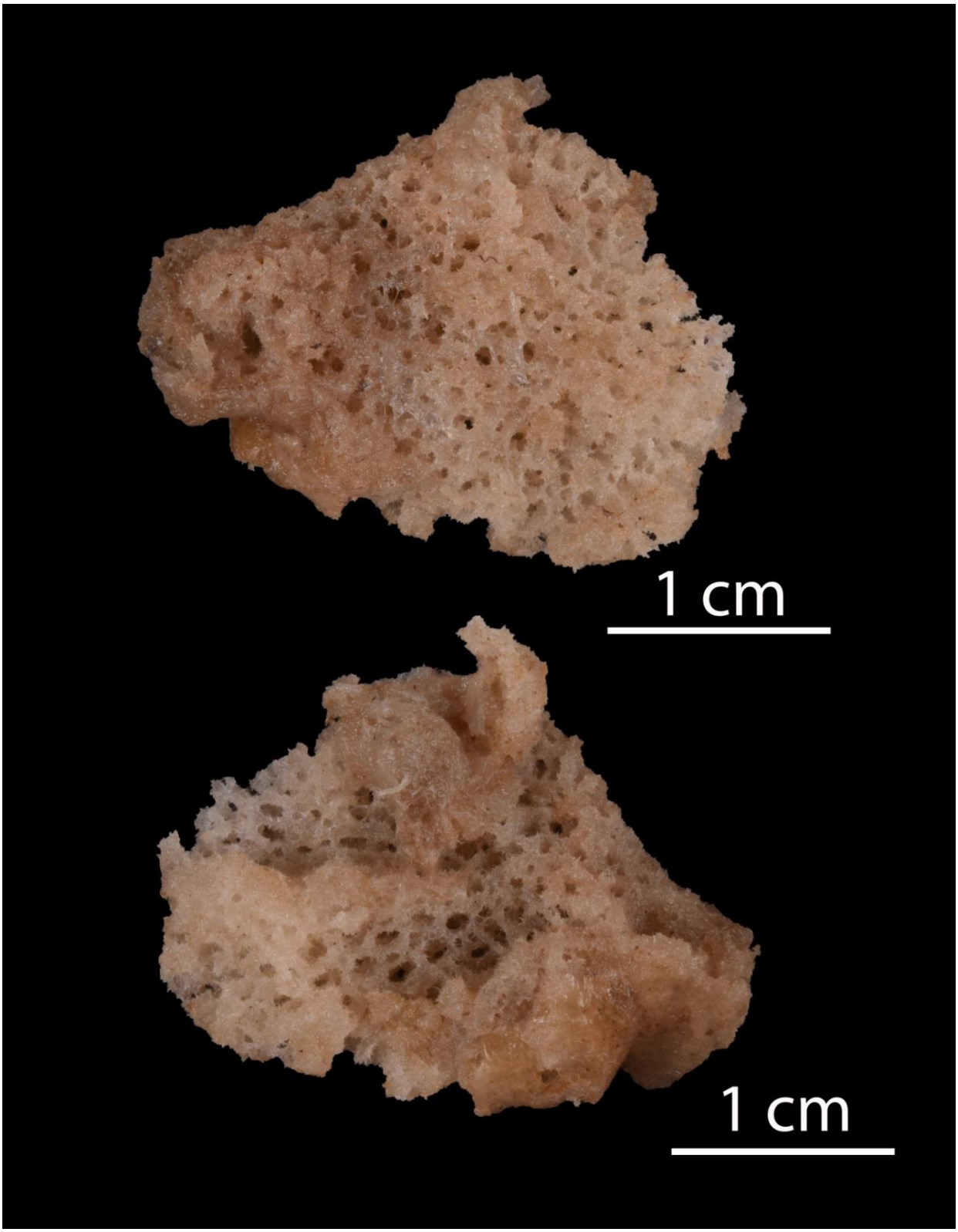

Figure 32. *Lissodendoryx (Lissodendoryx) lundbecki* specimen PA2012 Set 3 showing opposite surfaces. Note that spicule measurements for this specimen are not included in Table 11.

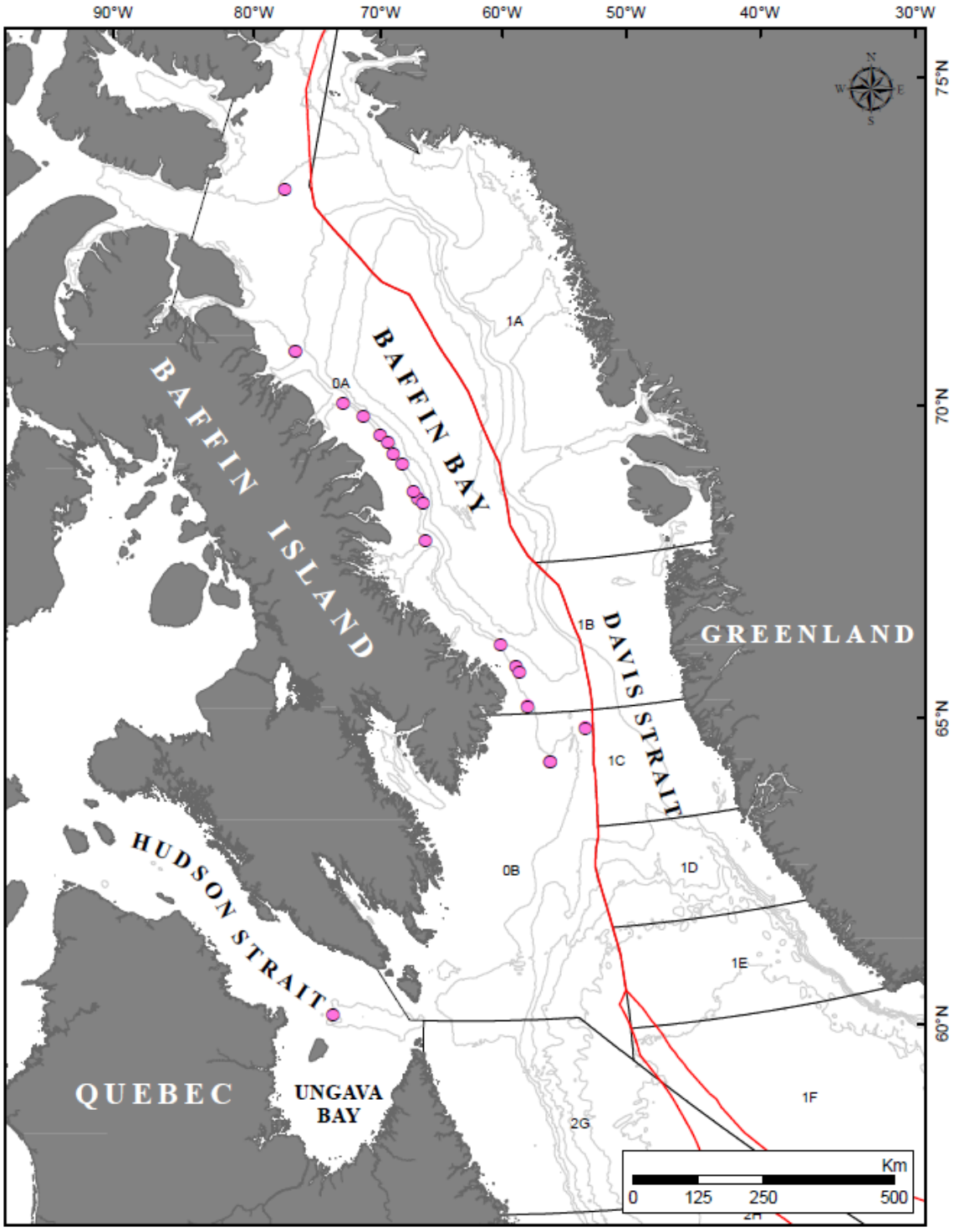

Figure 33. *Lissodendoryx (Lissodendoryx) lundbecki* collection locations. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray.

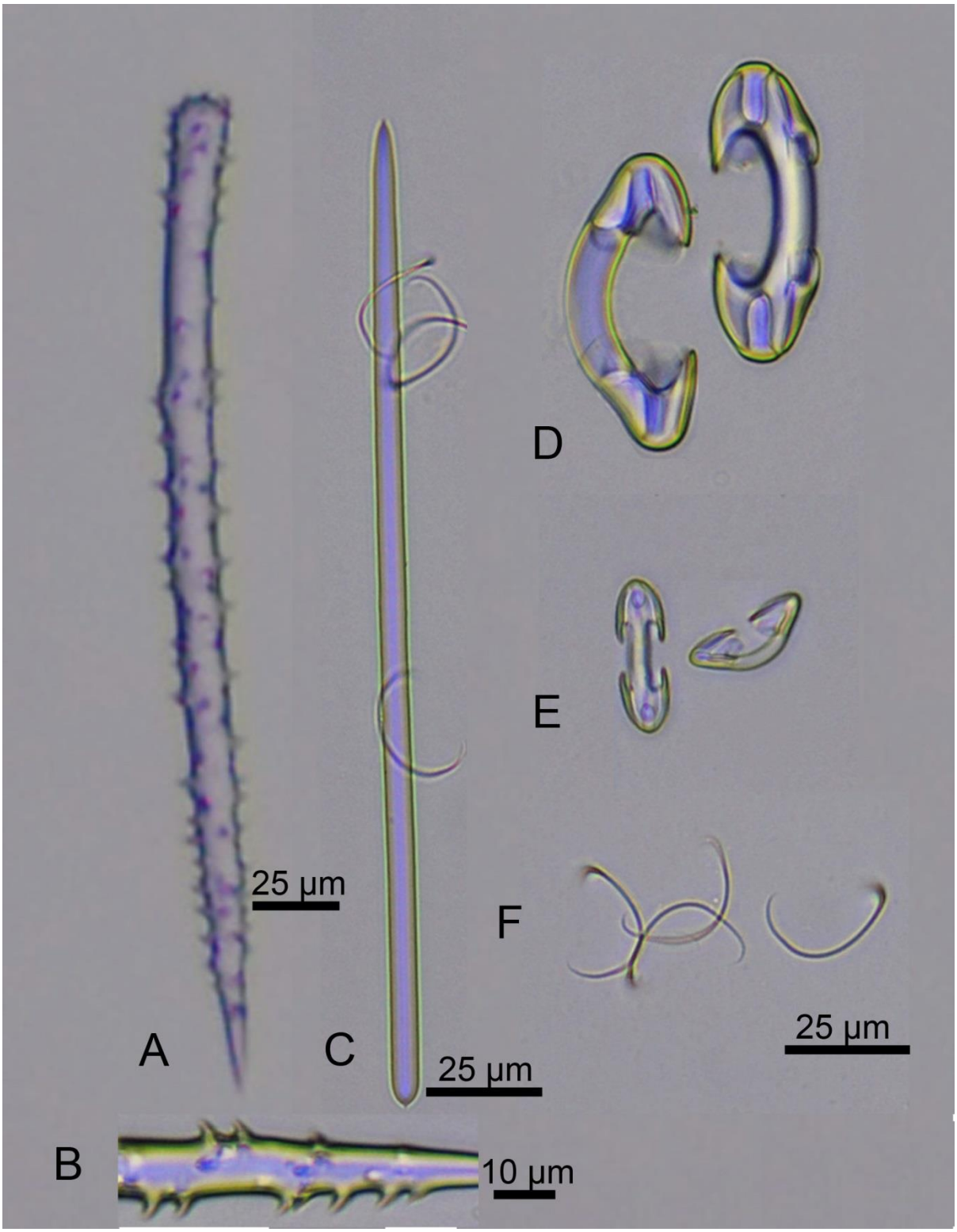

Figure 34. *Lissodendoryx (Lissodendoryx) lundbecki* spicules from specimen PA2014-7 Set 69. Acanthostyle (A), Acanthostyle spine detail (B), Tornote (C), Arcuate isochelae I (D), Arcuate isochelae II (E), Sigmas (F). D-F same scale.

Table 11. *Lissodendoryx (Lissodendoryx) lundbecki* spicule measurements, all reported as minimum-(average)-maximum for length (top line) x width (bottom line) in micrometers (µm).

Collection	n	Acanthostyles	Tornotes	Isochelae I	Isochelae II	Sigmas
PA2014-7 Set 69	30	273.6-(306.1)-332.3 x 11.2-(16.1)-19.6	176.6-(192.1)-214.7 x 4.1-(5.3)-6.8	44.9-(56.9)-63.5 x 5.6-(8.6)-11.0 (n=28)	20.8-(25.4)-39.3 x 2.1-(3.5)-5.0 (n=32)	20.9-(24.7)-30.5 x 2.1-(2.4)-3.2
PA2010-9 Set 60	30	264.4-(316.5)-349.3 x 13.4-(18.3)-25.1	171.7-(197.6)-227.2 x 4.2-(5.5)-6.7 (n=23)	47.9-(56.6)-62.6 x 5.1-(9.8)-12.3 (n=12)	21.1-(25.2)-30.0 x 2.9-(4.0)-5.3	22.1-(26.2)-30.9 x 2.1-(2.4)-2.9
PA2010-9 Set 62	10	273.1-(307.1)-332.8 x 12.8-(14.7)-17.2	179.6-(194.7)-208.6 x 4.3-(5.0)-5.8	50.9-(54.9)-60.7 x 7.0-(8.9)-10.5	23.7-(25.9)-29.9 x 2.8-(3.9)-5.8	22.6-(26.3)-31.5 x 2.1-(2.4)-2.6
PA2014-7 Set 16	10	179.0-(306.4)-335.1 x 14.3-(19.0)-25.6	177.7-(194.0)-211.8 x 2.9-(4.8)-5.6	56.9-(62.4)-68.2 x 7.2-(9.5)-11.7	22.8-(25.5)-31.3 x 2.8-(3.3)-4.7	21.2-(25.3)-28.2 x 2.1-(2.5)-2.9
PA2014 Set 49	10	227.2-(261.7)-285.9 x 13.5-(15.5)-16.6	173.6-(191.6)-204.1 x 4.5-(5.0)-5.6	51.7-(59.9)-71.8 x 7.8-(9.4)-10.9	21.5-(26.9)-36.1 x 2.6-(3.9)-6.8	22.6-(24.7)-27.0 x 2.2-(2.5)-3.0
PA2012-7 Set 101	10	274.9-(296.4)-321.6 x 13.1-(17.1)-20.2	180.4-(194.9)-224.2 x 4.3-(5.5)-6.2	44.2-(56.0)-64.5 x 5.6-(8.4)-10.8	21.6-(23.8)-27.4 x 3.0-(3.7)-4.5	23.8-(25.9)-28.5 x 2.1-(2.5)-3.0
PA2011-7 Set 168	10	260.1-(300.9)-349.0 x 16.7-(20.9)-26.0	191.3-(205.2)-216.1 x 4.8-(6.1)-7.3	40.8-(49.5)-61.4 x 5.9-(8.0)-10.4	20.7-(25.3)-33.3 x 3.0-(4.2)-5.6	20.9-(22.5)-25.5 x 2.2-(2.6)-3.3
PA2013-8 Set 116	10	277.5-(292.0)-301.9 x 15.0-(18.1)-21.3	162.9-(186.6)-208.2 x 5.2-(6.0)-6.6	41.3-(51.4)-59.4 x 5.8-(7.0)-8.8	18.9-(22.6)-26.0 x 3.0-(3.3)-3.8	20.3-(22.2)-23.4 x 2.1-(2.2)-2.4

ITIS TSN 203974

***Lissodendoryx (Lissodendoryx) stipitata* (Arnesen, 1903)** WORMS AphiaID 168994

Species description

The sponge consists of a single leaf or blade attached to a stalk, which in turn is anchored to a pebble. The stalk is firm and appears slightly translucent. The blade is thick and beige in color in ethanol and is composed of dense spicule tracts, giving it a brush-like appearance. The consistency is somewhat compressible, with soft tissue surrounding the fibrous spicule tracts. Holes or grooves are also visible at and below the surface (Figure 35). Only one specimen (5 cm long and 2 cm wide) was collected.

Habitat information

Specimen found in Davis Strait at 398 m depth (Figure 36).

Spicules (Table 12, Figure 37)

Megascleres: Styles are 426-676 by 11-20 µm, and are smooth, gently curved and fusiform in shape, widening at their mid-point. Tornotes are 364-473 by 6-11 µm with unequal ends.

Microscleres: Arcuate isochelae are 29-40 by 2-4 µm. Their shafts are gently curved and alae are elliptical and relatively narrow.

Distinguishing characteristics

This species is morphologically distinct among the sponges in this report, with a thick fleshy blade, composed of numerous spicule tracts, attached to a thin translucent stalk. Nonetheless spicules should be examined to distinguish it from other small stalked sponges including carnivorous sponges and sponges in the Order Suberitida. Among the *Lissodendoryx* species in this report this sponge uniquely lacks sigmas. Spicules include only smooth styles, tornotes, and arcuate isochelae.

Taxonomic remarks

The external morphology of our specimen matches the original description (Arnesen, 1903) and in Koltun (1959). Arnesen described two different types of megascleres: thick, crooked styles 600 by 19 µm, and tornotes (which he termed subtylostrongyla, measurements were not given); and arcuate isochelae 36 µm long for microscleres. Koltun's style and chelae measurements overlap Arnesen's: styles 390-620 by 12-16 µm and arcuate isochelae 32-45 µm long. Tornotes measured 310-488 by 6-10 µm. Our spicule measurements overlapped those reported by both Arnesen and Koltun. We did not obtain a CO1 barcode for this species.

Figure 35. *Lissodendoryx (Lissodendoryx) stipitata* specimen PA2010-9 Set 135 showing opposite surfaces.

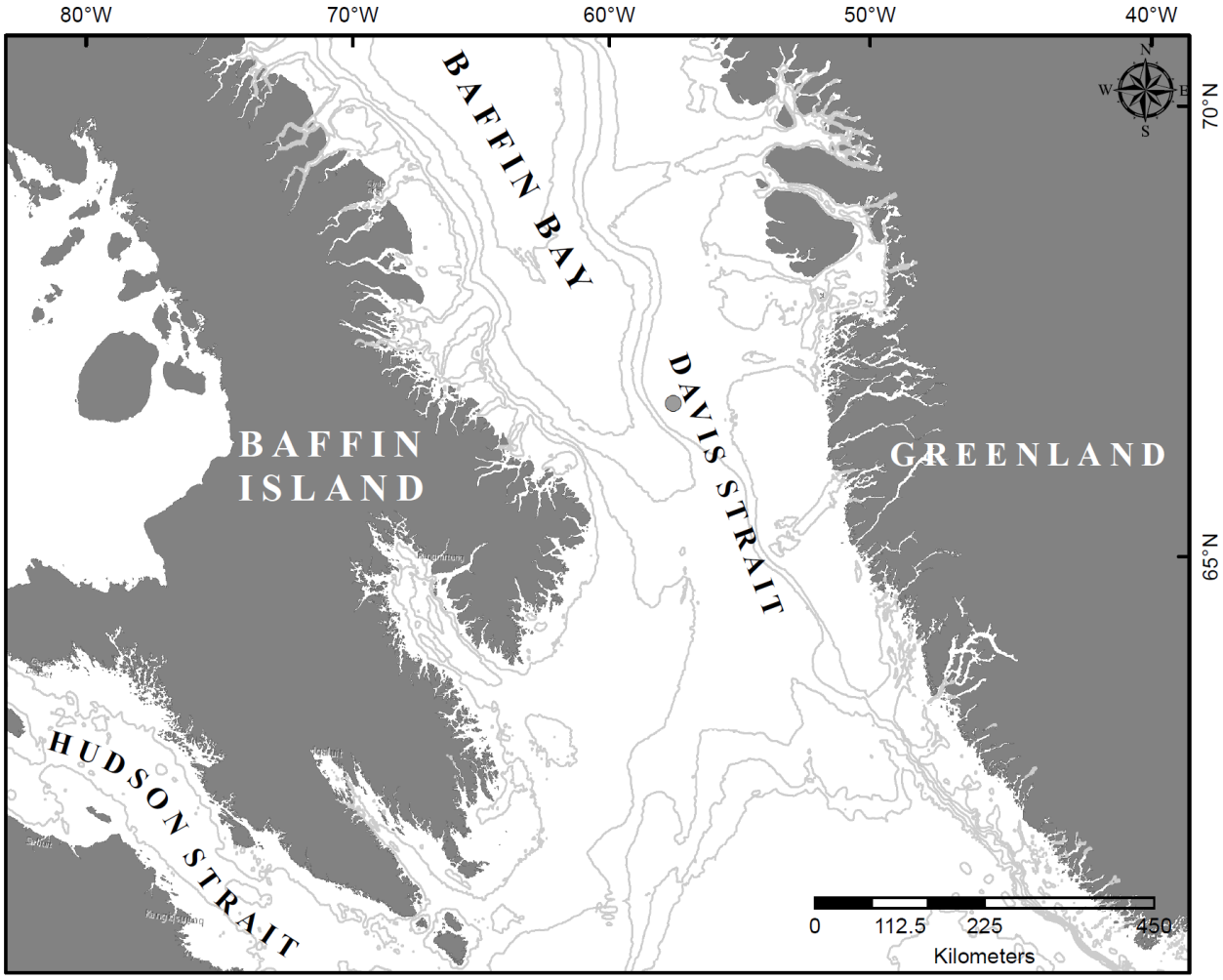

Figure 36. *Lissodendoryx (Lissodendoryx) stipitata* collection location.

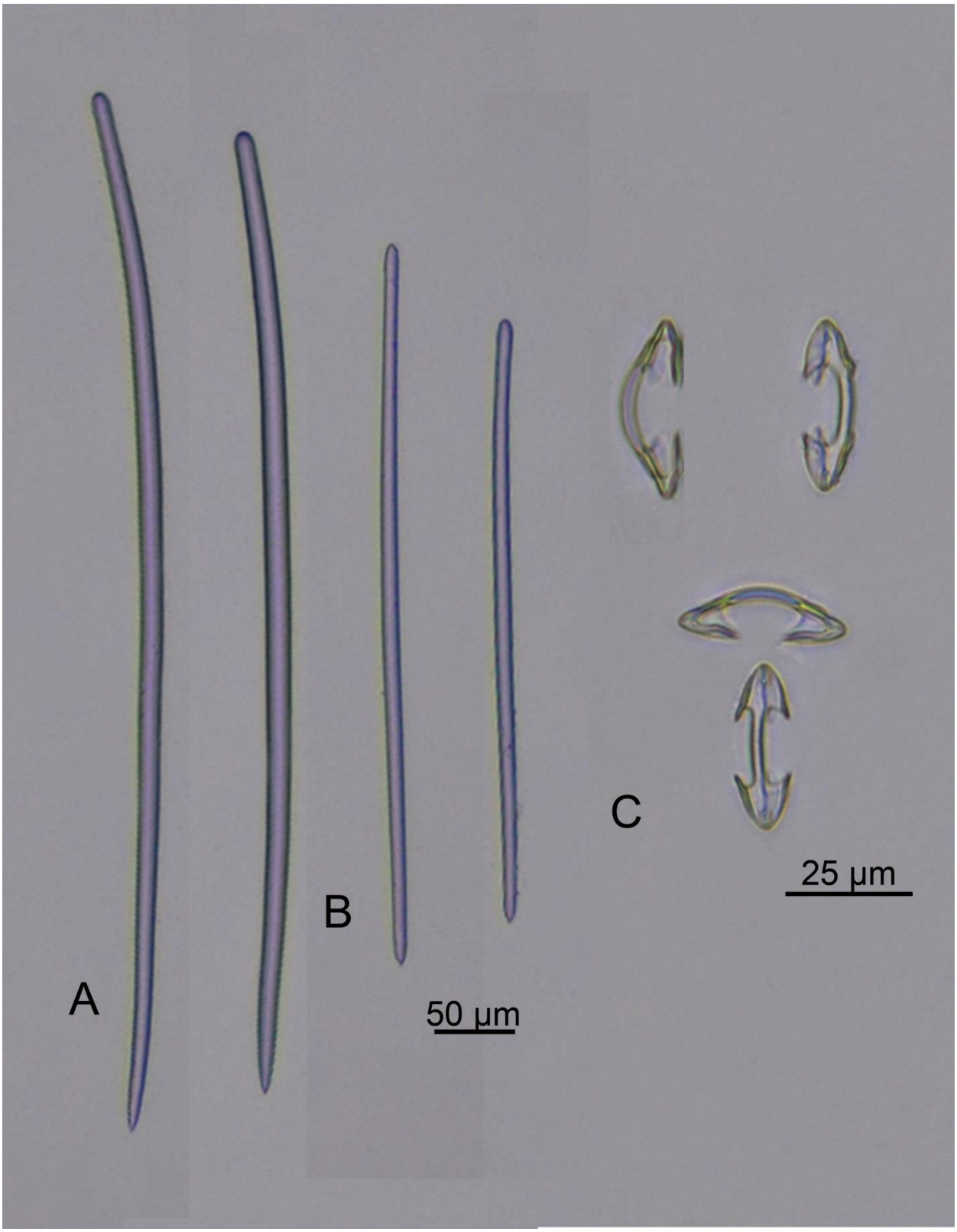

Figure 37. *Lissodendoryx (Lissodendoryx) stipitata* spicules from specimen PA2010-9 Set 135. Styles (A), Tornotes (B), Arcuate isochelae (C). A and B same scale.

Table 12. *Lissodendoryx (Lissodendoryx) stipitata* spicule measurements, all reported as minimum-(average)-maximum for length (top line) x width (bottom line) in micrometers (µm).

Collection	n	Styles	Tornotes	Isochelae
PA2010-9 Set 135	30	425.9-(582.3)-676.2 x 11.2-(15.2)-19.6	364.2-(409.5)-473.2 x 5.8-(8.9)-11.4 (n=8)	28.7-(33.7)-39.8 x 2.1-(3.0)-3.8

ITIS TSN 203971

***Lissodendoryx (Ectyodoryx)* cf. *diversichela* (Lundbeck, 1905)** WORMS AphiaID 1334332

Species description

Specimens were beige in color with a soft friable consistency. Portions of the surface are covered with a very thin membrane and the surface is marked by holes measuring < 1 to 3 mm in diameter. Canals or breaks in the specimen surface are visible as well (Figure 38). Two specimens 2-2.5 cm long by 0.5-1 cm thick were examined.

Habitat information

South of Davis Strait near Hudson Strait at 501-745 m depth (Figure 39).

Spicules (Table 13, Figure 40)

Megascleres: Gradually tapering acanthostyles in two size categories 253-390 by 8-24 μm and 90-126 by 6-8 μm with the heads of the small acanthostyles more heavily spined. Tornotes are tylote-like 223-287 by 5-8 μm with terminal swellings but still terminate in abruptly pointed (mucronate) ends. One end is typically wider than the other.

Microscleres: Arcuate isochelae in three size categories (I=large, II=medium, III=small). Isochelae I are 52-79 by 8-18 μm and characteristic in shape with a strongly curved shaft and short alae. Isochelae II are 19-34 by 2-5 μm. Isochelae III are 9-16 by 2-3 μm. Sigmas were contorted and fall in two size categories. Sigmas I are 27-53 by 2-4 μm and sigmas II are 64-94 by 4-5 μm.

Distinguishing characteristics

Lissodendoryx (Ectyodoryx) cf. *diversichela* is recognizable by the following spicule complement: one or two size classes of acanthostyles, tornotes, three size classes of chelae and two size classes of sigmas. This spicule complement is also seen in *Lissodendoryx (Ectyodoryx)* cf. *multiformis* with overlapping spicule measurements. The two species are difficult to distinguish, differing consistently only in the shape of the large chelae. *L. (E.)* cf. *diversichela* has large isochelae with a strongly curved shaft and short alae (see Figure 19D), similar to the chelae of *Lissodendoryx (Lissodendoryx) complicata.* The small isochelae of *L. (E.)* cf. *diversichela* are similarly shaped, with moderately to strongly curving shafts and small alae. By contrast, the small isochelae of *L. (E.)* cf. *multiformis* have longer alae, giving them a diamond-like shape when face up. This morphology may occur in the small isochelae of *L. (E.)* cf. *diversichela* as well, but it is less typical. Beyond the subtle differences in chela morphology *L. (E.)* cf. *diversichela* and *L. (E.)* cf. *multiformis* barcodes from *L. (E.)* cf. *diversichela* specimen

PA2011-7 Set 135 and *L. (E.)* cf. *multiformis* specimen PA2011-7 Set 157 were obtained and were not identical. Only a partial sequence (383 nucleotides) for *L. (E.) diversichela* was obtained however in a 383 nucleotide overlap the sequence were 97.1% similar to that for *L. (E.)* cf. *multiformis*. The sequences for both were medium or low quality so high quality full length CO1 sequences will be required for a full comparison. The specimens of *L. (E.)* cf. *diversichela* and *L. (E.)* cf. *multiformis* were collected from different areas with the former collected south, close to Hudson Strait and the latter collected north in Davis Strait. *L. (E.)* cf. *diversichela* is also similar in spicule complement to *Lissodendoryx* sp. 1, but *Lissodendoryx* sp. 1 differs in having tylotes instead of tornotes.

Taxonomic remarks

The type specimen described by Lundbeck (1905) was collected as flattened fragments where the largest piece was 0.8 cm thick and 4.5 cm long and is irregular and leaf shaped – possibly a portion of a larger flabelliform sponge. It is described as having a smooth surface and a thin dermal membrane. Morphologically this is consistent with our specimens of *Lissodendoryx (Ectyodoryx)* cf. *diversichela.* Lundbeck reports the following spicule measurements: gently curved acanthostyles 340-429 by 13-21 μm, straight or slightly curved tornotes 238-280 by 5-6 μm, large arcuate isochelae 47-71 by 6-14 μm, medium isochelae 18-28 by 2-3 μm and small chelae 10-15 by 4 μm and contorted sigmas 23-85 by 1-3 μm. Chelae intermediate in size are mentioned as well. All measurements overlap those in our specimens. Notably the characteristic large isochelae described and illustrated by Lundbeck match those in our specimens. Specifically Lundbeck describes large chelae that are very characteristic with their shafts strongly curved almost to a semi-circular and with short and stubby alae and teeth. Since Lundbeck did not report the presence of small acanthostyles in his specimens, we have retained the cf. designation for *L. (E.)* cf. *diversichela* because of small acanthostyles were present in one of our specimens but are not documented in the type specimen (Lundbeck 1905). Given that a small class of acanthostyles is characteristic of the subgenus *Ectyodoryx* it is curious that this sponge is assigned to the subgenus without documented small acanthostyles. Nonetheless small acanthostyles found in one of our two specimens supports inclusion of this species in *Ectyodoryx.* It is possible that this spicule type is absent in some specimens or restricted to only certain areas of the sponge body.

A partial CO1 barcode (383 nucleotides long) was obtained for specimen PA2014-7 Set 135 (BOLD Specimen ID PA2014007310) and is included in Appendix A (K).

Figure 38. *Lissodendoryx (Ectyodoryx)* cf. *diversichela* specimen PA2011-7 Set 112.

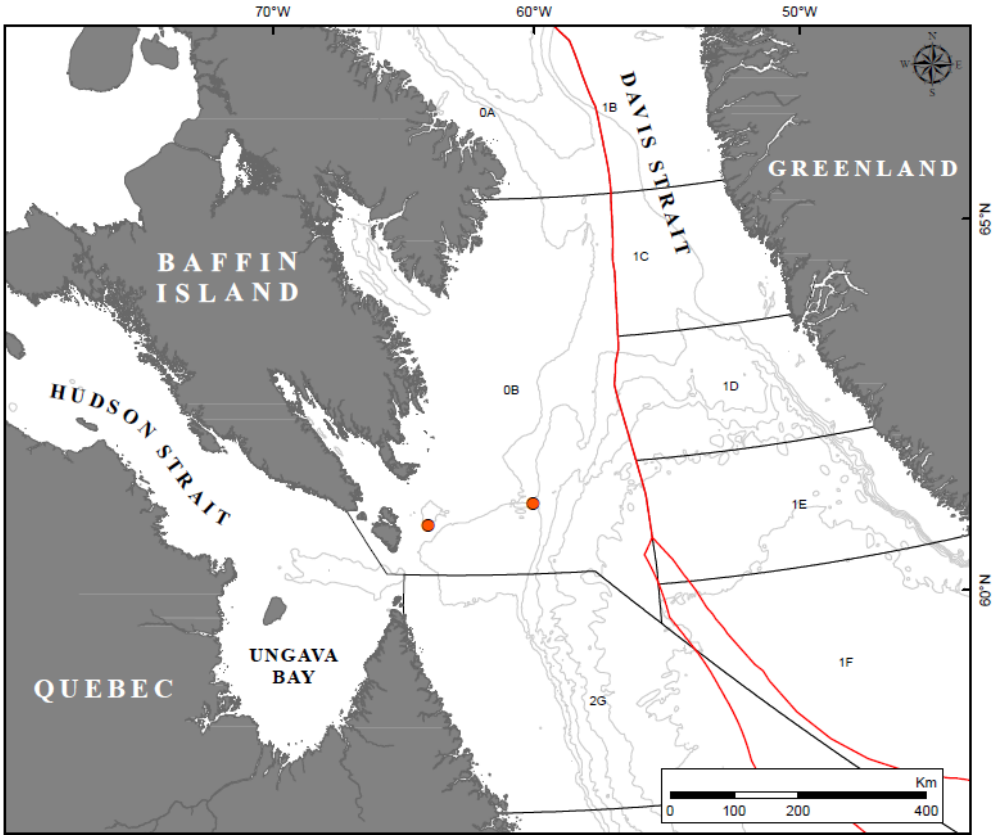

Figure 39. *Lissodendoryx (Ectyodoryx)* cf. *diversichela* collection location. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray.

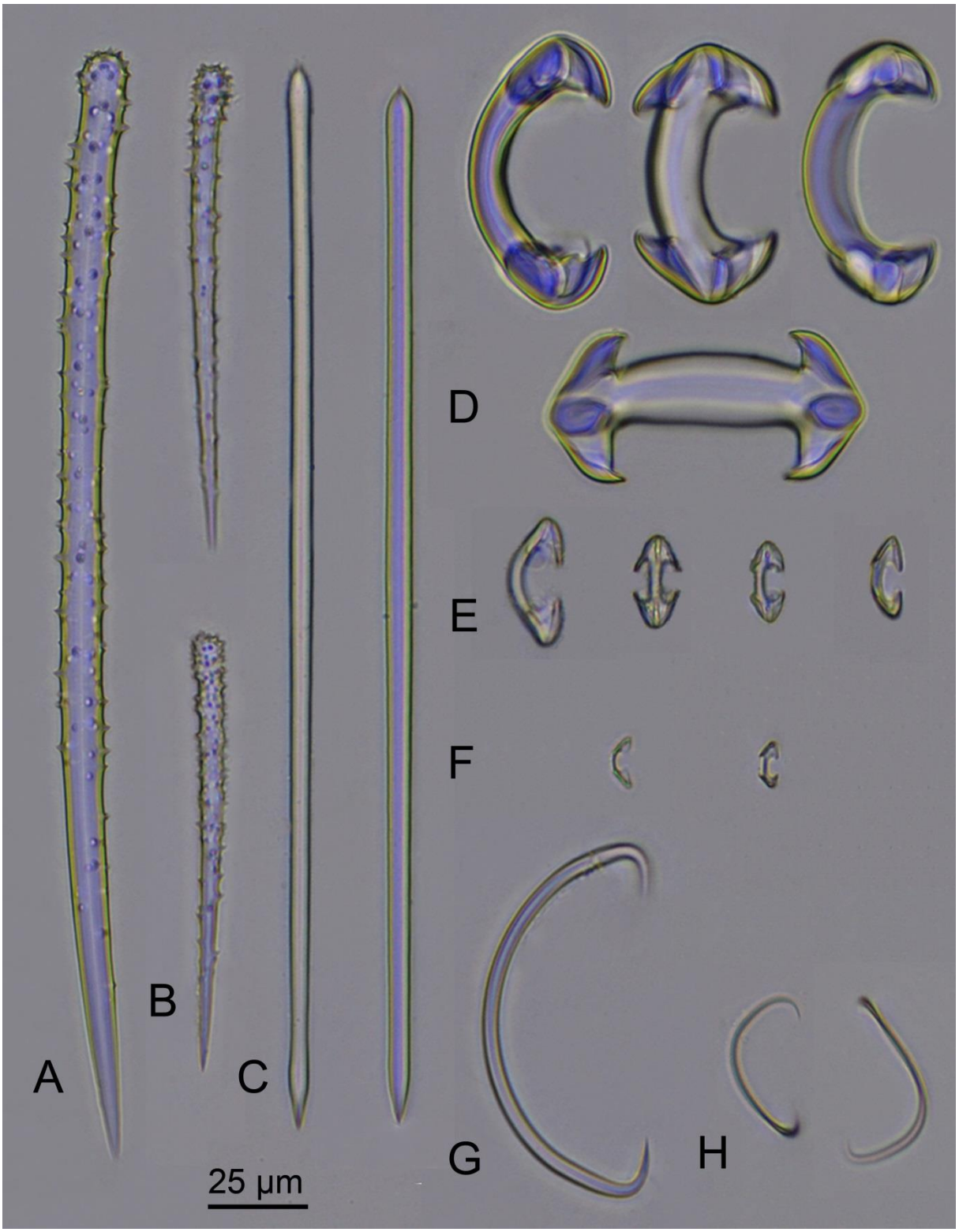

Figure 40. *Lissodendoryx (Ectyodoryx)* cf. *diversichela* spicules from specimen PA2010-9 Set 135. Acanthostyles I (A), Acanthostyles II (B), Tornotes (C), Arcuate isochelae I (D), II (E) and III (F), Large sigmas (G) Small sigmas II (H). A-H, same scale.

Table 13. *Lissodendoryx (Ectyodoryx)* cf. *diversichela* spicule measurements, all reported as minimum-(average)-maximum for length (top line) x width (bottom line) in micrometers (µm).

Collection	n	Acanthostyles I	Acanthostyles II	Tornotes	Isochelae I	Isochelae II	Isochelae III	Sigmas I	Sigmas II
PA2014-7 Set 135	30	253.1-(289.0)-326.3 8.3-(12.7)-16.1	89.5-(114.4)-126.5 5.8-(7.0)-8.4	242.3-(266.7)-287.1 4.6-(5.7)-8.0	52.9-(66.0)-79.0 8.2-(12.5)-18.4	19.5-(22.8)-30.0 2.5-(3.2)-4.8	9.1-(11.6)-14.5 2.1-(2.4)-2.8	26.6-(38.1)-52.6 2.1-(2.6)-3.5 (n=24)	63.6-(72.6)-82.5 3.7-(4.2)-5.1 (n=6)
PA2011-7 Set 112	30	343.1-(390.5)-437.9 15.4-(19.5)-23.7		222.7-(246.5)-270.2 4.7-(6.6)-8.0	51.8-(60.1)-72.5 8.5-(11.6)-16.1	18.8-(24.2)-33.6 2.2-(3.2)-5.0	9.6-(11.9)-16.2 2.1-(2.4)-2.9	27.4-(41.0)-53.7 2.1-(2.8)-3.6 (n=22)	73.8-(85.7)-94.2 3.8-(4.4)-5.4 (n=8)

ITIS TSN 659700 (subgenus)

Lissodendoryx (Ectyodoryx)* cf. *foliata WORMS AphiaID 168919

Species description

Sponge is pinkish-beige with a soft, friable consistency. Mound to irregular shaped. Surfaces are slightly hispid; however the outer surface and choanosome are difficult to distinguish. The body is porous, with holes ranging in size from 0.5 to 3 cm (Figure 41). Five pieces ranging in size from 1-6 cm long and 0.5-2 cm thick were examined. Two specimens each were examined from PA2010-9 Set 107 and PA2014-7 Set 70.

Habitat information

Davis Strait at 539-707 m depth (Figure 42).

Spicules (Table 14, Figure 43)

Megascleres: Acanthostyles in two size categories (I and II). The larger acanthostyles (I) are 250-321 by 11-19 μm, sparsely spined, taper gradually and are sometimes slightly curved. The small acanthostyles are 76-146 by 4-14 μm, have expanded and more densely-spined heads and taper sharply. Small acanthostyles were rare or absent in some spicule preps. Tornotes are 165-223 by 5-9 μm with tylote-like swollen ends that are slightly unequal and sharply pointed (mucronate). Additional swellings sometimes occur on the tornote shaft.

Microscleres: Arcuate isochelae 20-38 by 3-6 μm and small contorted sigmas 21-32 by 2-4 μm.

Distinguishing characteristics

This species is distinguished by its spicule characteristics including two size classes of acanthostyles and one size class each of tornotes, arcuate isochelae and sigmas. While small acanthostyles are missing in some of our specimens the possession of small acanthostyles is a character of the subgenus *Ectyodoryx.* This sponge is easily distinguished from the other *Lissodendoryx (Ectyodoryx)* sponge in this report because *Lissodendoryx (Ectyodoryx)* cf. *diversichela* and *L. (E.)* cf. *multiformis* have multiple size classes of both chelae and sigmas.

Taxonomic remarks

Lissodendoryx (Ectyodoryx) foliata was originally described by Fristedt (1887) as *Hastatus foliata*, and later transferred to the genus *Ectyodoryx* before assigning it to the genus *Lissodendoryx* while keeping *Ectyodoryx* as the subgenus. The type specimen collected from the east coast of Greenland is described as a small leaf-shaped sponge 3.5 cm long and only 3 mm thick. This description is not consistent with the lump-like sponge collected in PA2010-9 Set 107; as indicated by Fristedt the sponge is very fragile and the type specimen is probably a small fragment. The surface of the type specimen is smooth and described as perforated by many small disperse holes. Fristedt describes and draws the spicules of the type specimen including curved acanthose pointed spicules (styles) 130-300 μm in length, smooth spicules with mucronate ends (tornotes) 200 μm in length, isochelae 35 μm in length and thin C and S curved sigmas 20 μm in length. The original description lacked details of the skeleton however Lundbeck (1909) examined the type specimen and confirmed that it had echinating acanthostyles – a characteristic of the subgenus *Ectyodoryx*.

Topsent (1928) describes a thin encrusting sponge not more than 1 mm thick with a matching spicule complement and identified it as *Ectyodoryx foliatus.* However, the megasclere lengths reported by Topsent are considerably longer than those reported by Fristedt (260-315 by 3-8 μm vs. 200 μm for tornotes and 420-490 by 14-15 μm vs. 247-321 by 11-19 μm for large acanthostyles). The small acanthostyles were 135-160 and up to 190 μm. For miscroscleres Topsent measured arcuate isochelae 32-35 μm long and sigmas 16-20 μm. The larger tylote and large acanthostyle measurements given for Topsent's specimen cast doubt on whether Topsent's *Ectyodoryx foliatus* is the same as Fristedt's type specimen. This is problematic given that Topsent's description is listed in the World Porifera Database as an additional source for *Lissodendoryx foliata.* Moreover, the Sponges of the NE Atlantic resource housed on the Marine Species Identification Portal combines Fristedt's original measurements with the spicule figure drawn by Topsent (1928) despite the discrepancies in spicule sizes. The source of this spicule figure is listed as Arndt (1935) however it originally comes from Topsent (1928). Given the discrepences between the early descriptions of *Lissodendoryx foliata* we maintain the cf. designation pending further comparison with type material.

CO1 sequences were obtained for three specimens, two of which were from the same trawl set: PA2014-7 Set 71 (BOLD Specimen ID PA2014007120), PA2014-7 Set 71 (BOLD Specimen ID PA2014007569) and PA2012-7 Set 154 (BOLD Specimen ID PA2012007350). The sequences are included in Appendix A (L-N).

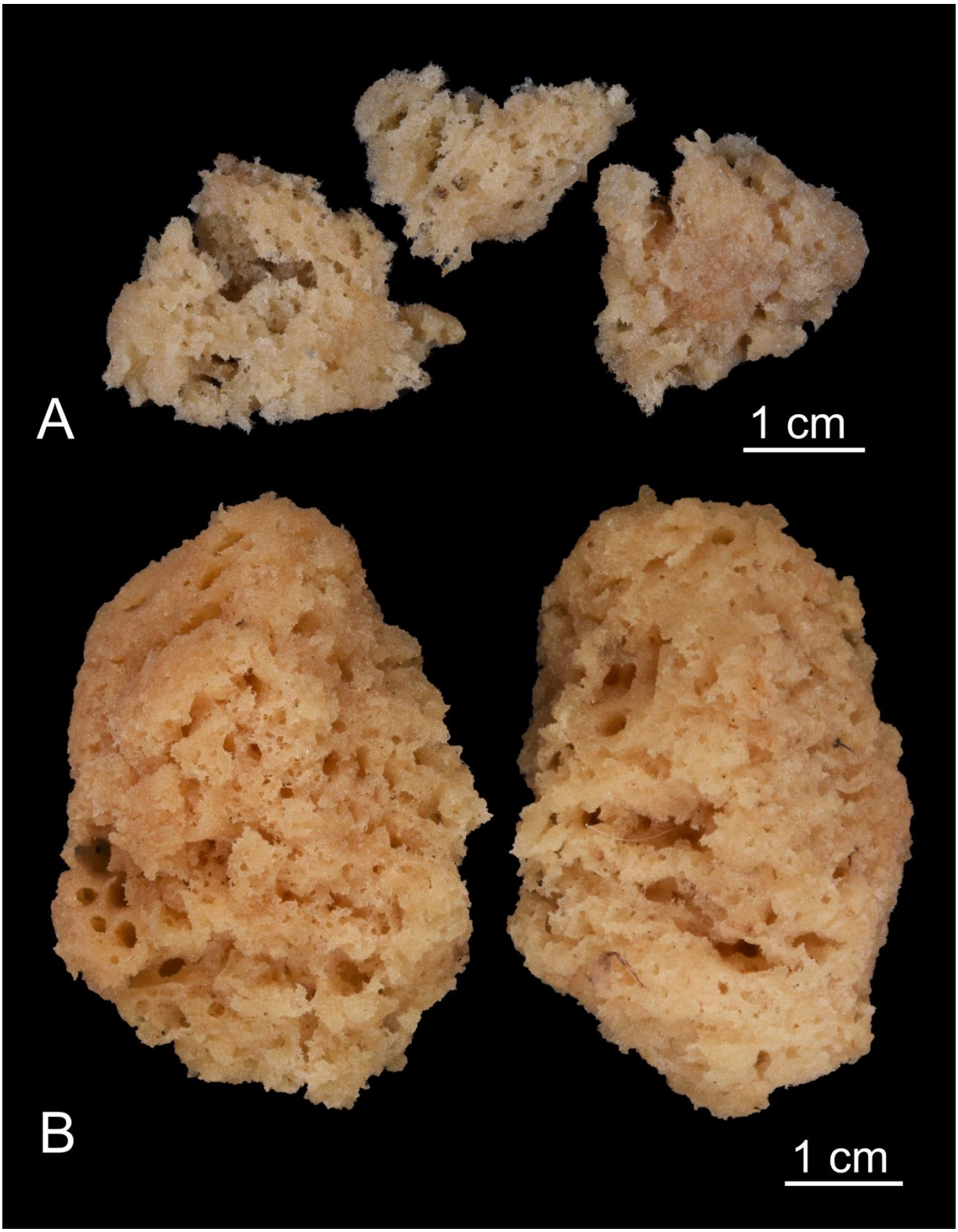

Figure 41. *Lissodendoryx (Ectyodoryx)* cf. *foliata* fragments from PA2012-7 Set 154 (A) and specimen from PA2010-9 Set 107b (B) showing opposite surfaces.

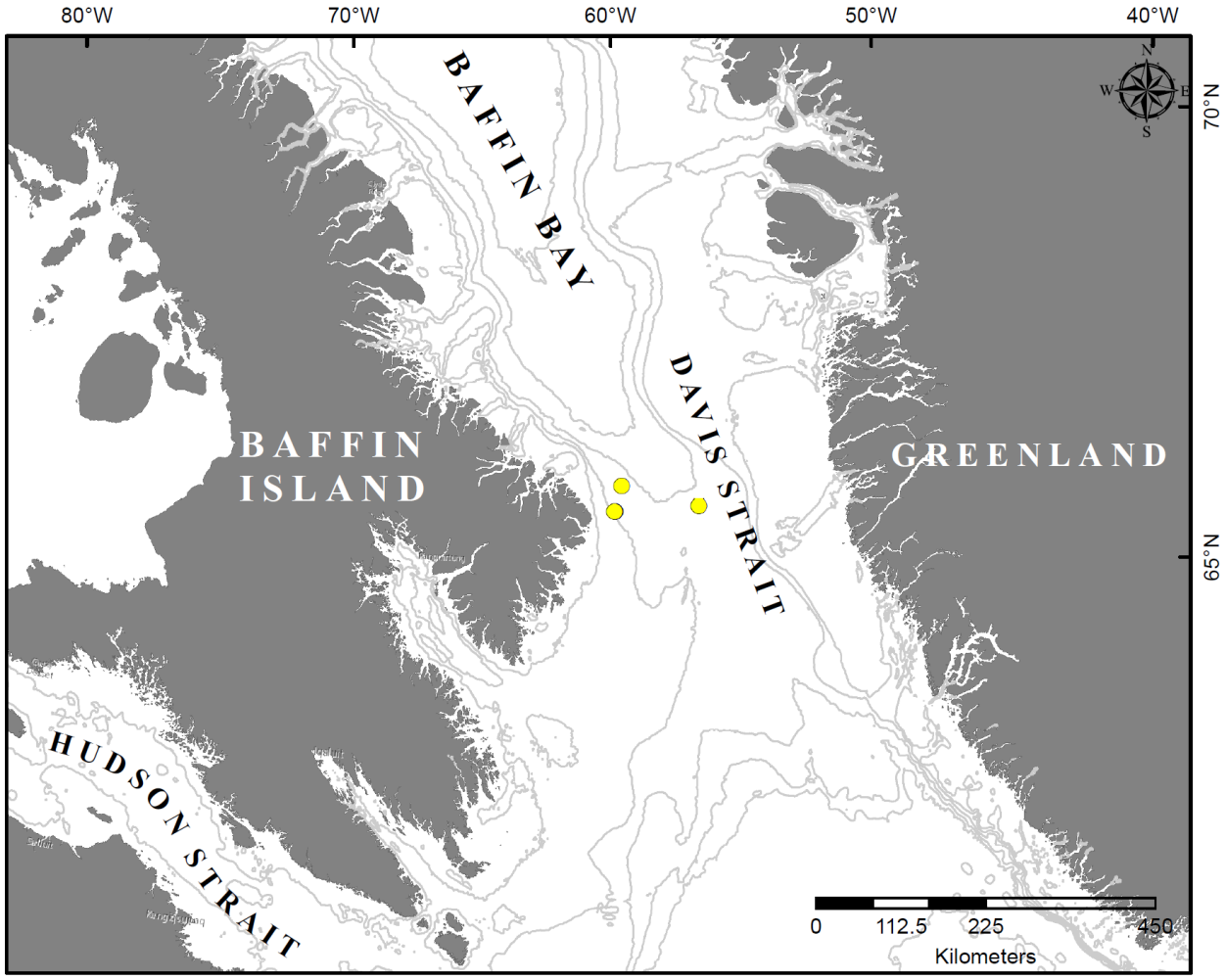

Figure 42. *Lissodendoryx (Ectyodoryx)* cf. *foliata* collection locations.

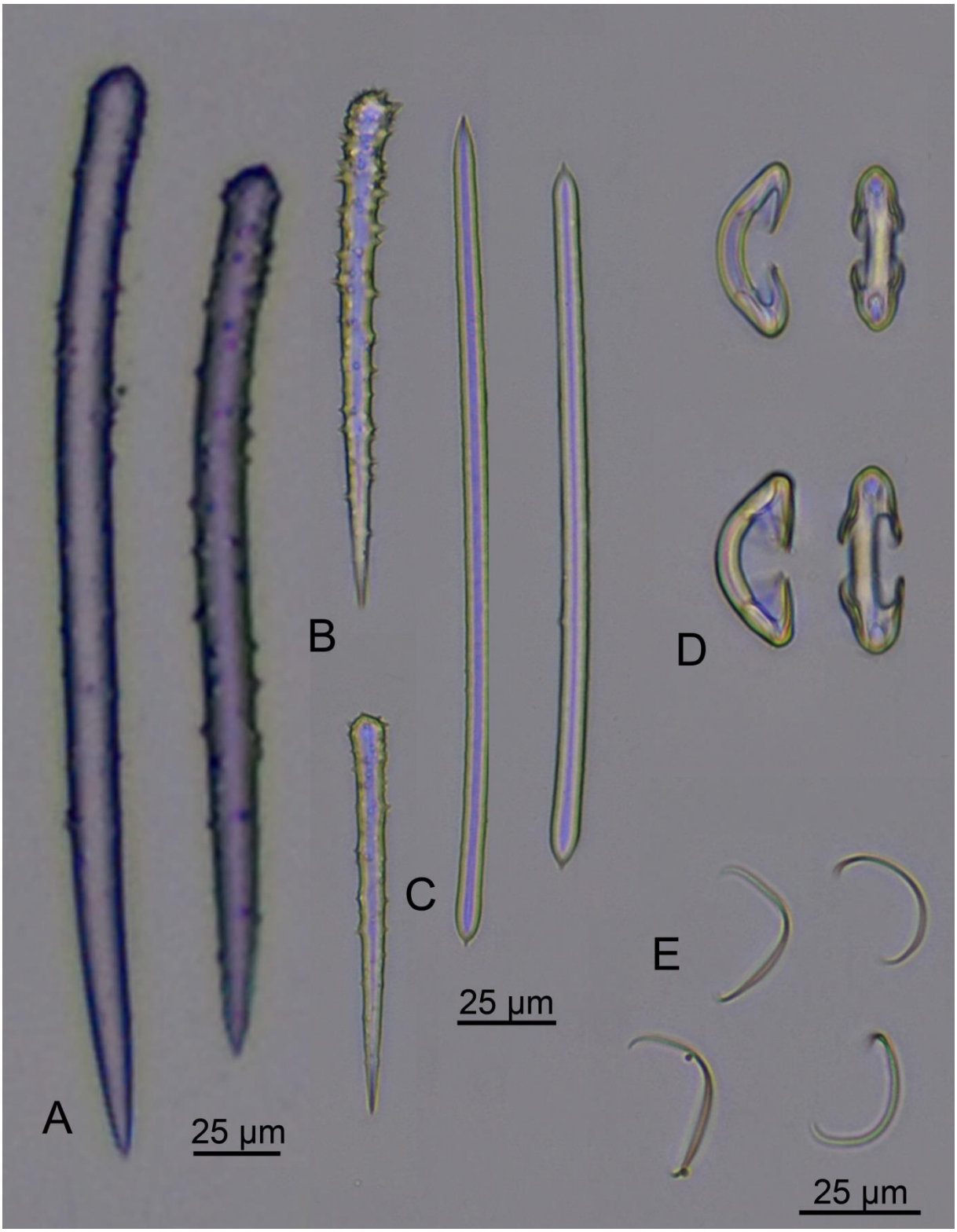

Figure 43. *Lissodendoryx (Ectyodoryx)* cf. *foliata* spicules from specimen PA2012-7 Set 154. Large acanthostyles (A), Amall acanthostyles (B), Tornotes (C), Arcuate isochelae (D), Sigmas (E). B and C same scale. D and E same scale.

Table 14. *Lissodendoryx (Ectyodoryx)* cf. *foliata* spicule measurements, all reported as minimum-(average)-maximum for length (top line) x width (bottom line) in micrometers (µm).

Collection	n	Acanthostyles I	Acanthostyles II	Tornotes	Isochelae	Sigmas
PA2012-7 Set 154	30	253.7-(284.1)-309.6 x 12.1-14.6-19.1	76.1-(107.9)-146.3 x 4.1-(8.4)-13.6	172.2-(200.4)-217.9 x 5.2-(6.4)-7.6	20.0-(29.7)-37.4 x 2.9-(4.4)-5.9	21.4-(25.6)-31.8 x 2.1-(2.4)-3.0
PA2014-7 Set 71	30	250.1-(286.6)-321.1 x 10.7-(14.4)-18.1		167.4-(205.3)-223.4 x 4.6-(6.4)-7.6	24.0-(31.9)-37.9 x 3.2-(4.4)-5.8	21.6-(26.3)-29.7 x 2.1-(2.4)-2.9
PA2014-7 Set 71	30	269.0-(293.4)-319.0 x 10.7-(14.1)-18.1		199.4-(214.8)-229.2 x 5.0-(6.6)-8.3	24.0-(33.7)-42.1 x 2.7-(4.6)-6.3	22.0-(26.2)-30.8 x 2.1-(2.4)-3.2
PA2010-9 Set 107a	10	253.2-(274.6)-298.7 x 12.8-(15.6)-18.9	111.1-(120.5)-129.9 x 11.9-(12.1)-12.3 (n=3)	165.0-(189.6)-205.0 x 5.8-(7.2)-9.0	23.4-(29.1)-34.1 x 3.0-(4.1)-4.7	22.0-(25.6)-30.5 x 2.1-(2.4)-3.0
PA2010-9 Set 107b	10	246.8-(276.0)-309.5 x 11.2-(15.1)-18.5		181.8-(195.2)-209.4 x 5.6-(6.4)-7.6	27.3-(32.3)-44.0 x 3.7-(4.7)-6.2	21.4-(24.2)-27.5 x 2.4-(2.5)-2.7

ITIS TSN 659700 (subgenus)

***Lissodendoryx (Ectyodoryx)* cf. *multiformis* (Brønsted 1932)** WORMS AphiaID 168926

Species description

The sponge is beige to pinkish beige, has a soft friable consistency and was collected as small fragments. A thin dermal membrane is visible on portions of the specimens and the surface is marked by small holes or canals measuring < 0.5 mm to 2 mm in diameter (Figure 44). Six specimens were examined and ranged in size from 1 to 2.5 cm long and 0.5 to 1 cm thick.

Habitat information

Davis Strait at 445-787 m depth (Figure 45).

Spicules (Table 15, Figure 46)

Megascleres: Gradually tapering acanthostyles in two size categories. Acanthostyles I are 274-414 by 11.2-26.5 μm. Acanthostyles II are 112-210 by 9-16 μm and may be rare or absent in some spicule preparations. Tornotes may have equal or slightly unequal ends with mucronate tips on one or both ends. They measure 163-271 by 4-10 μm.

Microscleres: Three size classes of arcuate isochelae (I=large, II=medium, III=small). Isochelae I are 30-74 by 5-14 μm with a gently curved shaft and alae appear to flare outward slightly. Isochelae II are 18-36 by 2-6 μm and Isochelae III are 10-19 by 2-3 μm. Viewed face on, the small isochelae have a characteristic diamond-like appearance with the upper and lower alae nearly touching. There may be overlap in the sizes of chela classes or a continuum of sizes. Sigmas were contorted and measured 24-84 by 2-6 μm. While there appear to be two size classes measuring around 25-45 and 55-80 μm we have combined all sigma measurements in our table and instead present the overall range in and average sigma measurements.

Distinguishing characteristics

Lissodendoryx (Ectyodoryx) cf. *multiformis* is distinguished from other sponges in this report by the following spicule complement: two size classes of acanthostyles, tornotes, three size classes of chelae where the large chelae have a characteristic shape, and two size classes of sigmas. *Lissodendoryx (Ectyodoryx)* cf. *diversichela* also summarized in this report only differs noticeably from *L. (E.)* cf. *multiformis* in the shape of the chelae. The large isochelae found in *L. (E.)* cf. *multiformis* have less strongly curved shafts than those found in *L. (E.)* cf. *diversichela*, and many of the large chelae in *L. (E).* cf. *multiformis* have alae that flare outward slightly. The small isochelae in *L. (E.)* cf. *multiformis* have alae that may be slightly longer relative to the overall spicule length, giving them a diamond-like shape when face up. This morphology can be present in *L. (E.)* cf. *diversichela* as well, but it is less typical. Alone, the differences in chela

shape may be insufficient to present *L. (E.)* cf. *multiformis* and *L. (E.)* cf. *diversichela* specimens as separate species in this report. However, barcodes of *L. (E.)* cf. *diversichela* specimen PA2011-7 Set 135 and *L. (E.)* cf. *multiformis* specimen PA2011-7 Set 157 are not identical. Specimens of *L. (E.)* cf. *diversichela* and *L. (E.)* cf. *multiformis* were collected from different areas with the former collected south, close to Hudson Strait and the latter collected north in Davis Strait. *L. (E.)* cf. *multiformis* is also similar in spicule complement to *Lissodendoryx* sp. 1 in this report – but *Lissodendoryx* sp. 1 has tylotes instead of tornotes.

Taxonomic remarks

The type specimen of *Lissodendoryx (Ectyodoryx)* cf. *multiformis* is described as an 8 mm long piece with an elastic consistency and an even surface marked by pores 50-100 um in diameter. Like in our specimens a dermal membrane was visible on parts of the type specimen. Brønsted (1933) reports the following spicule measurements: gently curved large acanthostyles 300-384 by 12 μm and rare straight small acanthostyles 120-168 by 10 μm and straight or slightly curved tornotes of unknown length with one end that tapers abruptly to a sharp point (mucronate) and the other end either tapering more evenly or also mucronate. The tornotes in our specimens have a similar morphology. Brønsted's acanthostyle measurements overlap those in our specimens but without tornote measurements of the type specimen we cannot fully compare measurements. Large and medium arcuate isochelae in the type specimen had evenly curved shafts and measured 55-65 μm and 24-30 μm with intermediate sizes mentioned as well. Consistent with these measurements our medium and large isochelae together span 18-74 μm with many intermediates and possibly a continuum of sizes. The small category of isochelae in Brønsted's description are strongly curved with long alae like in our specimens and similarly measure about 10 μm. Finally the sigmas in the type specimen may be regular or contorted and measure 58-71 and 25-42 μm, consistent with our measurement range of 24-84 μm with possible size classes within measuring 55-80 μm and 25-45 μm. Overall the morphology and spicule decriptions and measurements in our specimens are consistent with those in *Lissodendoryx (Ectyodoryx) multiformis.* Despite the convincing match however we retain *cf.* in our specimen name since we are lacking tornote measurements from the type specimen for comparison with our measurements. Brønsted also notes that the skeletal organization of the type specimen appeared confused rather than the reticulate arrangement that would be expected for *Ectyodoryx*. Further examination of skeletal organization of our specimens may help to clarify the type of skeletal organization. Van Soest includes Brønsted's description of *Lissodendoryx multiformis* in the "Sponges of the NE Atlantic" and notes that the skeletal arrangement described by Brønsted is more typical of the genus *Phorbas.*

A CO1 barcode for specimen PA2011-7 Set 157 (BOLD Specimen ID PA2011007459) was obtained and is included in Appendix A (O) but is low in quality.

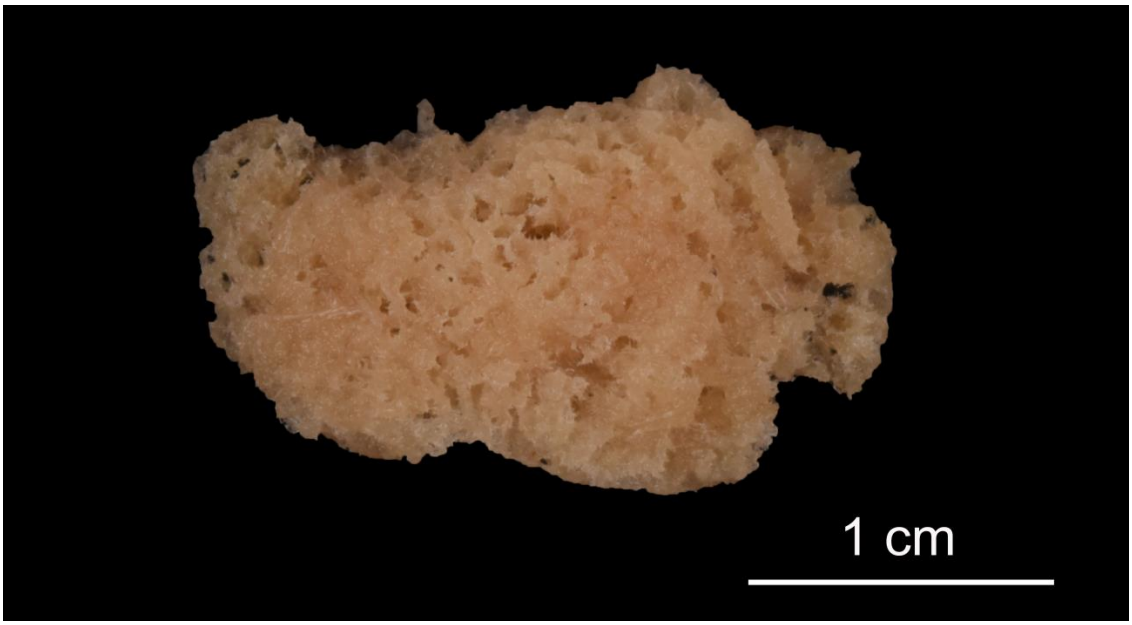

Figure 44. *Lissodendoryx (Lissodendoryx)* cf. *multiformis* specimen PA2011-7 Set 157.

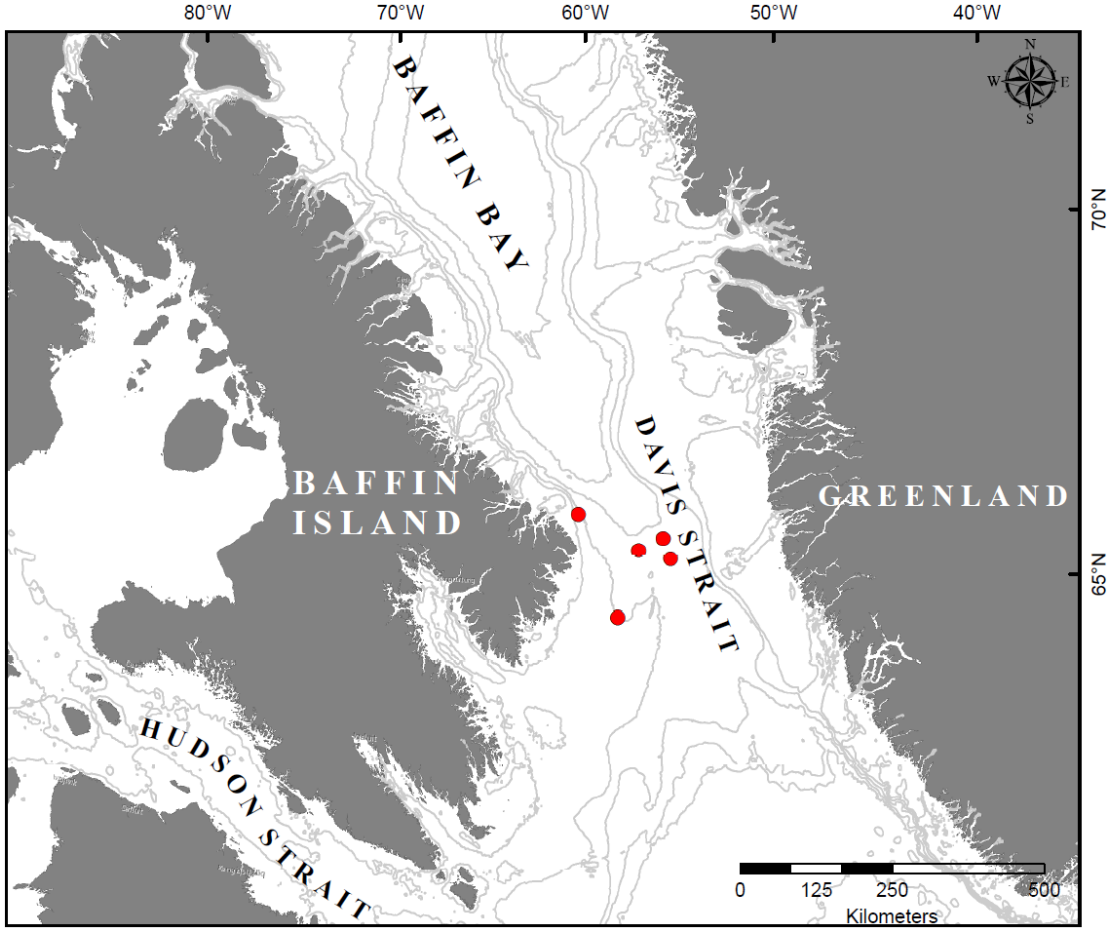

Figure 45. *Lissodendoryx (Ectyodoryx)* cf. *multiformis* collection locations.

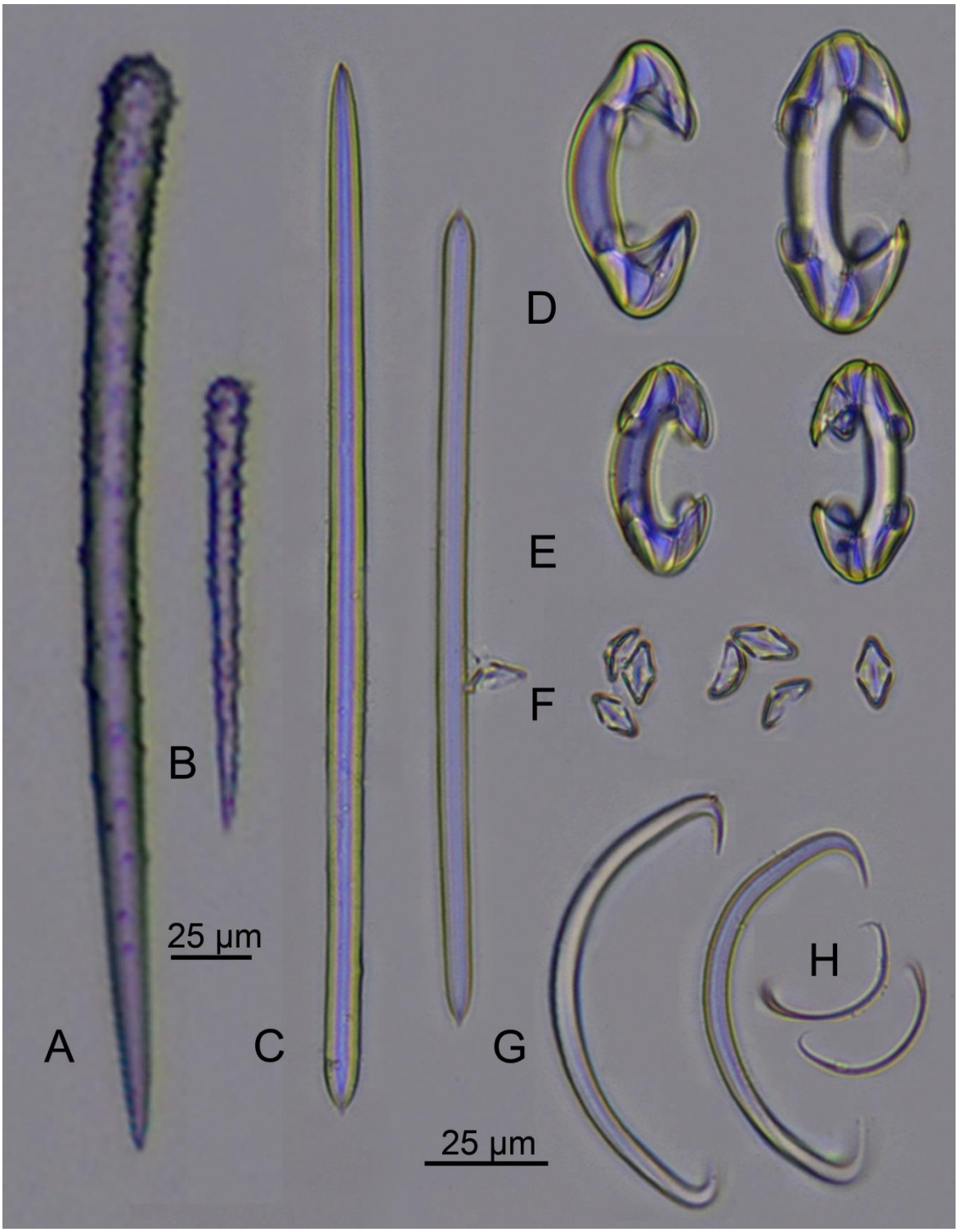

Figure 46. *Lissodendoryx (Ectyodoryx)* cf. *multiformis* spicules from specimen PA2011-7 Set 157. Acanthostyle I (A), Acanthostyle II (B), Tornote (C), Arcuate isochelae I (D), Arcuate isochelae II (E), Arcuate isochelae III (F), Sigmas I (G), Sigmas II (H). A-C same scale. D-H same scale.

Table 15. *Lissodendoryx (Ectyodoryx)* cf. *multiformis* spicule measurements, all reported as minimum-(average)-maximum for length (top line) x width (bottom line) in micrometers (µm).

collection	n	Acanthostyles I	Acanthostyles II	Tornotes	Isochelae I	Isochelae II	Isochelae III	Sigmas
PA2010-9 Set 161	30	316.0-(362.1)-414.1	145.0-(168.8)-208.2	211.5-(238.7)-267.3	40.3-(45.2)-50.3	22.0-(25.8)-34.0	13.8-(17.5)-19.0	39.3-(53.1)-64.3
		11.2-(15.7)-20.4	9.0-(11.6)-15.4	4.2-(5.8)-7.0	5.5-(7.6)-9.4 (n=28)	2.2-(3.5)-6.0 (n=3)	2.1-(2.5)-3.2 (n=29)	2.4-(3.0)-3.9
PA2011-7 Set 157	30	287.4-(328.7)-369.5	115.6-(146.1)-210.4	163.1-(213.1)-250.1	30.5-(52.4)-74.3	17.8-(26.5)-35.6	9.7-(11.7)-15.0	23.9-(49.6)-82.0
		16.5-(19.9)-26.5	10.2-(13.3)-16.5	5.6-(7.6)-10.0	4.7-(8.4)-11.2	3.2-(4.4)-6.3	2.1-(2.4)-2.9	2.1-(3.5)-5.8 (n=60)
PA2010-9 Set 103	10	286.8-(319.1)-348.2	136.3	189.2-(214.9)-235.0	32.6-(56.9)-71.5	17.8-(24.4)-29.3	11.3-(12.6)-14.5	24.7-(47.8)-83.8
		15.4-(18.6)-21.4 (n=9)	12.8 (n=1)	7.1-(8.5)-10.0	4.6-(9.5)-13.6	2.5-(3.7)-5.4	2.1-(2.4)-2.9	2.2-(3.3)-5.1
PA2010-9 Set 158	10	274.0-(317.9)-365.3		220.1-(251.0)-271.5	39.9-(52.3)-58.9	20.0-(25.2)-30.4	10.0-(12.0)-15.5	28.3-(41.7)-63.0
		13.5-(16.0)-18.1		4.6-(7.2)-9.7	5.9-(8.6)-10.9	2.8-(3.9)-4.3	2.1-(2.4)-2.8	2.4-(3.0)-3.8
PA2010-9 Set 158	10	331.6-(356.4)-401.5	111.9-(122.2)-137.1	231.7-(246.4)-253.6	32.9-(48.8)-58.3	23.0-(26.8)-30.3	11.0-(11.9)-13.7	27.1-(51.5)-75.6
		15.4-(17.5)-20.4	9.0-(11.6)-14.4	5.6-(6.8)-7.5	5.0-(9.0)-11.2	3.0-(4.3)-5.4	2.1-(2.4)-2.8	2.1-(3.1)-4.6 (n=20)
PA2010-9 Set 167	10	308.9-(355.9)-400.7	126.1-(136.1)-151.0	210.6-(236.2)-260.3	54.8-(60.2)-68.5	22.0-(25.6)-28.9	11.1-(12.3)-13.8	28.5-(50.6)-71.0
		14.3-(16.9)-19.6	9.0-(10.7)-13.5	5.9-(6.9)-8.0	7.5-(8.5)-10.6	3.2-(3.8)-4.5	2.1-(2.5)-2.9	2.2-(3.4)-4.8 (n=20)

ITIS TSN 48067 (genus)

***Lissodendoryx* sp. 1** WORMS AphiaID 131930 (genus)

Species description

Two orange-brown pieces of this sponge were collected from a single trawl set. The reverse surfaces of these two pieces are shown in Figure 47 (compare A and B). The specimens appear to be broken pieces but may narrow to a basal area that could be the attachment. The body expands in a plumose arrangement; however the overall body form cannot be determined from the pieces in our collection. The outer surface appears to be intact in the left specimen (Figure 47B) and the sponge has a smooth exterior with a thin dermal membrane marked by holes measuring 0.5 to 2 mm in diameter. Other visible surfaces presumably show the sponge interior and visible canals.

Habitat information

Hudson Strait north of Ungava Bay at 183 m depth (Figure 48).

Spicules (Table 16, Figure 49)

Megascleres: Gently curved thick or thin acanthostyles that taper gradually along their length or are even in width along most of the spicule and then taper gradually. The thick acanthostyles are 306-370 by 9-17 μm and the thin acanthostyles are 240-334 by 3-7 μm. Unlike the other acanthostyle containing *Lissodendoryx* species in this report this species has tylotes instead of tornotes. Tylotes are 213-279 by 4-7 μm and may be considered tylotostrongyli since the terminal swelling is not obvious or not visible at all on the wide end of the spicule, and this end appears strongyle-like. The shaft tapers from the wide to the narrow end of the tylote and at the narrow end a terminal swelling may or may not be visible.

Microscleres: Arcuate isochelae in three size categories (I=large, II=medium, III=small). Isochelae I are 40-62 by 4-7 μm. Like the large isochelae in *Lissodendoryx (Ectyodoryx)* cf. *diversichela* the alae flare out slightly. Isochelae II are 19-36 by 2-5 μm and isochelae III are 13-19 μm. Sigmas are contorted and 28-62 by 2-4 μm, either as a continuum of sizes or with possible size classes 28-35 μm and 43-62 μm.

Distinguishing characteristics

This species is disntinguished from other *Lissodendoryx* species in this report by having tylote megascleres in combination with acanthostyles. *Lissodendoryx (Lissodendoryx) complicata* also has tylotes but its styles are smooth, instead of acanthose and it is also morphologically distinct. The spicule complement in *Lissodendoryx* sp. 1 is very similar to *Lissodendoryx (Ectydoryx)* cf.

diversichela and *L. (E.)* cf. *multiformis.* These species share the presence of acanthostyles, three size classes of arcuate isochelae and sigmas in a broad size range with overlapping measurements. Despite these similarities the presence of tylotes instead of tornotes clearly distinguishes *Lissodendoryx* sp. 1.

Taxonomic remarks

The collected specimens did not contain a small acanthostyle class to place them in the subgenus *Ectyodoryx* however we have noticed that small acanthostyles may be rare or absent in some examined species but not others. For this reason we provisionally leave this species at the genus level instead of assigning it to the subgenus *Lissodendoryx.*

The spicule complement in this species may be found in either of the genera *Lissodendoryx* or *Coelosphaera*. Both may contain acanthostyles, tylotes or strongyles, arcuate isochelae and sigmas. Because *Lissodendoryx* sp. 1 does not have a hollow fistular body characteristic of the genus *Coelosphaera* it is provisionally identified as a *Lissodendoryx* instead of *Coelosphaera* despite having a spicule complement that matches both.

A CO1 barcode was obtained for specimen PA2013-8 Set 130 (BOLD Specimen ID PA2013008264) and is included in Appendix A (P).

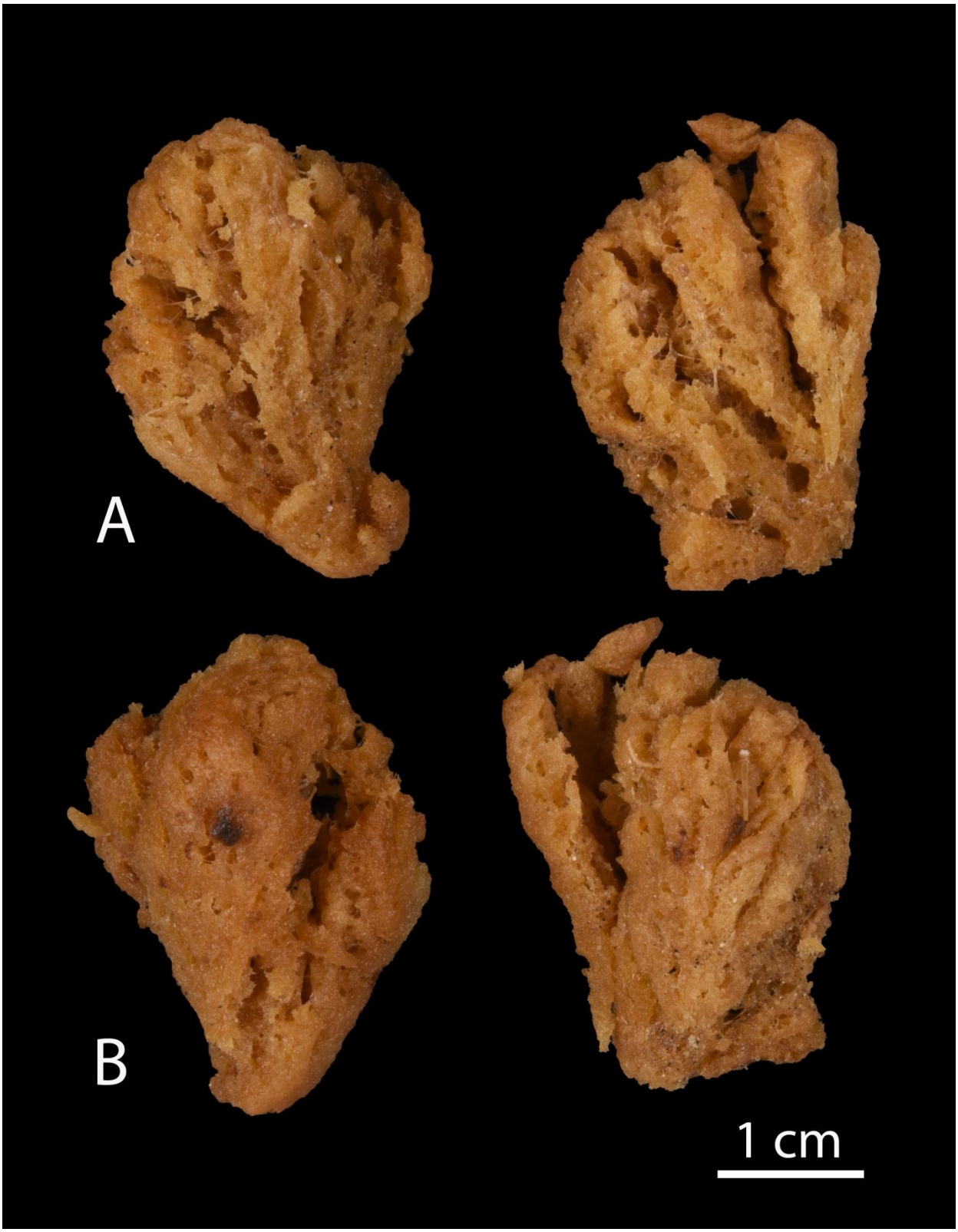

Figure 47. *Lissodendoryx* sp. 1 specimens from PA2013-8 Set 130 showing opposite surfaces of two specimens in A and B.

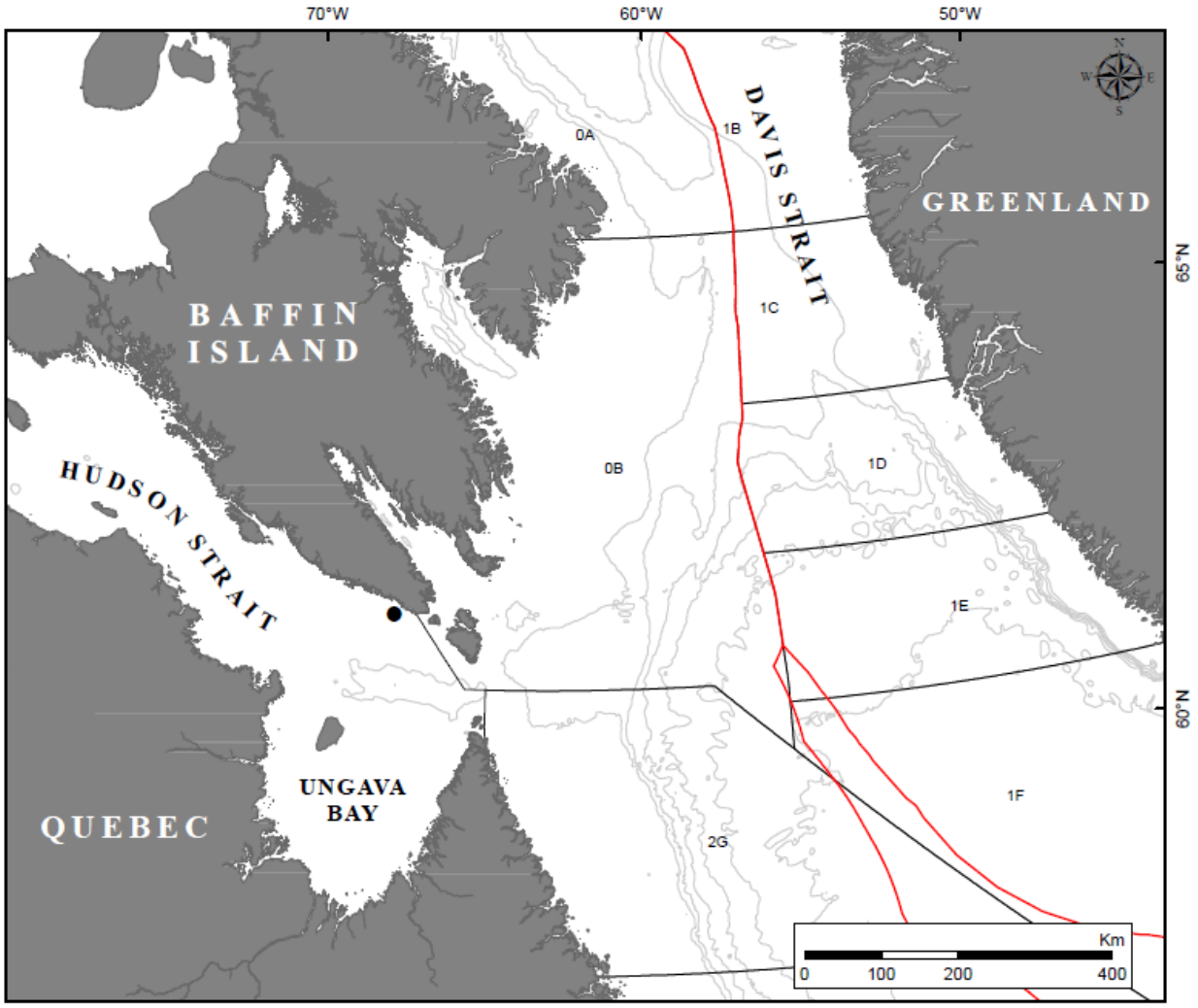

Figure 48. *Lissodendoryx* sp. 1 collection location. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated in red. Depth contours at 500m intervals (500 to 3000 m) are in light gray.

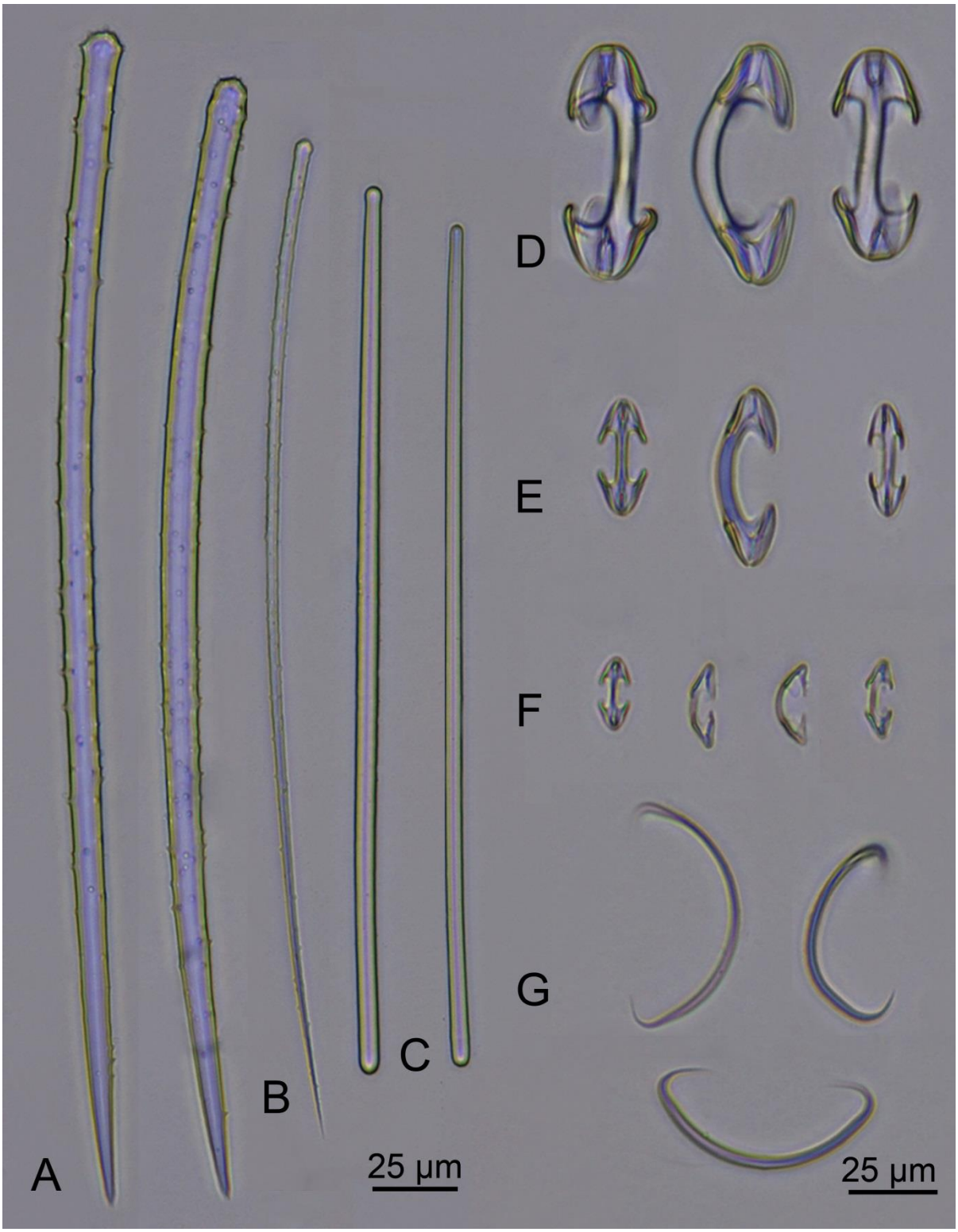

Figure 49. *Lissodendoryx* sp. 1 spicules from specimen PA2013-8 Set 130. Acanthostyles (A), Thin acanthostyle (B), Tylotes (C), Arcuate isochelae I (D), Arcuate isochelae II (E), Arcuate isochelae III (F) and Sigmas (G). A-C same scale. D-G same scale.

Table 16. Measurements of spicules from *Lissodendoryx* sp. 1 all reported as minimum-(average)-maximum for length (top line) x width (bottom line). N indicates the number of spicule measurements per specimen.

Collection	n	Acanthostyles	Thin Acanthostyles	Tylotes	Isochelae I	Isochelae II	Isochelae III	Sigmas
PA2013-8 Set 130	30	305.6 -(330.0)- 369.9 x 9.0 -(11.2)- 16.6	240.3 -(282.0)- 334.4 x 2.6 -(4.3)- 6.6	212.9 -(251.8)- 279.3 x 4.2 -(5.6)- 7.3	39.7 -(53.8)- 62.2 x 4.1 -(5.5)- 7.2	18.8 -(25.5)- 36.2 x 2.2 -(3.0)- 4.6	12.9 -(15.7)- 18.8 x 2.1 -(2.3)- 2.8	28.0 -(49.3)- 61.5 x 2.2 -(3.0)- 3.9

ACKNOWLEDGEMENTS

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APPENDIX A

Barcode of Life Database (BOLD) specimen data and sequence page screen shots from the BOLD project Sponges of the Eastern Arctic [EAS] managed by Ellen L. Kenchington. BOLD pages were prepared for the following specimens: **A.** *Forcepia (Forcepia) fabricans* BOLD Specimen ID PA2010009465 (PA2010-9 Set 128), **B.** *Forcepia (Forcepia) fabricans* BOLD Specimen ID PA2013008047 (PA2013-8 Set 16), **C.** *Forcepia (Forcepia) forcipis* BOLD Specimen ID PA2013008203 (PA2013-8 Set 56), **D.** *Forcepia (Forcepia) forcipula* BOLD Specimen ID PA2011007135 (PA2011-7 Set 45), **E.** *Forcepia (Forcepia) forcipula* BOLD Specimen ID PA2011007163 (PA2011-7 Set 69), **F.** *Forcepia (Forcepia)* aff. *japonica* BOLD Specimen ID PA2011007639 (PA2011-7 Set 139), **G.** *Forcepia (Forcepia) thielei* BOLD Specimen ID PA2011007115 (PA2011-7 Set 36), **H.** *Forcepia (Leptolabis)* cf. *brunnea* BOLD Specimen ID PA2014007550 (PA2014-7 Set 78), **I.** *Lissodendoryx (Lissodendoryx) lundbecki* BOLD Specimen ID PA2014007107 (PA2014-7 Set 69), **J.** *Lissodendoryx (Lissodendoryx) lundbecki* BOLD Specimen ID PA2010009513 (PA2010-9 Set 60), **K.** *Lissodendoryx (Ectyodoryx)* cf. *diversichela* PA2014007310 (PA2014-7 Set 135), **L.** *Lissodendoryx (Ectyodoryx)* cf. *foliata* BOLD Specimen ID PA2014007120 (PA2014-7 Set 71), **M.** *Lissodendoryx (Ectyodoryx)* cf. *foliata* BOLD Specimen ID PA2014007569 (PA2014-7 Set 71), **N.** *Lissodendoryx (Ectyodoryx)* cf. *foliata* BOLD Specimen ID PA2012007350 (PA2012-7 Set 154), **O.** *Lissodendoryx (Ectyodoryx)* cf. *multiformis* BOLD Specimen ID PA2011007459 (PA2011-7 Set 157), **P.** *Lissodendoryx* sp. 1 BOLD Specimen ID PA2013008264 (PA2013-8 Set 130).

A.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2010009465
Process ID: EAS009-17
Identification: Foroepia fabricans

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-05

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *640 bp*

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AGTGATGATTGGTGGGTTTGGGAATTGGTTTGTGCCCTTATATATTGGGGCGCCCGACAT
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ATTGGCTTCTGCTTTTGTGGAGCAAGGGGGGGGTACTGGGTGAACAGTTTATCCCCCGTT
ATCCGGGATTCAGGCTCATTCCGGGGGTTCAGTAGATTTGGTAATATTTAGTTTACATTT
AGCGGGGATCTCTTCTATATTAGGAGCTATGAATTTTATTACTACTATAATAAATATGAG
GGCGCCGGGGGATAACAATGGATAGAATGCCCTTGTTTGTTTGGTCTATTTTAGTAACTGC
GGTTTTATTATTATTATCTTTACCAGTATTAGCAGGTGCCATTACTATGTTATTAACGGA
TAGAAATTTCAATACTGCTTTTTTTGATCCTGCGGGGGGG
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Composition: A (143), C (161), C (89), T (247)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *229 residues*

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VMIGGFGNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGGGTGWTVYPPL
SGIQAHSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRAPGITMDRMPLFVWSILVTA
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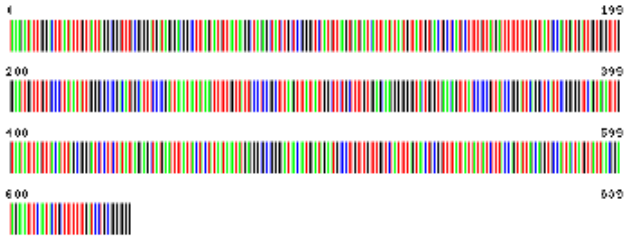
ILLUSTRATIVE BARCODE



SEQUENCING RUNS: Bedford Institute of Oceanography

Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198				
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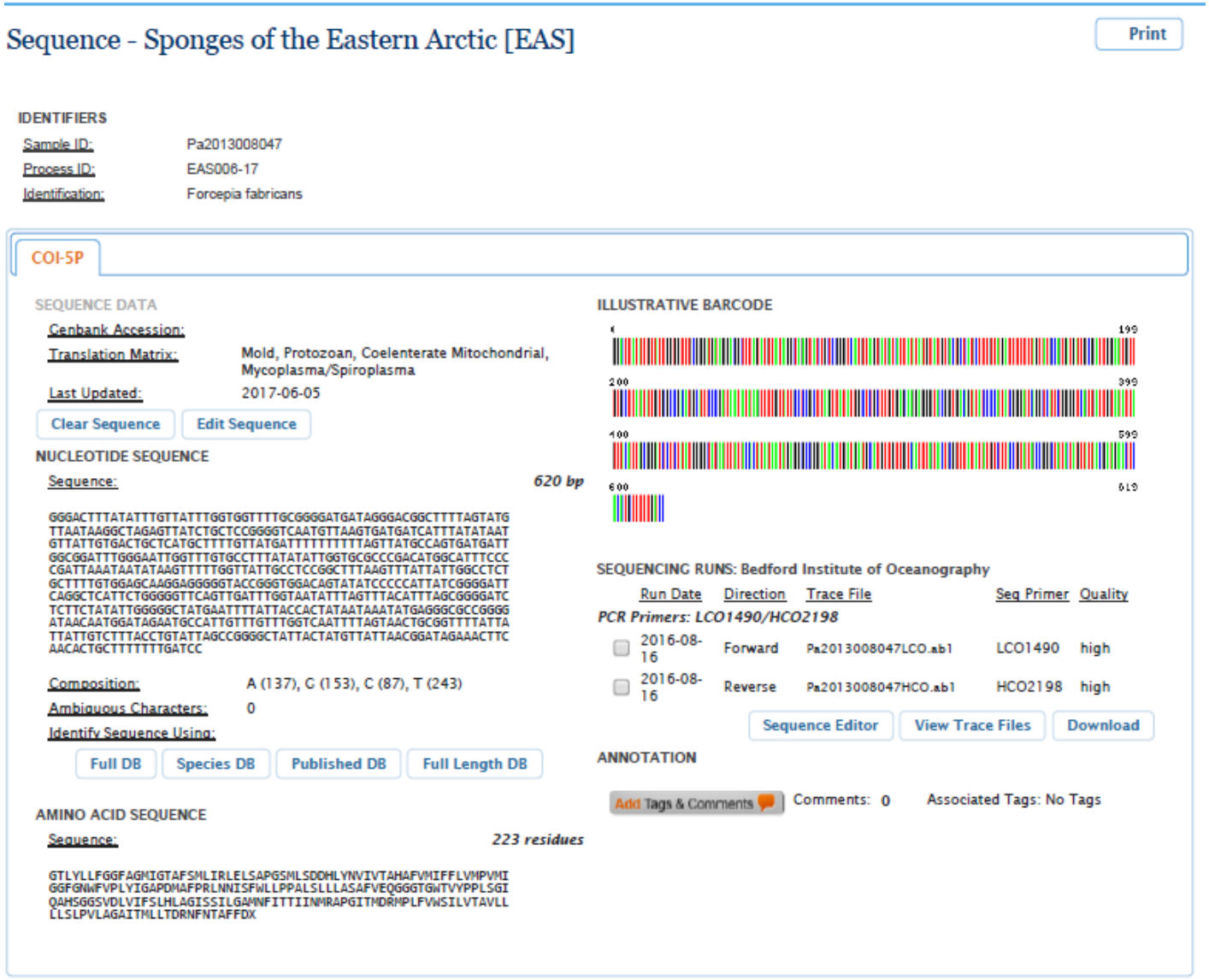
2015-12-09	Reverse	Pa2010009465HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

B.



Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2013008047
Process ID: EAS006-17
Identification: Forcepia fabricans

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-05

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: 620 bp

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GTTATTGTGACTGCTCATGCTTTTGTTATGATTTTTTTTTTAGTTATGCCAGTGATGATT
GGCGGATTTGGGAATTGGTTTGTGCCTTTATATATTGGTGCGCCCGACATGGCATTTCCC
CGATTAAATAATATAAGTTTTTGGTTATTGCCTCCGGCTTTAAGTTTATTATTGGCCTCT
GCTTTTGTGGAGCAAGGAGGGGGTACCGGGTGGACAGTATATCCCCCATTATCGGGGATT
CAGGCTCATTCTGGGGGTTCAGTTGATTTGGTAATATTTAGTTTACATTTAGCGGGGATC
TCTTCTATATTGGGGGCTATGAATTTTATTACCACTATAATAAATATGAGGGCGCCGGGG
ATAACAATGGATAGAATGCCATTGTTTGTTTGGTCAATTTTAGTAACTGCGGTTTTATTA
TTATTGTCTTTACCTGTATTAGCCGGGGCTATTACTATGTTATTAACGGATAGAAACTTC
AACACTGCTTTTTTTGATCC

Composition: A (137), C (153), C (87), T (243)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: 223 residues

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QAHSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRAPGITMDRMPLFVWSILVTAVLL
LLSLPVLAGAITMLLTDRNFNTAFFDX

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198				
2016-08-16	Forward	Pa2013008047LCO.ab1	LCO1490	high
2016-08-16	Reverse	Pa2013008047HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

C.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2013008203
Process ID: EAS005-17
Identification: Forcepia forcipis

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-05

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *605 bp*

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GGGTTCTGTAGATTTGGTAATATTTAGTTTACATTTAGCGGGTATCTCTTCTATATTGGG
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CGATC
```

Composition: A (139), C (143), C (83), T (240)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *219 residues*

```
LFGGFAGMIGTAFSMLIRLELFAPGSMLSDDHLYNVIVTAHAFVMIFFLVMPVMIGGFGN
WFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGGGTGWTVYPPLSGIQAHSG
GSVDLVIFSLHLAGISSILGAMNFITTIINMRAPGITMDRMPLFVWSILVTAVLLLLSLP
VLAGAITMLLTDRNFNTAFFDX
```

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Reverse	Pa2013008203HCO.ab1	HCO2198	high
☐	2016-08-16	Forward	Pa2013008203LCO.ab1	LCO1490	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

D.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2011007135
Process ID: EAS003-17
Identification: Forcepia forcipula

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-05

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *650 bp*

```
TGGGACTTTATATTTGTTATTTGGTGGTTTTGCGGGGATGATAGGGACGGCTTTTAGTAT
GTTAATAAGGCTAGAGTTATCTGCTCCGGGGTCAATGTTAAGTGATGATCATTTATATAA
TGTTATTGTGACTGCTCATGCTTTTGTTATGATTTTTTTTTTTAGTTATGCCAGTGATGAT
TGGCGGATTTGGGAATTGGTTTGTGCCTTTATATATTGGTGCGCCCGACATGGCATTTCC
CCGATTAAATAATATAAGTTTTTGGTTATTGCCTCCGGCTTTAAGTTTATTATTGGCCTC
TGCTTTTGTGGAGCAAGGAGGGGGTACCGGGTGGACAGTATATCCCCCATTATCGGGGAT
TCAGGCTCATTCTGGGGGTTCAGTTGATTTGGTAATATTTAGTTTACATTTAGCGGGGAT
CTCTTCTATATTGGGGGCTATGAATTTTATTACCACTATAATAAATATGAGGGCGCCGGG
GATAACAATGGATAGAATGCCATTGTTTGTTTGGTCAATTTTAGTAACTGCGGTTTTATT
ATTATTGTCTTTACCTGTATTAGCCGGGGCTATTACTATGTTATTAACGGATAGAAACTT
CAACACTGCTTTTTTTGATCCTGCGGGGGGGGGAGACCCTGTTTTATATC
```

Composition: A (141), G (165), C (92), T (252)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *233 residues*

```
GTLYLLFGGFAGMIGTAFSMLIRLELSAPGSMLSDDHLYNVIVTAHAFVMIFFLVMPVMI
GGFGNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGGGTGWTVYPPLSGI
QAHSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRAPGITMDRMPLFVWSILVTAVLL
LLSLPVLAGAITMLLTDRNFNTAFFDPAGGGDPVLYX
```

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

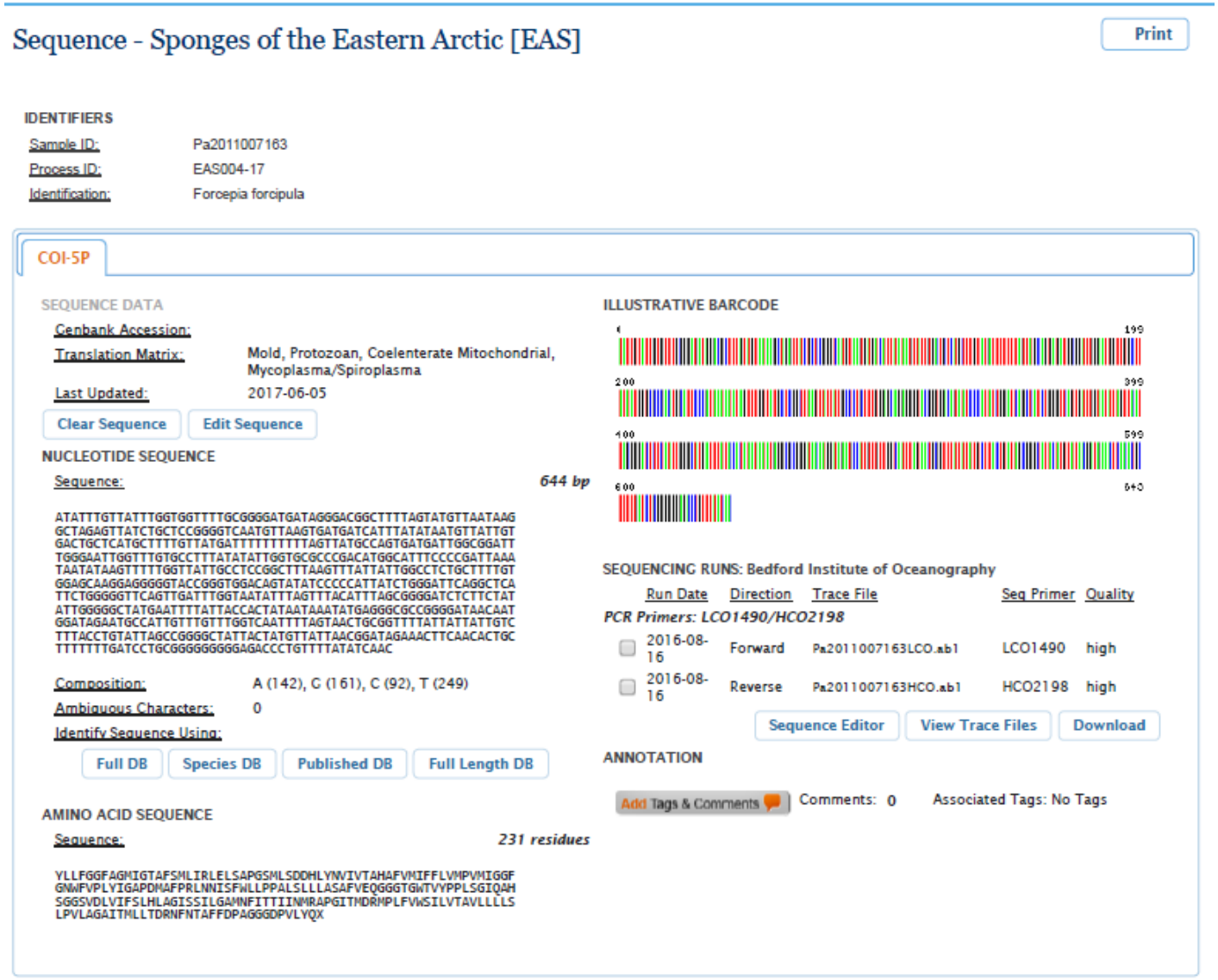
	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2011007135LCO.ab1	LCO1490	high
☐	2016-08-16	Reverse	PA2011007135HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

E.



Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2011007163
Process ID: EAS004-17
Identification: Forcepia forcipula

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-05

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: 644 bp

ATATTTGTTATTTGGTGGTTTTGCGGGGATGATAGGGACGGCTTTTAGTATGTTAATAAG
GCTAGAGTTATCTGCTCCGGGGTCAATGTTAAGTGATGATCATTTATATAATGTTATTGT
GACTGCTCATGCTTTTGTTATGATTTTTTTTTTTAGTTATGCCAGTGATGATTGGCGGATT
TGGGAATTGGTTTGTGCCTTTATATATTGGTGCGCCCGACATGGCATTTCCCCGATTAAA
TAATATAAGTTTTTGGTTATTGCCTCCGGCTTTAAGTTTATTATTGGCCTCTGCTTTTGT
GGAGCAAGGAGGGGGTACCGGGTGGACAGTATATCCCCCATTATCTGGGATTCAGGCTCA
TTCTGGGGGTTCAGTTGATTTGGTAATATTTAGTTTACATTTAGCGGGGATCTCTTCTAT
ATTGGGGGCTATGAATTTTATTACCACTATAATAAATATGAGGGCGCCGGGGATAACAAT
GGATAGAATGCCATTGTTTGTTTGGTCAATTTTAGTAACTGCGGTTTTATTATTATTGTC
TTTACCTGTATTAGCCGGGGCTATTACTATGTTATTAACGGATAGAAACTTCAACACTGC
TTTTTTTGATCCTGCGGGGGGGGGAGACCCTGTTTTATATCAAC

Composition: A (142), C (161), C (92), T (249)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: 231 residues

YLLFGGFAGMIGTAFSMLIRLELSAPGSMLSDDHLYNVIVTAHAFVMIFFLVMPVMIGGF
GNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGGGTGWTVYPPLSGIQAH
SGGSVDLVIFSLHLAGISSILGAMNFITTIINMRAPGITMDRMPLFVWSILVTAVLLLLS
LPVLAGAITMLLTDRNFNTAFFDPAGGGDPVLYQX

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198				
2016-08-16	Forward	Pa2011007163LCO.ab1	LCO1490	high
2016-08-16	Reverse	Pa2011007163HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

F.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2011007639
Process ID: EAS008-17
Identification: Forcepia aff. japonica

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-05

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *655 bp*

```
ATTGGGACTTTATATTTGTTATTAGGCGGGTTTGCGGGGATGATAGGGACGGCCTTTAGT
ATGTTAATAAGGCTAGAGTTATCTGCTCCGGGGTCTATGTTAAGTGATGATCATTTATAT
AATGTTATTGTGACTGCTCATGCTTTTGTTATGATTTTTTTTTTAGTTATGCCAGTGATG
ATTGGTGGGTTTGGGAATTGGTTTGTGCCTTTATATATTGGGGCGCCCGACATGGCATTT
CCCCGATTAAATAATATAAGCTTTTGGTTATTGCCTCCGGCTTTAAGTTTATTATTGGCT
TCTGCTTTTGTGGAGCAAGGGGGGGGTACTGGGTGAACCGTTTATCCCCCGTTATCTGGG
ATTCAGGCTCATTCCGGGGGTTCAGTAGATTTGGTAATCTTTAGTTTACATTTAGCGGGG
ATCTCTTCTATATTAGGGGCTATGAATTTTATTACCACTATAATAAATATGAGGGCGCCG
GGGATAACAATGGATAGAATGCCCTTGTTTGTTTGGTCTATTTTAGTAACTGCGGTTTTA
TTATTATTATCTTTACCAGTATTAGCAGGTGCCATTACTATGTTATTAACAGATAGAAAT
TTCAATACTGCTTTTTTTGATCCTGCGGGGGGGGGAGACCCCATTTTATATCAAC
```

Composition: A (144), C (163), C (96), T (252)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *234 residues*

```
IGTLYLLLGGFAGMIGTAFSMLIRLELSAPGSMLSDDHLYNVIVTAHAFVMIFFLVMPVM
IGGFGNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGGGTGWTVYPPLSG
IQAHSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRAPGITMDRMPLFVWSILVTAVL
LLLSLPVLAGAITMLLTDRNFNTAFFDPAGGGDPILYQX
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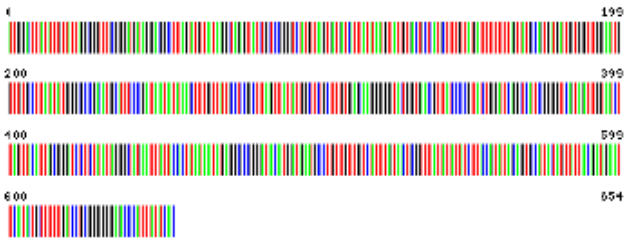
ILLUSTRATIVE BARCODE



SEQUENCING RUNS: Bedford Institute of Oceanography

	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2011007639LCO.ab1	LCO1490	high
☐	2016-08-16	Reverse	Pa2011007639HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

G.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2011007115
Process ID: EAS002-17
Identification: Forcepia thielei

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-05

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: 677 bp

AAGATATTGGGACTTTATATTTGTTATTTGGTGGTTTTGCTGGGATGATAGGGACGGCCT
TTAGTATGTTAATAAGGCTAGAGTTATCTGCTCCAGGGTCAATGTTAAGTGATGATCATT
TATATAATGTTATTGTTACTGCTCATGCTTTTGTTATGATTTTTTTTTTTAGTTATGCCAG
TGATGATTGGTGGATTTGGTAATTGGTTTGTGCCTTTATATATTGGTGCGCCTGACATGG
CTTTTCCCCGATTAAATAATATAAGTTTTTGGTTATTGCCTCCGGCTTTAAGTTTATTAT
TAGCCTCTGCTTTTGTGGAGCAAGGAGGGGGTACTGGGTGGACAGTATATCCTCCATTAT
CGGGGATTCAGGCTCATTCTGGGGGTTCAGTAGATTTGGTAATATTTAGTTTACATTTAG
CAGGGATTTCTTCTATATTAGGGGCTATGAATTTTATTACCACTATAATAAATATGAGGG
CGCCAGGGATAACGATGGATAGAATGCCATTATTTGTTTGGTCTATTTTAGTAACTGCGG
TTTTATTATTATTATCTTTACCAGTATTAGCAGGTGCAATTACTATGTTATTAACGGATA
GAAATTTCAATACTGCTTTTTTTGATCCTGCGGGTGGGGGAGACCCAATTTTATATCAAC
ATTTATTTTGATTTTTGNNN

Composition: A (160), C (156), C (86), T (275)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: 244 residues

DIGTLVLLFGGFAGMIGTAFSMLIRLELSAPGSMLSDDHLYNVIVTAHAFVMIFFLVMPV
MIGGFGNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGGGTGWTVYPPLS
GIQAHSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRAPGITMDRMPLFVWSILVTAV
LLLLSLPVLAGAITMLLTDRNFNTAFFDPAGGGDPILYQHLFWFL-

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198				
2016-08-16	Forward	Pa2011007115LCO.ab1	LCO1490	high
2016-08-16	Reverse	PA2011007115HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

H.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2014007550
Process ID: EAS007-17
Identification: Forcepia cf. brunnea

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-05

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *655 bp*

GATATTGGGACTTTATATTTGTTATTTGGTGGTTTTGCTGGGATGATAGGGACGGCCTTT
AGTATGTTAATAAGGCTAGAGTTATCTGCTTCGGGGTCAATGTTAAGCGATGATCATTTA
TATAATGTTATTGTAACTGCTCATGCTTTTGTTATGATTTTTTTTTTTAGTTATGCCAGTG
ATGATTGGGGGATTTGGGAATTGGTTTGTGCCTTTATATATTGGTGCGCCTGACATGGCC
TTTCCCCGATTAAATAATATAAGTTTTTGGTTATTGCCTCCGGCTTTAAGTTTATTATTG
GCCTCTGCTTTTGTGGAGCAAGGAGGGGGTACAGGGTGGACAGTATATCCCCCATTATCT
GGGATTCAGGCCCATTCCGGGGGGTTCAGTAGATTTGGTAATATTTAGTTTACATTTAGCG
GGGATCTCTTCTATATTGGGGGCTATGAATTTTATTACCACTATAATAAATATGAGGGCG
CCGGGGATAACAATGGATAGAATGCCATTGTTTGTTTGGTCTATTTTAGTAACTGCGGTT
TTATTATTATTGTCTTTACCTGTATTAGCGGGTGCGATAACCATGTTATTAACGGATAGA
AATTTCAATACTGCTTTTTTTGATCCTGCGGGAGGGGGAGACCCTATTTTATATC

Composition: A (147), C (163), C (91), T (254)
Ambiguous Characters: 0
Identify Sequence Using:

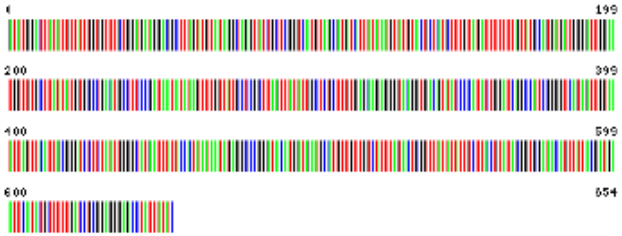
Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *235 residues*

DIGTLVLLFGGFAGMIGTAFSMLIRLELSASGSMLSDDHLYNVIVTAHAFVMIFFLVMPV
MIGGFGNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGGGTGWTVYPPLS
GIQAHSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRAPGITMDRMPLFVWSILVTAV
LLLLSLPVLAGAITMLLTDRNFNTAFFDPAGGGDPILYX

ILLUSTRATIVE BARCODE



SEQUENCING RUNS: Bedford Institute of Oceanography

	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2014007550LCO.ab1	LCO1490	high
☐	2016-08-16	Reverse	Pa2014007550HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

I.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2014007107
Process ID: EAS015-17
Identification: Lissodendoryx lundbecki

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-06

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *615 bp*

TTTTATTTGGAGCCTTTGCGGGGATGATAGGTACTGCCTTTAGTATGTTAATTCGGTTAG
AGTTGTCTGCGCCTGGGTCAATGTTGGGGGATGATCATTTATATAATGTTATTGTAACTG
CTCATGCTTTTGTCATGATTTTTTTTTTAGTTATGCCGGTAATGATCGGGGGATTTGGTA
ACTGGTTTGTGCCTTTATATATTGGTGCGCCTGACATGGCTTTTCCTCGGTTAAATAATA
TAAGTTTTTGATTATTGCCTCCGGCCTTAAGTTTATTATTGGCTTCTGCTTTTGTGGAGC
AAGGGGCAGGTACCGGATGGACAGTTTATCCGCCATTATCGGGTATTCAGGCCCATTCGG
GGGGGTCAGTTGATTTAGTAATATTTAGCTTACACTTGGCGGGGATTTCTTCTATATTGG
GGGCTATGAATTTTATAACTACAATAATAAATATGAGGGCATTGGGGGTAACTTTGGATA
GAATGCCATTATTCGTTTGATCTATTTTAGTAACTGCTGTTTTATTATTATTATCTTTAC
CAGTATTAGCTGGGGCTATTACTATGTTATTAACGGATAGAAACTTTAATACTGCTTTTT
TTGATCCTGCAGGAG

Composition: A (135), C (149), C (87), T (244)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *221 residues*

LFGAFAGMIGTAFSMLIRLELSAPGSMLGDDHLYNVIVTAHAFVMIFFLVMPVMIGGFGN
WFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGAGTGWTVYPPLSGIQAHSG
GSVDLVIFSLHLAGISSILGAMNFITTIINMRALGVTLDRMPLFVWSILVTAVLLLLSLP
VLAGAITMLLTDRNFNTAFFDPAGX

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2014007107LCO.ab1	LCO1490	high
☐	2016-08-16	Reverse	Pa2014007107HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

J.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2010009513
Process ID: EAS011-17
Identification: Lissodendoryx lundbecki

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-06

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *563 bp*

ATGTTAATTCGGTTAGAGTTGTCTGCGCCTGGGTCAATGTTGGGGGATGATCATTTATAT
AATGTTATTGTAACTGCTCATGCTTTTGTCATGATTTTTTTTTTAGTTATGCCGGTAATG
ATCGGGGGATTTGGTAACTGGTTTGTGCCTTTATATATTGGTGCGCCTGACATGGCTTTT
CCTCGGTTAAATAATATAAGTTTTTGATTATTGCCTCCGGCCTTAAGTTTATTATTGGCT
TCTGCTTTTGTGGAGCAAGGGGCAGGTACCGGATGGACAGTTTATCCGCCATTATCGGGT
ATTCAGGCCCATTCGGGGGGGTCAGTTGATTTAGTAATATTTAGCTTACACTTGGCGGGG
ATTTCTTCTATATTGGGGGCTATGAATTTTATAACTACAATAATAAATATGAGGGCATTG
GGGGTAACTTTGGATAGAATGCCATTATTCGTTTGATCTATTTTAGTAACTGCTGTTTTA
TTATTATTATCTTTACCAGTATTAGCTGGGGCNATTACTATGTTATTAACGGATAGAAAC
TTTAATACTGCTTTTTTTGATCC

Composition: A (126), C (132), C (80), T (224)
Ambiguous Characters: 1
Identify Sequence Using:

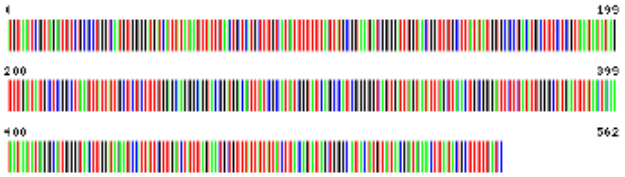
Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *200 residues*

MLIRLELSAPGSMLGDDHLYNVIVTAHAFVMIFFLVMPVMIGGFGNWFVPLYIGAPDMAF
PRLNNISFWLLPPALSLLLASAFVEQGAGTGWTVYPPLSGIQAHSGGSVDLVIFSLHLAG
ISSILGAMNFITTIINMRALGVTLDRMPLFVWSILVTAVLLLLSLPVLAGXITMLLTDRN
FNTAFFDX

ILLUSTRATIVE BARCODE



SEQUENCING RUNS: Bedford Institute of Oceanography

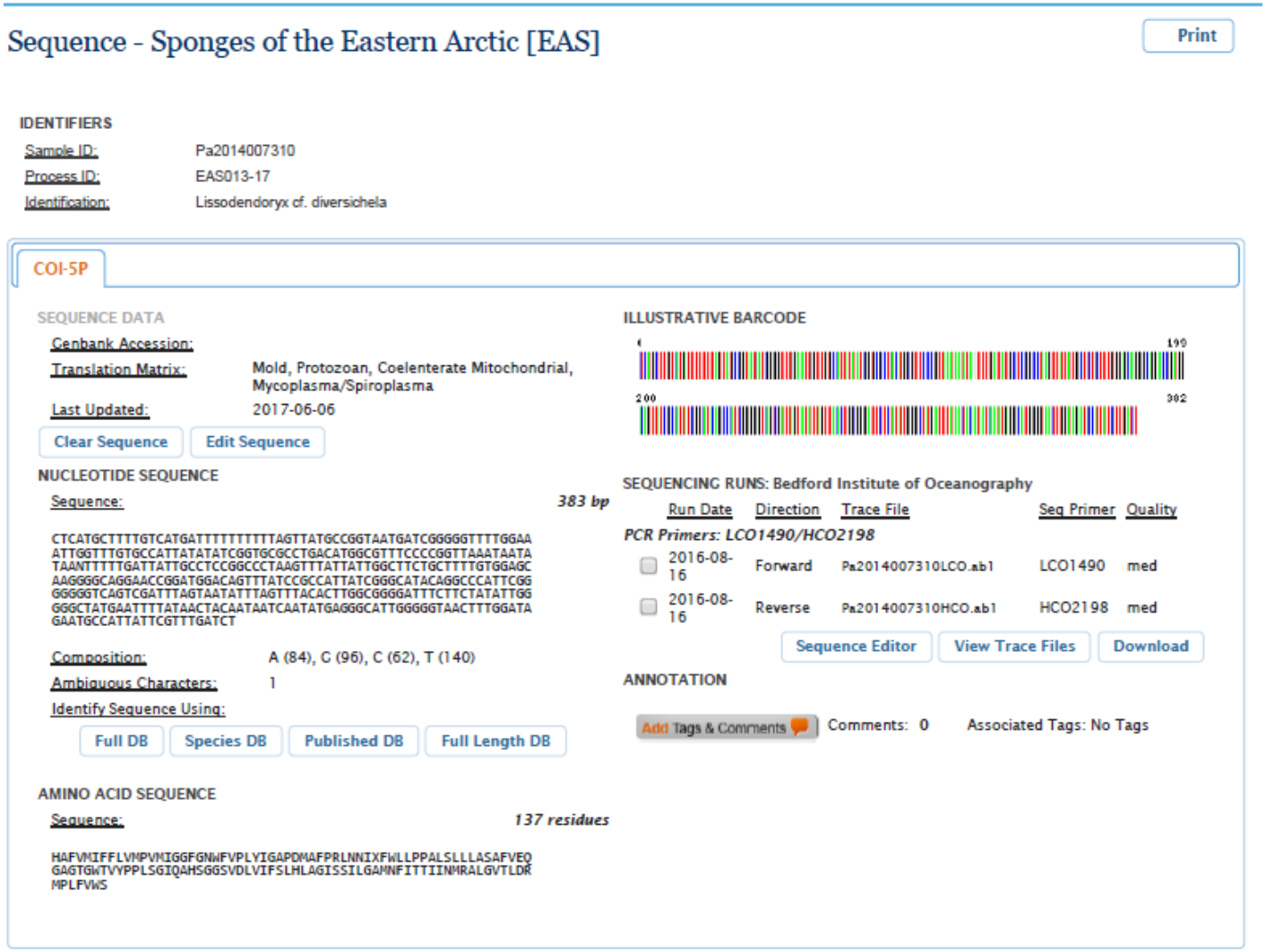
	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2010009513LCO.ab1	LCO1490	med
☐	2016-08-16	Reverse	Pa2010009513HCO.ab1	HCO2198	med

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

K.



Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2014007310
Process ID: EAS013-17
Identification: Lissodendoryx cf. diversichela

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-06

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: 383 bp

CTCATGCTTTTGTCATGATTTTTTTTTTAGTTATGCCGGTAATGATCGGGGGTTTTGGAA
ATTGGTTTGTGCCATTATATATCGGTGCGCCTGACATGGCGTTTCCCCGGTTAAATAATA
TAANTTTTTGATTATTGCCTCCGGCCCTAAGTTTATTATTGGCTTCTGCTTTTGTGGAGC
AAGGGGCAGGAACCGGATGGACAGTTTATCCGCCATTATCGGGCATACAGGCCCATTCGG
GGGGGTCAGTCGATTTAGTAATATTTAGTTTACACTTGGCGGGGATTTCTTCTATATTGG
GGGCTATGAATTTTATAACTACAATAATCAATATGAGGGCATTGGGGGTAACTTTGGATA
GAATGCCATTATTCGTTTGATCT

Composition: A (84), G (96), C (62), T (140)
Ambiguous Characters: 1
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: 137 residues

HAFVMIFFLVMPVMIGGFGNWFVPLYIGAPDMAFPRLNNIXFWLLPPALSLLLASAFVEQ
GAGTGWTVYPPLSGIQAHSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRALGVTLDR
MPLFVWS

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2014007310LCO.ab1	LCO1490	med
☐	2016-08-16	Reverse	Pa2014007310HCO.ab1	HCO2198	med

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

L.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2014007120
Process ID: EAS014-17
Identification: Lissodendoryx cf. foliata

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-06

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *659 bp*

```
CATTATATCTTTTATTTGGAGCCTTTGCGGGGATGATAGGTACTGCCTTTAGTATGTTAA
TTCGGTTAGAGTTGTCTGCGCCTGGGTCAATGTTGGGGGATGATCATTTATATAATGTTA
TTGTAACTGCTCATGCTTTTGTCATGATTTTTTTTTTAGTTATGCCGGTAATGATCGGGG
GATTTGGTAACTGGTTTTGTGCCTTTATATATTGGTGCGCCTGACATGGCTTTTCCTCGGT
TAAATAATATAAGTTTTTGATTATTGCCTCCGGCCTTAAGTTTATTATTGGCTTCTGCTT
TTGTGGAGCAAGGGGCAGGAACCGGATGGACAGTTTATCCGCCATTATCGGGTATTCAGG
CCCATTCGGGGGGGTCAGTTGATTTAGTAATATTTAGCTTACACTTAGCGGGGATTTCTT
CTATATTGGGGGCTATGAATTTTATAACTACAATAATAAATATGAGGGCATTGGGGGTAA
CTTTGGATAGAATGCCATTATTCGTTTGATCTATTTTAGTAACTGCTGTTTTATTATTAT
TATCTTTACCTGTATTAGCTGGGGCTATTACTATGTTATTAACGGATAGAAACTTTAATA
CTGCTTTTTTTGATCCTGCAGGAGGTGGAGATCCTATTTTATATCAACATTTATTTTGA
```

Composition: A (149), C (153), C (93), T (264)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *237 residues*

```
LYLLFGAFAGMIGTAFSMLIRLELSAPGSMLGDDHLYNVIVTAHAFVMIFFLVMPVMIGG
FGNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGAGTGWTVYPPLSGIQA
HSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRALGVTLDRMPLFVWSILVTAVLLLL
SLPVLAGAITMLLTDRNFNTAFFDPAGGGDPILYQHLFW
```

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

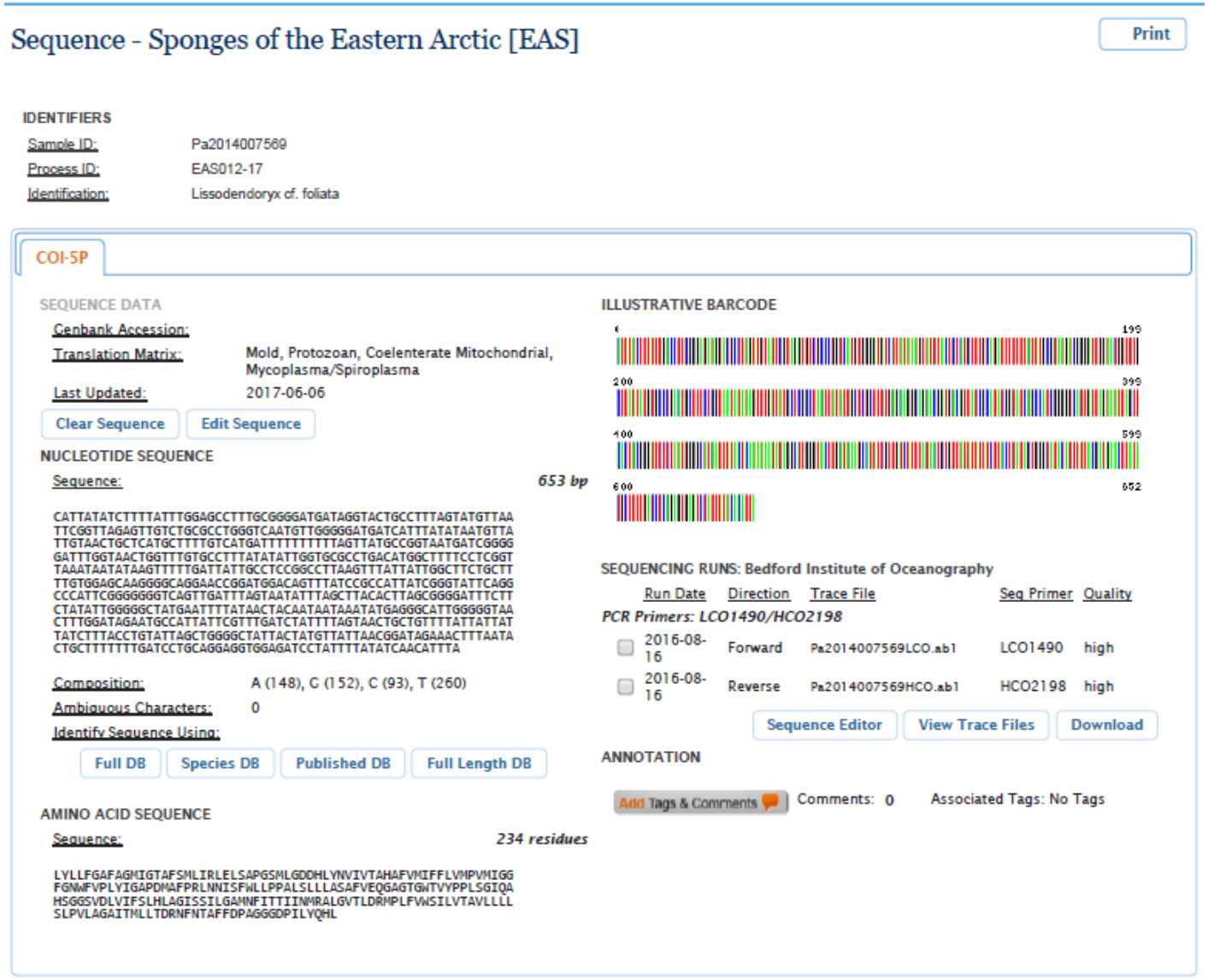
Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198				
2016-08-16	Forward	Pa2014007120LCO.ab1	LCO1490	high
2016-08-16	Reverse	Pa2014007120HCO.ab1	HCO2198	high

Sequence Editor | View Trace Files | Download

ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

M.



Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2014007569
Process ID: EAS012-17
Identification: Lissodendoryx cf. foliata

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-06

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *653 bp*

```
CATTATATCTTTTATTTGGAGCCTTTGCGGGGATGATAGGTACTGCCTTTAGTATGTTAA
TTCGGTTAGAGTTGTCTGCGCCTGGGTCAATGTTGGGGGATGATCATTTATATAATGTTA
TTGTAACTGCTCATGCTTTTGTCATGATTTTTTTTTTAGTTATGCCGGTAATGATCGGGG
GATTTGGTAACTGGTTTGTGCCTTTATATATTGGTGCGCCTGACATGGCTTTTCCTCGGT
TAAATAATATAAGTTTTTGATTATTGCCTCCGGCCTTAAGTTTATTATTGGCTTCTGCTT
TTGTGGAGCAAGGGGCAGGAACCGGATGGACAGTTTATCCGCCATTATCGGGTATTCAGG
CCCATTCGGGGGGGTCAGTTGATTTAGTAATATTTAGCTTACACTTAGCGGGGATTTCTT
CTATATTGGGGGCTATGAATTTTATAACTACAATAATAAATATGAGGGCATTGGGGGTAA
CTTTGGATAGAATGCCATTATTCGTTTGATCTATTTTAGTAACTGCTGTTTTATTATTAT
TATCTTTACCTGTATTAGCTGGGGCTATTACTATGTTATTAACGGATAGAAACTTTAATA
CTGCTTTTTTTGATCCTGCAGGAGGTGGAGATCCTATTTTATATCAACATTTA
```

Composition: A (148), C (152), C (93), T (260)
Ambiguous Characters: 0
Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *234 residues*

```
LYLLFGAFAGMIGTAFSMLIRLELSAPGSMLGDDHLYNVIVTAHAFVMIFFLVMPVMIGG
FGNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGAGTGWTVYPPLSGIQA
HSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRALGVTLDRMPLFVWSILVTAVLLLL
SLPVLAGAITMLLTDRNFNTAFFDPAGGGDPILYQHL
```

ILLUSTRATIVE BARCODE

SEQUENCING RUNS: Bedford Institute of Oceanography

	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2014007569LCO.ab1	LCO1490	high
☐	2016-08-16	Reverse	Pa2014007569HCO.ab1	HCO2198	high

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ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

N.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2012007350
Process ID: EAS017-17
Identification: Lissodendoryx cf. foliata

COI-5P

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-06

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *616 bp*

```
TCTTTTATTTGGAGCCTTTGCGGGGATGATAGGTACTGCCTTTAGTATGTTAATTCGGTT
AGAGTTGTCTGCGCCTGGGTCAATGTTGGGGGATGATCATTTATATAATGTTATTGTAAC
TGCTCATGCTTTTGTCATGATTTTTTTTTTAGTTATGCCGGTAATGATCGGGGGATTTGG
TAACTGGTTTGTGCCTTTATATATTGGTGCGCCTGACATGGCTTTTCCTCGGTTAAATAA
TATAAGTTTTTGATTATTGCCTCCGGCCTTAAGTTTATTATTGGCTTCTGCTTTTGTGGA
GCAAGGGGCAGGAACCGGATGGACAGTTTATCCGCCATTATCGGGTATTCAGGCCCATTC
GGGGGGGTCAGTTGATTTAGTAATATTTAGCTTACACTTAGCGGGGATTTCTTCTATATT
GGGGGCTATGAATTTTATAACTACAATAATAAATATGAGGGCATTGGGGGTAACTTTGGA
TAGAATGCCATTATTCGTTTGATCTATTTTAGTAACTGCTGTTTTATTATTATTATCTTT
ACCTGTATTAGCTGGGGCTATTACTATGTTATTAACGGATAGAAACTTTAATACTGCTTT
TTTTGATCCTGCAGGA
```

Composition: A (136), C (147), C (88), T (245)
Ambiguous Characters: 0
Identify Sequence Using:

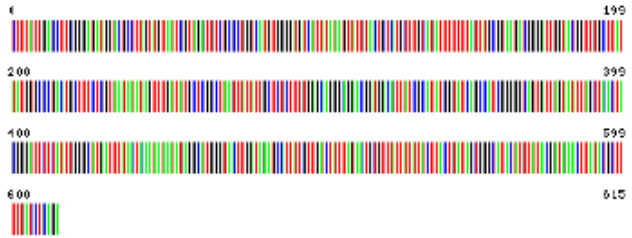
Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *222 residues*

```
LLFGAFAGMIGTAFSMLIRLELSAPGSMLGDDHLYNVIVTAHAFVMIFFLVMPVMIGGFG
NWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGAGTGWTVYPPLSGIQAHS
GGSVDLVIFSLHLAGISSILGAMNFITTIINMRALGVTLDRMPLFVWSILVTAVLLLLSL
PVLAGAITMLLTDRNFNTAFFDPAG
```

ILLUSTRATIVE BARCODE



SEQUENCING RUNS: Bedford Institute of Oceanography

Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198				
2016-08-16	Forward	Pa2012007350LCO.ab1	LCO1490	high
2016-08-16	Reverse	Pa2012007350HCO.ab1	HCO2198	high

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ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

O.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID: Pa2011007459
Process ID: EAS018-17
Identification: Lissodendoryx cf. multiformis

COI-5P *

SEQUENCE DATA

Genbank Accession:
Translation Matrix: Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated: 2017-06-06

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *582 bp*

GCCAGGGTCAATGTTGGGGGATGATCATTTATATAATGTTATAGTAACTGCTCATGCTTT
TGTCATGATTTTTTTTTTAGTTATGCCGGTAATGATCGGGGGATTTGGAAATTGGTTTGT
GCCGTTATATATCGGTGCGCCGGACATGGCTTTTCCCCGGTTAAATAANANAAGTTTTTG
ATTATTGCCTCCGGCCCTAAGTTTATTATTGGCCTCTGCTTTTGTGGAGCAAGGGGCAGG
AACCGGGTGGACAGTTTATCCGCCATTATCGGGTATACAGGCCCATTCGGGGGGGTCAGT
TGATTTAGTAATATTTAGTTTACACTTGGCGGGGATTTCTTCTATATTGGGGGCTATGAA
TTTTATAACTACAATAATCAATATGAGGGCATTGGGGGTAACTTTGGATAGAATGCCATT
ATTCGTTTGATCTATTCTAGTAACTGCGGTTTTATTATTATTGNCTTTACCTGNATTANC
TGGNNNNCTATTACTATGTTATTAACGGATANAAACTTTAATACTGCTTTTTTTGATCCT
GCAGGAGGGGGGNATCCTATTTTATATCAACATTTATTTTGA

Composition: A (133), C (136), C (86), T (216)
Ambiguous Characters: 11
Identify Sequence Using:

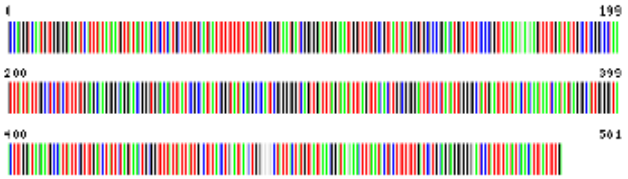
Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *198 residues*

PGSMLGDDHLYNVIVTAHAFVMIFFLVMPVMIGGFGNWFVPLYIGAPDMAFPRLNXXSFW
LLPPALSLLLASAFVEQGAGTGWTVYPPLSGIQAHSGGSVDLVIFSLHLAGISSILGAMN
FITTIINMRALGVTLDRMPLFVWSILVTAVLLLLXLPXLXX-LLLCY*RIXTLILLFLIL
QEGXILFYINIYFX

ILLUSTRATIVE BARCODE



SEQUENCING RUNS: Bedford Institute of Oceanography

	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2011007459LCO.ab1	LCO1490	low
☐	2016-08-16	Reverse	Pa2011007459HCO.ab1	HCO2198	low

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ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags

P.

Sequence - Sponges of the Eastern Arctic [EAS]

Print

IDENTIFIERS

Sample ID:	Pa2013008264
Process ID:	EAS016-17
Identification:	Lissodendoryx sp. 1

COI-5P

SEQUENCE DATA

Genbank Accession:	
Translation Matrix:	Mold, Protozoan, Coelenterate Mitochondrial, Mycoplasma/Spiroplasma
Last Updated:	2017-06-06

Clear Sequence | Edit Sequence

NUCLEOTIDE SEQUENCE

Sequence: *662 bp*

```
CATTATATCTTTTATTTGGGGCCTTTGCGGGGATGATAGGTACTGCCTTTAGTATGTTAA
TTCGGTTAGAGTTGTCTGCGCCAGGGTCAATGTTGGGGGATGATCATTTATATAATGTTA
TAGTAACTGCTCATGCTTTTGTCATGATTTTTTTTTTAGTTATGCCGGTAATGATCGGGG
GATTTGGAAATTGGTTTGTGCCATTATATATCGGTGCGCCTGACATGGCTTTTCCCCGGT
TAAATAATATAAGTTTTTGATTATTGCCTCCGGCCCTAAGTTTATTATTGGCTTCTGCTT
TTGTGGAGCAAGGGGCAGGAACCGGATGGACAGTTTATCCGCCATTATCGGGTATACAGG
CCCATTCGGGGGGGTCAGTTGATTTAGTAATATTTAGTTTACACTTGGCGGGGATTTCTT
CTATATTGGGGGCTATGAATTTTATAACTACAATAATCAATATGAGGGCATTGGGGGTAA
CTTTGGATAGAATGCCATTATTCGTTTGATCTATTCTAGTAACTGCGGTTTTATTATTAT
TATCTTTACCTGTATTAGCTGGGGCTATTACTATGTTATTAACGGATAGAAACTTTAATA
CTGCTTTTTTTGATCCTGCAGGAGGGGGGGATCCTATTTTATATCAACATTTATTTTGAT
TT
```

Composition:	A (150), G (158), C (96), T (258)
Ambiguous Characters:	0

Identify Sequence Using:

Full DB | Species DB | Published DB | Full Length DB

AMINO ACID SEQUENCE

Sequence: *239 residues*

```
LYLLFGAFAGMIGTAFSMLIRLELSAPGSMLGDDHLYNVIVTAHAFVMIFFLVMPVMIGG
FGNWFVPLYIGAPDMAFPRLNNISFWLLPPALSLLLASAFVEQGAGTGWTVYPPLSGIQA
HSGGSVDLVIFSLHLAGISSILGAMNFITTIINMRALGVTLDRMPLFVWSILVTAVLLL
SLPVLAGAITMLLTDRNFNTAFFDPAGGGDPILYQHLFWF
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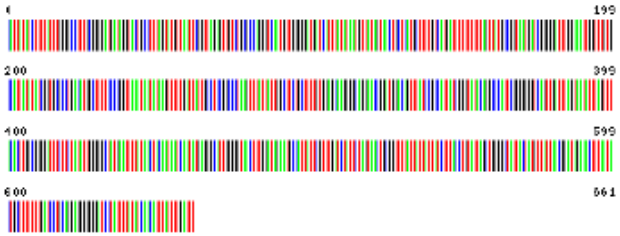
ILLUSTRATIVE BARCODE



SEQUENCING RUNS: Bedford Institute of Oceanography

	Run Date	Direction	Trace File	Seq Primer	Quality
PCR Primers: LCO1490/HCO2198					
☐	2016-08-16	Forward	Pa2013008264LCO.ab1	LCO1490	high
☐	2016-08-16	Reverse	Pa2013008264HCO.ab1	HCO2198	high

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ANNOTATION

Add Tags & Comments | Comments: 0 | Associated Tags: No Tags