Sponges from the 2010-2014 Paamiut Multispecies Trawl Surveys, Eastern Arctic and Subarctic: Class Demospongiae, Subclass Heteroscleromorpha, Order Poecilosclerida, Families Crellidae and Myxillidae

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by

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ABSTRACT

Baker, E., Odenthal, B., Tompkins, G., Walkusz, W., Siferd, T. and Kenchington, E. 2018. Sponges from the 2010-2014 Paamiut Multispecies Trawl Surveys, Eastern Arctic and Subarctic: Class Demospongiae, Subclass Heteroscleromorpha, Order Poecilosclerida, Families Crellidae and Myxillidae. Can. Tech. Rep. Fish. Aquat. Sci. 3253: iv + 52 p.

Sponges (phylum Porifera) are benthic filter-feeding animals that play an important role 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 from the family Crellidae (class Demospongiae, subclass Heteroscleromorpha, order Poecilosclerida, family Crellidae) and family Myxillidae (class Demospongiae, subclass Heteroscleromorpha, order Poecilosclerida, family Myxillidae). A total of six species are described, from the genus *Crella* (Crellidae), and genera *Melonanchora* and *Myxilla* (Myxillidae). These species are: *Crella (Yvesia) pyrula*, *Melonanchora* cf. *elliptica*, *Melonanchora* cf. *emphysema*, *Myxilla brunnea*, *Myxilla (Myxilla) fimbriata*, and *Myxilla (Myxilla)* cf. *incrustans*. Descriptions include morphological and spicule descriptions and dimensions, and taxonomic discussion.

RÉSUMÉ

Baker, E., Odenthal, B., Tompkins, G., Walkusz, W., Siferd, T. and Kenchington, E. 2018. 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, familles Crellidae et Myxillidae. Can. Tech. Rep. Fish. Aquat. Sci. 3253: iv + 52 p.

Les éponges (phylum Porifera) sont des animaux filtreurs benthiques qui jouent un rôle important dans le cycle des éléments nutritifs et la production d'habitats dans les profondeurs de la mer. Les éponges recueillies au cours des relevés plurispécifiques annuels au chalut effectués par Pêches et Océans Canada (MPO) entre 2010 et 2014 dans la baie de Baffin, le détroit de Davis et certaines parties du détroit d'Hudson ont été examinées sur le plan taxonomique. Au total, environ 2 500 spécimens ont été identifiés, et ceux-ci représentaient plus de 100 taxons d'éponges connues. Presque la moitié des espèces recensées étaient de l'ordre Poecilosclerida. Le présent rapport fait état des éponges appartenant à la famille Crellidae (classe Demospongiae, sous-classe Heteroscleromorpha, ordre Poecilosclerida, famille Crellidae) et à la famille Myxillidae (classe Demospongiae, sous-classe Heteroscleromorpha, ordre Poecilosclerida, famille Myxillidae). En tout, six espèces du genre *Crella* (Crellidae) et des genres *Melonanchora* et *Myxilla* (Myxillidae) sont décrites. Ces espèces sont : *Crella (Yvesia) pyrula*, *Melonanchora* cf. *elliptica*, *Melonanchora* cf. *emphysema*, *Myxilla brunnea*, *Myxilla (Myxilla) fimbriata* et *Myxilla (Myxilla)* cf. *incrustans*. Les descriptions portent sur les éléments morphologiques et comprennent des détails descriptifs et dimensionnels sur les spicules ainsi que des observations sur les aspects taxinomiques.

INTRODUCTION

Tompkins et al. (2017) presented 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). The order Poecilosclerida comprised nearly half of the ~100 species identified from 479 trawl sets conducted in the eastern Canadian Arctic (Figure 1). Here we provide a similar description of six further species from two additional families belonging to Poecilosclerida: one from Crellidae, and five from Myxillidae. They are, as follows: *Crella (Yvesia) pyrula*, *Melonanchora* cf. *elliptica*, *Melonanchora* cf. *emphysema*, *Myxilla brunnea*, *Myxilla (Myxilla) fimbriata*, and *Myxilla (Myxilla)* cf. *incrustans*. In keeping with the previous report, our intent is to provide a resource to facilitate accurate, consistent and efficient identification of eastern Canadian sponges for the purpose of monitoring and mapping species distributions. DNA barcodes were not attempted for these taxa.

Taxonomic Background on the Families Crellidae and Myxillidae

The order Poecilosclerida includes 20 families: 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). Spicule composition may include chelae microscleres, sigmas and sigmancistra derivatives, and sometimes toxas, raphides, microoxeas, dicorhabds or spinorhabds.

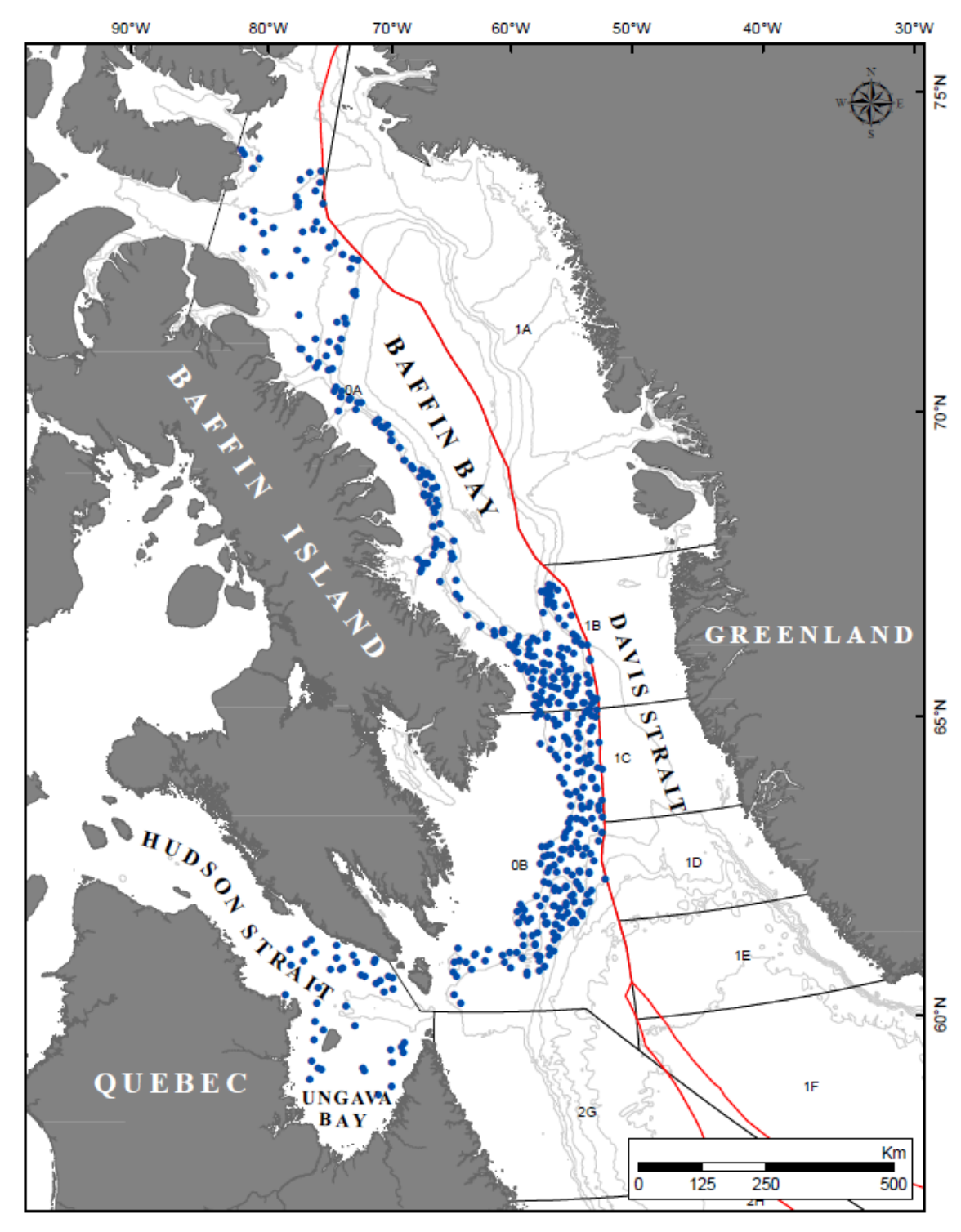

Figure 1. Locations of *Paamiut* 2010-2014 trawl sets (N=479) with sponge catch, from areas of Baffin Bay, Davis Strait, Ungava Bay and Hudson Strait. Northwest Atlantic Fisheries Organization (NAFO) Divisions are indicated in black. The exclusive economic zones of Canada and Greenland are indicated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

Family Crellidae (Dendy, 1922)

Family Crellidae was formed by Dendy (1922), and consists of sponges ranging in form from encrusting to lobate, to erect and branching. The surface contains areolated pores, similar to those found in the family Hymedesmiidae, although in hymedesmids the spicules supporting the pores are smooth, while in crellids they are acanthose (Hooper and Van Soest 2002). Dendy originally placed his "Section Crelleae" (the original name for Crellidae) under Ectyoninae, a former subfamily that was characterised by the presence of echinating acanthostyles, i.e., acanthostyles found erect at the base of a sponge (Hooper and Van Soest 2002). While this trait can be found in some species of Crellidae, it is not currently used as a means of diagnosing the family. The primary synapomorphy displayed by members of the Crellidae is the presence of a surface crust with tangentially-arranged acanthose megascleres (Dendy 1922, Hooper and Van Soest 2002). The choanosomal skeleton, by contrast, is composed of tracts of smooth megascleres arranged in a net-like, or reticulate, fashion. The spicule complement for sponges belonging to the Crellidae includes the following: 1) ectosomal acanthose megascleres: acanthostyles, acanthoxeas, or acanthostrongyles; 2) choanosomal smooth megascleres in the form of tornotes or oxeas; 3) microscleres that include arcuate chelae and occasionally sigmas. In most taxa, the chelae are equal-ended (isochelae), but both isochelae and anisochelae are found in the genus *Anisocrella*. The current classification for Crellidae is as follows: phylum Porifera > class Demospongiae > subclass Heteroscleromorpha > order Poecilosclerida > family Crellidae.

Taxa belonging to the Crellidae can display variations in their spicule complements that range from small differences in shape and size to the presence/absence of some microscleres. Past authors were therefore inclined to create new genera for every deviation they noted. As the characteristics they cited often overlapped with those of other genera, numerous artificial genera resulted: Of the twenty-three nominal genera noted by Hooper and Van Soest (2002), only five are now considered valid. These are: *Anisocrella*, *Crellastrina*, *Spirorhabdia*, *Crella*, and *Crellomima*. *Crella* is by far the most speciose genus, containing fifty-nine valid species (World Porifera Database, Accessed 24 October 2017). Hooper and Van Soest (2002) have suggested retaining the following four subgenera for *Crella* to assist in differentiating species: *Crella, Grayella, Pytheas,* and *Yvesia*.

Of the genera listed above, only specimens of *Crella* have been identified within our collections (*Paamiut* 2010-2014); specifically *Crella (Yvesia) pyrula*. However, we cannot say with certainty that other species and/or genera from Crellidae are not present in the area surveyed, as sampling with fishing trawls may bias our collections toward the identification of larger and/or more robust taxa. Therefore, a list of the defining characteristics of each genus, as given by Hooper and Van Soest (2002), is provided below to assist with identifications in future.

Crellidae lacking microscleres

Crellastrina (monospecific): megascleres include tornotes and acanthoxeas; the acanthoxeas are found in the ectosomal crust and are spiraster and aster-shaped; microscleres are absent

Spirorhabdia: megascleres include basal acanthostyles, polytylotic tornotes, and acanthose rhabds; the rhabds are found within the ectosomal crust; microscleres are absent

Crellidae with microscleres

Anisocrella (monospecific): megascleres include acanthoxeas and tornotes; microscleres include reduced arcuate anisochelae as well as arcuate isochelae

Crella: megascleres include acanthose styles, oxeas, or strongyles; tornotes can be oxeote or have rounded ends; microscleres include arcuate isochelae and occasionally sigmas, but both types can be present or absent

Crellomima: megascleres include acanthose styles, oxeas, or strongyles (found in the ectosome); tornotes are smooth; microscleres include polydentate anchorate isochelae

***Crella* (Gray, 1867)**

Crella is the largest genus within Crellidae, with four subgenera and fifty-eight valid species (Hooper and Van Soest 2002; World Porifera Database, Accessed 21 November 2017). *Crella* species can vary widely in form, with some encrusting, and others pedunculate or lobate. As such, external morphology, while a useful aid in identifying the more distinctive-looking species of *Crella* (including *Crella (Yvesia) pyrula*), is not particularly useful for identification at the genus level. The spicule complement and spicule locations within the skeleton are better indicators of whether a sponge belongs to *Crella*. As noted in Systema Porifera, *Crella* possesses acanthose and smooth megascleres; the former are acanthostyles, acanthoxeas, or acanthostrongyles that are arranged tangentially to form a distinct surface crust, while the latter are tornotes or strongyles that form reticulate tracts in the choanosome (Hooper and Van Soest 2002). Encrusting forms have also been found to possess a basal layer of echinating acanthostyles. The microscleres, when present, consist of arcuate equal-ended chelae (isochelae), and very rarely sigmas (Hooper and Van Soest 2002).

As noted previously, Crellidae is rife with artificial genera, most of which were created in response to slight variations in spicule complements. A majority of these former genera have now been placed under the genus *Crella*, but Hooper and Van Soest (2002) have reclassified three of them (*Grayella*, *Pytheas*, and *Yvesia*) as subgenera, alongside the subgenus *Crella*. Subgenus *Crella* lacks chelae and has basal echinating acanthostyles; *Grayella* lacks chelae as well as basal echinating acanthostyles; *Pytheas* possesses chelae and has basal echinating

acanthostyles; and *Yvesia* has chelae and lacks basal echinating acanthostyles (Hooper and Van Soest 2002). However, some species of *Crella* do not have a subgenus. Further, Hooper and Van Soest (2002) stress that these subgenera are retained solely for ease of identification; they do not represent natural phylogenetic groupings within the genus. Among our *Crella* specimens, the only subgenus represented is *Crella (Yvesia),* in *Crella (Yvesia) pyrula*, identified by its spicule complement and its distinctive external morphology.

Family Myxillidae (Dendy, 1922)

Family Myxillidae was formed by Dendy in 1922. Known originally as "Section Myxilleae", Dendy placed the group within Ectyoninae, a now-extinct subfamily of sponges characterised by the presence of echinating acanthostyles (Hooper and Van Soest 2002). Myxillidae has, in the past, been broadly defined in terms of possession of symmetrical or near-symmetrical dermal megascleres (Dendy 1922, Hooper and Van Soest 2002). As such, the family displays a wide range of growth forms, and once encompassed numerous groups, including sponges that now belong to Families Hymedesmiidae, Crellidae, Iotrochotidae, and Desmacellidae, among others. The current definition of Myxillidae is much narrower, including only sponges with anchorate or anchorate-derived isochelae in conjuction with ectosomal tornotes and choanosomal styles (Hooper and Van Soest 2002). The skeleton is divisible into an ectosomal crust of perpendicularly-arranged tornotes and a choanosome composed of reticulated tracts of smooth or slightly spined megascleres. The spicule complement is as follows: 1) ectosomal tornotes range from oxeote to tylote in shape, they are either smooth or slightly spined at either end; 2) choanosomal monactinal or diactinal megascleres (styles or strongyles) that can be smooth or acanthose; 3) microscleres consist of one or multiple size classes of anchorate or anchorate-derived isochelae, and occasionally one or more size classes of sigmas. The following is the updated classification for the Myxillidae: phylum Porifera > class Demospongiae > subclass Heteroscleromorpha > order Poecilosclerida > family Myxillidae.

There have been thirty-three genera associated with Myxillidae, but out of these only eight are currently considered valid. These are: *Damiriopsis*, *Ectyonopsis*, *Hymenancora*, *Melonanchora*, *Myxilla*, *Plocamiancora*, *Psammochela*, and *Stelodoryx*. Of these genera, *Myxilla* is the most speciose, with approximately eighty-five species described (Hooper and Van Soest 2002). These have been organised into the following subgenera: *Burtonancora*, *Ectyomyxilla*, *Myxilla*, and *Styloptilon*.

The Myxillidae species identified in our collections (*Paamiut* 2010-2014) belong only to *Melonanchora* and *Myxilla*. These are *Melonanchora* cf. *elliptica*, *Melonanchora* cf. *emphysema*, *Myxilla brunnea*, *Myxilla (Myxilla) fimbriata*, and *Myxilla (Myxilla)* cf. *incrustans*. However, sponge surveys in the area of study are on-going, and it is possible that other genera from Myxillidae will be found as we continue to find new specimens and refine our

identifications. Therefore, a brief list of the characteristics of each genus, as detailed in Systema Porifera, is included below.

Myxillidae with choanosomal strongyles

Damiriopsis (monospecific): megascleres include apically-spined tylotes and strongyles that are smooth or slightly spined at the endpoints; microscleres consist of anchorate chelae, but sigmas are absent

Ectyonopsis: megascleres include smooth mucronate tornotes in the ectosome and acanthostrongyles in the choanosome, some of these are echinating; microscleres consist of spatulate anchorate chelae

Plocamiancora: form is encrusting; skeleton consists of a basal reticulated bed of strongyles upon which long styles stand erect, other megascleres include smaller acanthostyles and smooth ectosomal tornotes; microscleres are isochelae, either unguiferate or polydentate anchorate

Myxillidae lacking choanosomal strongyles

Hymenancora: spicules have a hymedesmoid arrangement; megascleres include acanthostyles and occasionally smooth ectosomal strongyles and tylotes; microscleres include polydentate isochelae and sometimes anisochelae and sigmas

Melonanchora: external morphology is fistular with a clearly-defined membrane; megascleres consist of smooth styles and ectosomal tylotes; microscleres include sphaerancoras and anchorate chelae

Myxilla: megascleres include ectosomal tylotes/tornotes, some of which are spined, and choanosomal styles that are either smooth or acanthose; microscleres include unguiferate or spatulate isochelae with no more than three teeth, and occasionally sigmas

Psammochela: skeleton is reticulate and incorporates sand grains; megascleres consist of either a single type (styles or strongyles) or are absent completely, tornotes are absent; microscleres include both polydentate and anchorate isochelae, as well as sigmas

Stelodoryx: choanosomal skeleton is reticulate and composed of smooth or slightly-spined styles; ectosome contains tornotes; microscleres include unguiferate isochelae, polydentate or tridentate anchorate isochelae, and sigmas

***Melonanchora* (Carter, 1874)**

The genus *Melonanchora*, first described by Carter in 1874 when he described *Melonanchora elliptica*, is distinct in several respects with regard to its external morphology. Sponges of the genus *Melonanchora* tend to be compact and globular in form, often with projections off of their surfaces. A well-developed dermal membrane is also present, with mesh-like openings over the pores (Hooper and Van Soest 2002). While we did not prepare thick sections to examine the skeletal elements, it should be noted that sponges of the genus *Melonanchora* have a clearly differentiated ectosome and choanosome, with tangentially-arranged tylotes forming the ectosome or dermal membrane, and smooth styles found in the choanosome in a disorganised fashion (Hooper and Van Soest 2002). However, the trait that most distinguishes *Melonanchora* from other genera of Myxillidae, and from other sponges in general, is the presence of sphaerancoras among the spicule complement. These are oval to elliptical in shape and are composed of two perpendicularly-intersecting planes. Sphaerancoras are derived from anchorate isochelae, also present in *Melonanchora*, and thus far they appear a unique feature of the genus. In this report, two *Melonanchora* taxa are examined: *Melonanchora* cf. *elliptica* and *Melonanchora* cf. *emphysema*.

***Myxilla* (Schmidt, 1862)**

The genus *Myxilla* is the largest genus within the Myxillidae, and as such, it has been rather broadly defined in the past. Schmidt (1862) originally separated it from the genus *Reniera* (now invalid) on the basis of its spicule complement, chiefly the presence of acanthose spicules. This contrasted sharply with the smoother and more uniform spicules of other species of *Reniera*, most of which now belong to the genus *Haliclona* (World Porifera Database, accessed 28 November, 2017). Gray (1867), in a description of the genus *Dendoryx* (a predecessor to *Myxilla*) noted that the genus was irregular in form, and described four types of spicules: needle-like ones with spines, fusiform spicules with pointed ends, and anchorate and bihamate spicules. This description fits well with the spicule complement of *Myxilla*, which possesses 1) tylotes, usually mucronate or slightly spined at the ends, that are arranged tangentially in the ectosome; 2) choanosomal spicules, which are typically styles or style-like, with bases that can either be spined or smooth; and 3) microscleres that include anchorate tri-dentate isochelae and sigmas, although some taxa have secondarily lost the latter. The unifying feature of *Myxilla*, as noted by Hooper and Van Soest (2002), is the presence of anchorate isochelae with no more than three teeth. However, in an effort to streamline the identification process, they have recommended retaining four former Myxillidae genera as subgenera of *Myxilla*. These subgenera are not phylogenetically relevant, but are somewhat useful in helping to separate the eighty-five species of *Myxilla* into more manageable groups. These subgenera are: *Burtonanchora*, *Ectyomyxilla*, *Myxilla*, and *Styloptilon*.

Sponges belonging to *Myxilla (Burtonanchora)* are normally massive to flabellate in form, and most specimens have smooth or very faintly-spined styles. Other spicules include ectosomal tornotes, often arranged in bundles, tri-dentate anchorate isochelae, and sigmas. *Myxilla (Ectyomyxilla)* can exhibit a range of physical forms, including encrusting and flabellate. Its spicules include choansomal acanthostyles, smooth tornotes, anchorate isochelae, and sigmas. Its acanthostyles come in two distinct size classes, the smaller of which can form an ectosomal palisade, or be echinating at the base of the sponge. *Myxilla (Myxilla)* primarily consists of massive to lobate sponges, typically with punctuate surfaces (Hooper and Van Soest 2002). They have only been found in the Northern Hemisphere thus far, but their range extends from the North Pole to the tropics. Their spicule complement includes acanthostyles, ectosomal tornotes and/or tylotes with mucronate heads, and multiple size classes of both anchorate isochelae and sigmas. Their acanthostyles are a defining feature of the subgenus, as there is only one class of them, and they tend to be short. Lastly, *Myxilla (Styloptilon)* is encrusting and possesses acanthostyles, anisotornotes, anchorate tri-dentate isochelae, and sigmas. The acanthostyles are divisible into two size classes. Its plumose skeleton renders it distinct from *Myxilla (Myxilla)*, and there is only one species associated with it thus far. In our collections, two species from *Myxilla (Myxilla)* have been found. These are *Myxilla (Myxilla) fimbriata*, and *Myxilla (Myxilla)* cf. *incrustans*. The third species, *Myxilla brunnea*, is not associated with a subgenus.

Using this Report

For each of the six species included in this report we provide morphological and spicule descriptions and dimensions, macro-photos and spicule figures, 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 only amongst the six species in this report and may not be applicable when considering a broader group of species. As noted in Tompkins et al. (2017), the full descriptions should be consulted and spicule measurements or morphological characteristics compared prior to confirming any identification. Sponge taxonomy, including taxonomy of Crellidae and Myxillidae, is subject to change and naming schemes for the sponges in this report may differ in the future from those detailed here. 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 were collected during five annual multispecies surveys (2010-2014) with the Greenland Institute of Natural Resources (GINR) research vessel *Paamiut*. The missions examined were coded as PA2010-9, PA2011-7, PA2012-7, PA2013-8 and PA2014-7 using a vessel code (PA), year (XXXX) and cruise number (X) syntax. 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. 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. Also, in 2011 and 2013 samples were collected during the 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. 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 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 a combination of gross morphology and spicule arrangement, and microscopic analysis of the sponge spicules. Taxonomic resources consulted include Ackers et al. (2007), Boury-Esnault and Rützler (1997), Koltun (1959), Van Soest (Marine Species Identification Portal, Sponges of the NE Atlantic http://species-

identification.org/species.php?species_group=sponges&menuentry=inleiding, accessed 28 November 2017), Systema Porifera (Hooper and Van Soest 2002), and World Porifera Database (http://www.marinespecies.org/porifera). Full details of procedures used for spicule preparations, terminology and identification are provided in Tompkins et al. (2017).

Descriptions

The remainder of this report is comprised of descriptions for 6 species collected in the Paamiut surveys: 1 from Crellidae (genus *Crella*), and the remaining 5 from Myxillidae (2 from genus *Melonanchora*, and 3 from genus *Myxilla*). Our descriptions are based on spicule characteristics as this was sufficient for identification for these taxa.

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
- Table with spicule measurements

RESULTS

Species from the Family Crellidae

One species from Family Crellidae was collected, from the genus *Crella*: *Crella (Yvesia) pyrula* (with two associated specimens). *C. (Y.) pyrula* possesses acanthose megascleres and smooth tornotes, thus conforming to the descriptions of Crellidae found in the work of Dendy (1922) and in the Systema Porifera (Hooper and Van Soest 2002) with regard to its spicule complement. As noted previously, the location of these megascleres within the sponges is critical in the diagnosis of Crellidae: Crellidae sponges have a tangential ectosomal crust of acanthose megascleres, while sponges belonging to family Myxillidae possess a dermal layer of smooth tornotes instead.

As our collection of *C. (Y.) pyrula* consists of two specimens that are fairly intact, it was possible to examine spicules from distinct regions of the sponge. The ectosome was distinct from the

choanosome, as is typical of sponges from the Poecilosclerida (Hooper and Van Soest 2002), and acanthostyles were found in a layer on the surface. *C. (Y.) pyrula* is quite distinctive in its external morphology, and both of our specimens remained abnormally intact despite having been collected by trawl gear. As such, further identification to *C. (Y.) pyrula* was possible by examining their appearance, alongside the spicule complement. The latter consists of short acanthostyles, longer oxeote tornotes, and one size class of arcuate isochelae.

Species of the Family Myxillidae

A total of five species from two genera of Family Myxillidae were collected. Two are from the genus *Melonanchora*: *Melonanchora* cf. *elliptica* (five specimens) and *Melonanchora* cf. *emphysema* (three specimens). The remaining three are from the genus *Myxilla*: *Myxilla brunnea* (four specimens), *Myxilla (Myxilla) fimbriata* (three specimens) and *Myxilla (Myxilla)* cf. *incrustans* (two specimens). Sponges belonging to the family Myxillidae display an outer surface layer of smooth tornotes, and contain acanthose megascleres within their choanosome (Dendy 1922, Hooper and Van Soest 2002). Many of our specimens were not intact, but where possible, we examined their ectosomes and choanosomes, and found that tornotes occurred on the surface layer. For those specimens that did not have a dermal membrane, we examined their spicule complements in order to identify them.

The specimens belonging to *Melonanchora* lacked dermal membranes, and were identified primarily by their spicule complement. This includes the presence of sphaerancora spicules, which are unique to *Melonanchora*. Other spicules associated with *Melonanchora* sponges include styles, tylotes, and anchorate isochelae (Carter 1874, Hooper and Van Soest 2002). In this report, two *Melonanchora* taxa are examined: *Melonanchora* cf. *elliptica* and *Melonanchora* cf. *emphysema*. We have kept the *cf.* designation for both species epithets due to some ambiguity concerning the presence and shape of styles in each. *M. elliptica* is described as having styles, while *M. emphysema* possesses only tylotes, some of which grade into strongyles (Lundbeck 1905). In our collection, sponges have been named *M.* cf. *elliptica* if they possess the ‘abruptly pointed’ styles in Carter’s original description. Sponges that have only tylotes and strongyles have been designated *M.* cf. *emphysema*. It should be noted that considerable overlap in the shapes of the megascleres was found: strongyle-like styles occur in specimens of *M.* cf. *elliptica* along with styles ending in rounded points. Furthermore, the measurements given by Lundbeck (1905) for the tylotes in *M. emphysema* are smaller than those of the strongyles in our specimens. It is possible that the ‘abruptly pointed’ styles of *M.* cf. *elliptica* and the strongyles of *M.* cf. *emphysema* are the same spicule type, with a range of intermediate forms found between them. If this is true, then both taxa could be the same species. However, the ambiguity in spicule shape warrants the separation of our *Melonanchora* specimens into two separate taxa.

Our collections contain nine specimens from the genus *Myxilla*, four from *Myxilla brunnea*, three from *Myxilla (Myxilla) fimbriata*, and two from *Myxilla (Myxilla)* cf. *incrustans*. The sizes of our specimens vary, but the external morphologies and spicule complements fit with descriptions of *Myxilla*, although it should be noted that external morphology can vary widely within the genus and is not particularly useful for identification at the genus level. However, all three of our taxa have anchorate isochelae with three teeth, a trait characteristic of *Myxilla* (Hooper and Van Soest 2002). Our *Myxilla brunnea* specimens were identified based primarily on their spicule components, as all four specimens were fragmented and missing the characteristic dermal membrane. The presence of multidentate tornotes, a distinctive trait for the species, in conjuction with the remainder of the spicules (acanthostyles, acanthostrongyles, and two size classes of anchorate isochelae) and their associated measurements, was used to confirm the species identity.

Two of the species in this report belong to subgenus *Myxilla*, and possess its characteristic single class of short acanthostyles (Hooper and Van Soest 2002), as well as mucronate tornotes and tridentate anchorate isochelae. Our specimens of *Myxilla (Myxilla) fimbriata* match previous descriptions for the species, having acanthostyles, mucronate tornotes, and two size classes of anchorate isochelae (Bowerbank 1866, Lundbeck 1905). The isochelae have a distinctive ridge along their shafts. Sigmas are notably absent from this species, and from the specimens in our collections as well. Our primary reference specimen also has an intact dermal membrane and conforms to the descriptions of *M. (M.) fimbriata*. *Myxilla (Myxilla)* cf. *incrustans* has been given the *cf.* designation at the species epithet level, as the sponges we have worked with are incomplete specimens. However, the spicule complements of both match the one described for *Myxilla (Myxilla) incrustans*, consisting of acanthostyles, tornotes, two size classes of anchorate isochelae, and two size classes of sigmas (Bowerbank 1874, Lundbeck 1905). The tornotes of *M. (M.) incrustans* are very distinctive, with numerous spines lining the endpoints, and our specimens possess these as well. Therefore, we have diagnosed our specimens as belonging to this species, but have chosen to retain the *cf.* designation for the species epithet due to the small size of our specimens.

Spicule Key for Species of the Families Crellidae and Myxillidae

(1) Smooth megascleres are larger than acanthose megascleres…….....*Crella (Yvesia) pyrula*
Smooth megascleres are smaller than acanthose megascleres…….2
(2) Sphaerancora spicules present…….....3 (*Melonanchora*)
Sphaerancora spicules absent……...…4 (*Myxilla*)
(3) Clearly-pointed styles are present among the megascleres …....*Melonanchora* cf. *elliptica*
Clearly-pointed styles are not among the megascleres……..*Melonanchora* cf. *emphysema*
(4) Sigmas are present.…….……*Myxilla (Myxilla)* cf. *incrustans*
Sigmas are absent…….5
(5) Tornotes are multidentate……..……..*Myxilla brunnea*
Tornotes are mucronate……..*Myxilla (Myxilla) fimbriata*

Descriptions of Species of the Family Crellidae

Crella

ITIS TSN 659705 (subgenus)

Crella (Yvesia) pyrula **(Carter, 1876)** WORMS AphiaID 169084

Species description

The sponge is massive and stalked in form, with a holdfast site present on our reference specimen that is wide and irregular in shape (Figure 2). From the stalk, the body branches into multiple prominent lobes that widen toward their apices. The sponge is beige in colour, and has a fairly firm consistency. Numerous small pores cover the surface, giving it a lace or mesh-like appearance. The oscula, by contrast, are fewer and somewhat larger, and these are found on the terminal ends of the lobes. Two specimens, the largest of them 5.5 cm long, were examined.

Habitat information

Hudson Strait, near the mouth of Ungava Bay at 129-242 m depth (Figure 3).

Spicules (Table 1, Figure 4)

Megascleres: Acanthostyles are 105-160 x 8-18 µm, with prominent spines found over the entire spicule. Tornotes are long and somewhat oxeote in appearance, 368-548 x 5-10 µm.

Microscleres: Arcuate isochelae of one size class: 20-33 x 2-4 µm.

Distinguishing characteristics

This species can be diagnosed by examining both its external morphology and spicule complement. The sponge's compact and lobed aspect is very distinct, as is the stalked base. These traits, in conjunction with the sponge's firm consistency and porous surface, make it possible to identify the species based on external morphology alone, provided the specimen is intact. However, the spicule complement is also rather distinctive, composed of long tornotes, short and heavily-spined acanthostyles, and one size class of arcuate isochelae. This is one of the few sponges we have found in our collections with tornotes that are notably longer than acanthostyles, and the only one featured in this report. The fact that the sponge's microsclere complement consists of only one size class of isochelae is also unusual.

Taxonomic remarks

Crella (Yvesia) pyrula was originally described by Carter in 1876 as *Cometella pyrula*. However, it was also described as *Crella lobata* (Arnesen, 1903), *Crella pedunculata* (Topsent, 1890), *Reniera membranacea* (Hansen, 1885), *Sclerilla arctica* (Hansen, 1885), *Sclerilla dura* (Hansen, 1885), *Yvesia lobata* (Arnesen, 1903), and *Yvesia pedunculata* (Topsent, 1890). Carter himself also described species *Crella pyrula* (Carter, 1876), *Grayella pyrula* (Carter, 1876), and *Yvesiella pyrula* (Carter, 1876) (World Porifera Database, accessed 17 November 2017). Topsent (1890) described *Y. pedunculata* as an ovoid, stalked sponge with short acanthostyles, long tornotes, and one class of isochelae. Hansen's 1885 descriptions of *S. arctica* and *S. dura* described sponges that are or may have been pedunculate, and for both of them and *R. membranacea* the spicule types and locations were the same: acanthostyles at the surface, large smooth tornotes in the choanosome, and isochelae. Given these examples, it is perhaps not surprising that all of the species listed above have since been grouped under genus *Crella*, as the differences between their spicule morphologies were deemed too minor to justify maintaining seperate species and genera (Hooper and Van Soest 2002). *Yvesia* and *Grayella* have been retained as subgenera, along with *Crella* and *Pytheas*, for ease of identification within the genus *Crella*.

Our specimens are considerably larger than Carter's type specimen; his measures 1.16 cm by 0.42 cm (Carter 1876). However, the external morphology appears to match that of ours. Carter described a sponge that is pedunculate and attaches to small stones; likewise our specimens display this growth form and one has a holdfast at the base. Carter's sponge, like ours, was light yellow in colour, firm in texture, and had a smooth surface covered in numerous small perforations. The spicule complement also matches ours. Carter's specimen had three types of spicules: large, smooth, and fusiform tornotes with an average length of 522.11 µm; short acanthostyles with numerous conical spines that were around 155.22 µm; and arcuate isochelae. He did not provide measurements for the chelae, but described them as having teeth that were webbed 'nearly to the points'; a feature that can be seen in Figure 7C in the left-hand chela. Carter also noted that the tornotes formed the choanosomal skeleton of the sponge, while the acanthostyles were found in a layer at the sponge's surface; a synapomorphy of Crellidae. Given that our specimens share these external and spicule morphology features with Carter's specimen, we have called this species *C. (Y.) pyrula*.

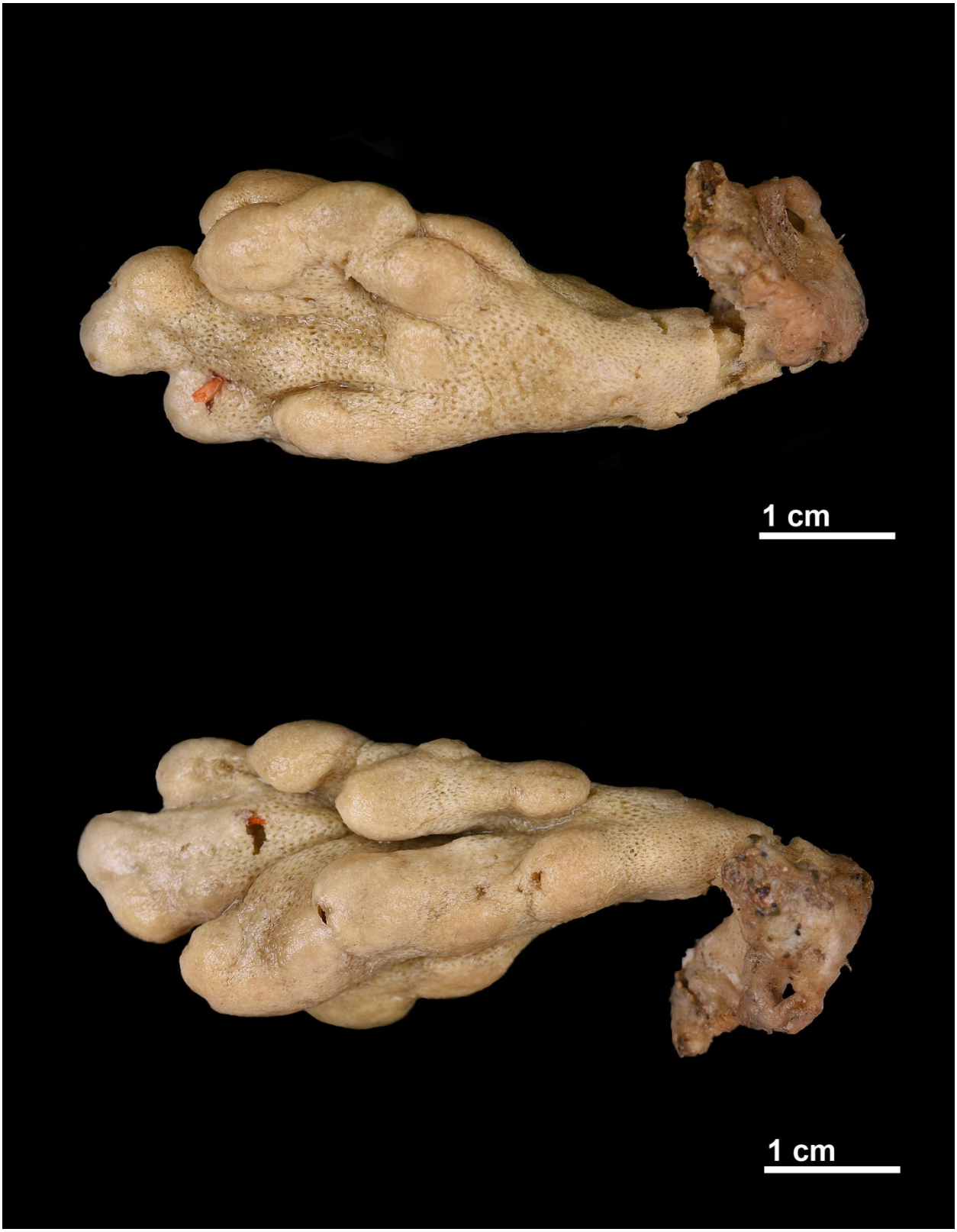

Figure 2. *Crella (Yvesia) pyrula* specimen PA2013-8 Set 133 showing opposite sides.

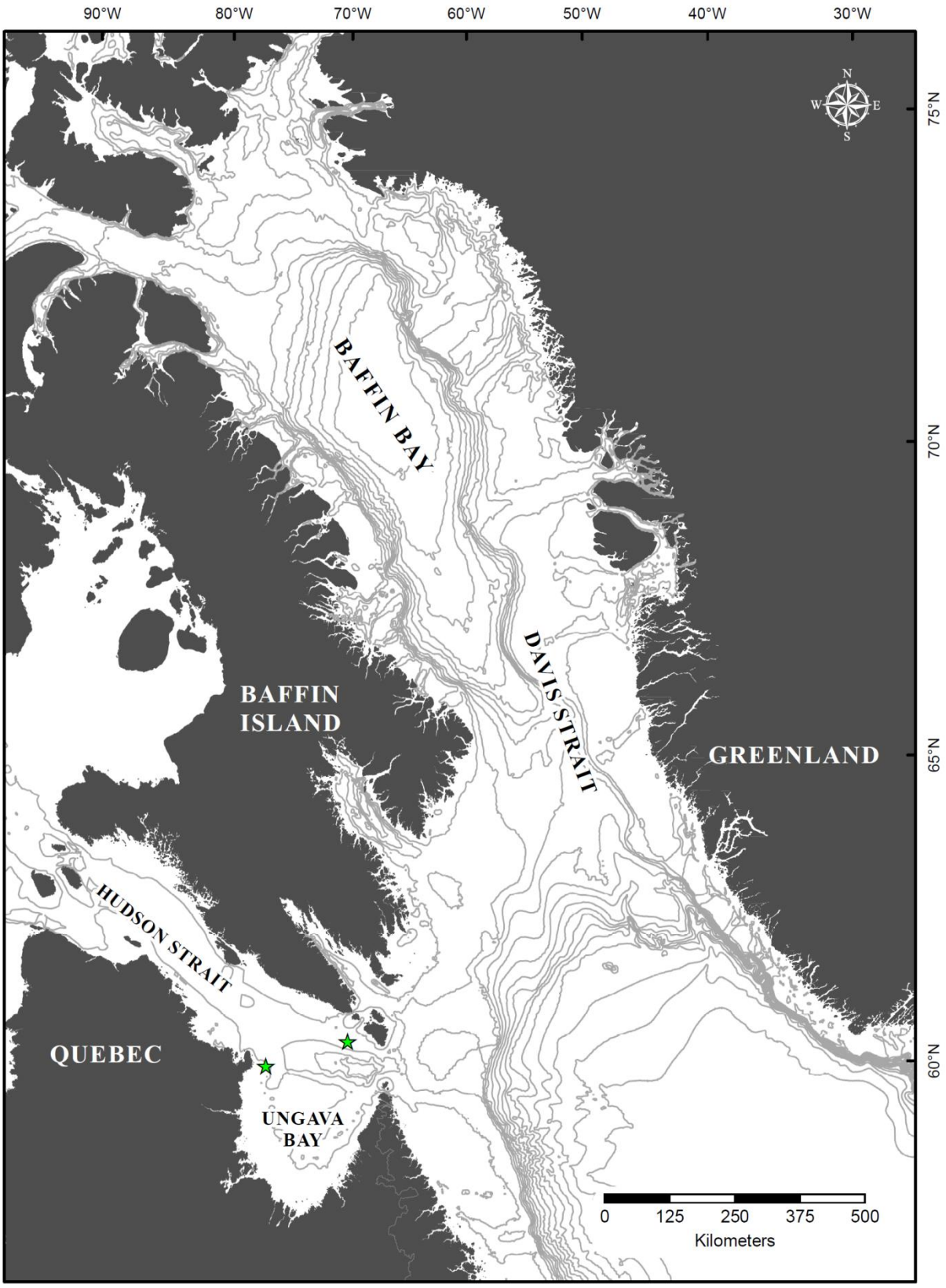

Figure 3. *Crella (Yvesia) pyrula* collection locations.

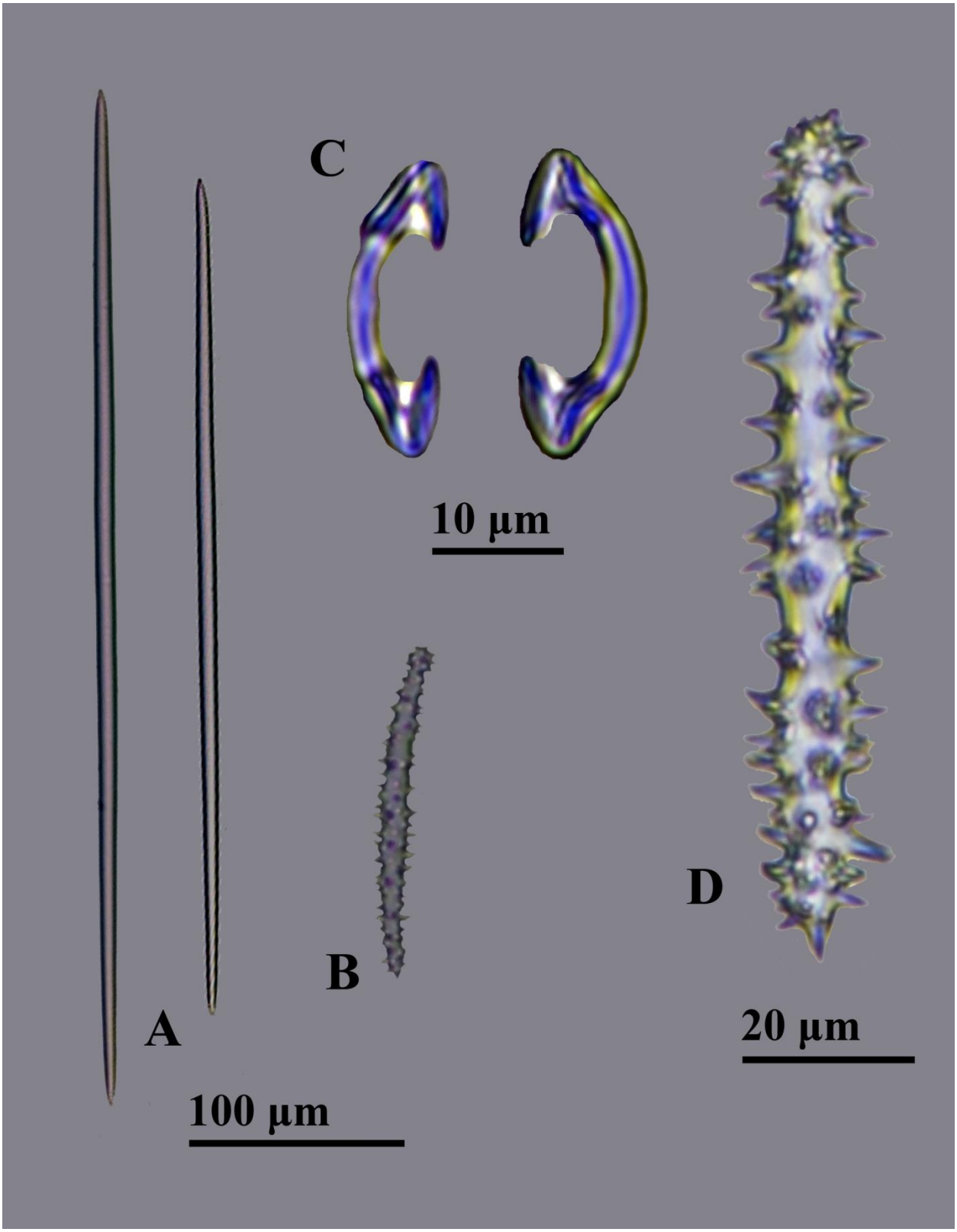

Figure 4. *Crella (Yvesia) pyrula* spicules from PA2013-8 Set 133. Tornotes (A), Acanthostyles (B and D), and Isochelae (C). A and B same scale.

Table 1. Measurements of spicules from specimens of *Crella (Yvesia) pyrula* 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	Acanthostyles	Tornotes	Isochelae
PA2013-8 Set 133	30	114.4-(126.1)-160.1 x 7.5-(10.9)-17.6	383.2-(451.8)-508.4 x 5.2-(6.6)-8.1	20.5-(25.1)-32.8 x 2.3-(2.9)-4.0
PA2011-7 Set 80	10	105.4-(136.2)-151.7 x 7.5-(10.4)-14.1	367.5-(473.4)-547.7 x 4.5-(7.6)-10.1	19.6-(22.7)-24.3 x 1.8-(2.6)-3.4

Descriptions of Species of the Family Myxillidae

Melonanchora

ITIS TSN 203975

***Melonanchora* cf. *elliptica* (Carter, 1874)** WORMS AphiaID 133868

Species description

The sponge is beige in colour, and irregular or lump-like in shape. The texture is slightly compressible. The outer surface appears smooth and slightly fibrous, with several pores visible. The dermal membrane characteristic of this species is lacking in the specimens we examined (Figure 5). The choanosome contains numerous pores and channels. Five specimens were examined, ranging in size from 3 to 5 cm.

Habitat information

Davis Strait and south of Davis Strait at 537-1132 m depth (Figure 6).

Spicules (Table 2, Figure 7)

Megascleres: Styles (682-903 x 14-25 μm) are smooth with one end rounded. The style tapers slightly toward the other end, which can appear rounded or strongyle-like, but is typically abruptly pointed in a fashion similar to a tornote. Tylotes are 497-726 x 11-21 μm. The terminal swellings are poorly-defined, giving them a strongyle-like appearance.

Microscleres: Sphaerancoras are 42-68 x 24-38 μm and their shape varies between oval and elliptical. Isochelae are anchorate and found in two size classes. Isochelae I are 40-83 x 3-9 μm. Isochelae II are 21-29 x 1-2 μm.

Distinguishing characteristics

This species can be distinguished by its dermal membrane (when present) and the presence of sphaerancoras and styles among its spicules. The dermal membrane is thin and paper-like, with numerous papillate projections, the openings of which have a mesh-like covering. It is absent in our specimens, either because they never possessed one, or because it was lost at sea during the sampling process. Given the delicate nature of the membrane, the latter seems most likely. The spicule complement appears a more reliable means of distinguishing this species. Sphaerancora spicules are unique to the genus *Melonanchora*; they are oval to elliptical in shape and consist of two plates formed from modified isochelae that intersect at right angles (Hooper and Van Soest 2002). The presence of styles among the spicules suggests that this specimen is most similar to *Melonanchora elliptica*, as *M. elliptica* possesses styles while *Melonanchora emphysema* lacks them.

Taxonomic remarks

Melonanchora elliptica was first described in 1874 by Carter from a specimen collected in the northeast Atlantic. He described a soft-bodied sponge surrounded by a stiff dermal membrane with papillate projections, upon which pores and oscula were found. This membrane was composed of 'linear spicules' that intersected perpendicularly within the same plane. Carter described these spicules as being inflated at each end; a description that matches that of a tylote. This specimen also contained within its parenchyma styles, anchorate isochelae, and the sphaerancora spicules characteristic of the genus *Melonanchora*. Carter (1874) considered the anchorate isochelae to be developmental forms of the sphaerancoras, a conclusion later refuted by Schmidt (1880) and subsequent taxonomists. In 1880, Schmidt put forth a second description of *M. elliptica*, from a specimen found in the Caribbean Sea. He described his specimen as being crust-like in form, irregular, and 'uninteresting', and he did not mention the dermal membrane described by Carter. These discrepancies in external morphology between his and Carter's specimens are notable, and as Schmidt did not examine the megascleres in his specimen, there is some uncertainty regarding whether the sponge he found is *M. elliptica* (Hooper and Van Soest 2002). Schmidt did note that the anchorate isochelae and the sphaerancoras were separate spicule types. He cited as proof the large numbers of each spicule in the parenchyma and the fact that in his specimen, the largest isochelae were larger than the sphaerancoras, which were the final developmental form according to Carter. Vosmaer (1885) later corroborated Schmidt's assessment, but noted that his Arctic specimen bore a strong resemblance to the one described by Carter, most notably in its possession of a dermal membrane. He documented the presence of a mesh-like covering over the openings of many of the pores and oscula, as well as the relatively few attachment points of the membrane to the main body of the sponge. Topsent (1892) also noted this, and suggested that the differences in the descriptions of Carter and Schmidt could be attributed to loss of this membrane from Schmidt's specimen during collection.

Our specimens conform best with descriptions of *M. elliptica*. They lack dermal membranes, likely because they were detached during the collection process. The spicule complement and morphology of our specimens closely matches *M. elliptica* as well. However, the styles and tylotes in our specimens have length ranges 40-100 µm larger than those given by Carter, Lundbeck (1905), or Koltun (1959). These size differences could be due to individual variation or geographic location, or they could indicate that our specimens belong to a different species or subspecies. The most notable discrepancy between our specimens and the *M. elliptica* descriptions, however, is in the shape of the styles. Carter (1874) described styles that are 'abruptly pointed', but made no mention of strongyles or styles with more subtle points. However, Lundbeck (1905) noted that his specimen of *M. elliptica* had pointed styles, along with others that displayed 'a broad rounding of the pointed end'. In our specimens, we found a mixture of styles that fit Carter's description and styles that appear more strongyle-like. We do not think these are contaminating, due to their prevalence in the specimen and their overall similarity to the styles in every respect but their lack of clearly-pointed ends. They may be

developmental forms of styles, or there may be variation in the shape of the styles like that described by Lundbeck. However, the presence of strongyles or strongyle-like styles in these specimens is problematic, as *Melonanchora emphysema* is distinguished from *M. elliptica* chiefly by its lack of styles and the presence of strongyles. Because our specimens contain styles that fit Carter's description, but also have strongyles or strongyle-like styles, we have called them *Melonanchora* cf. *elliptica*.

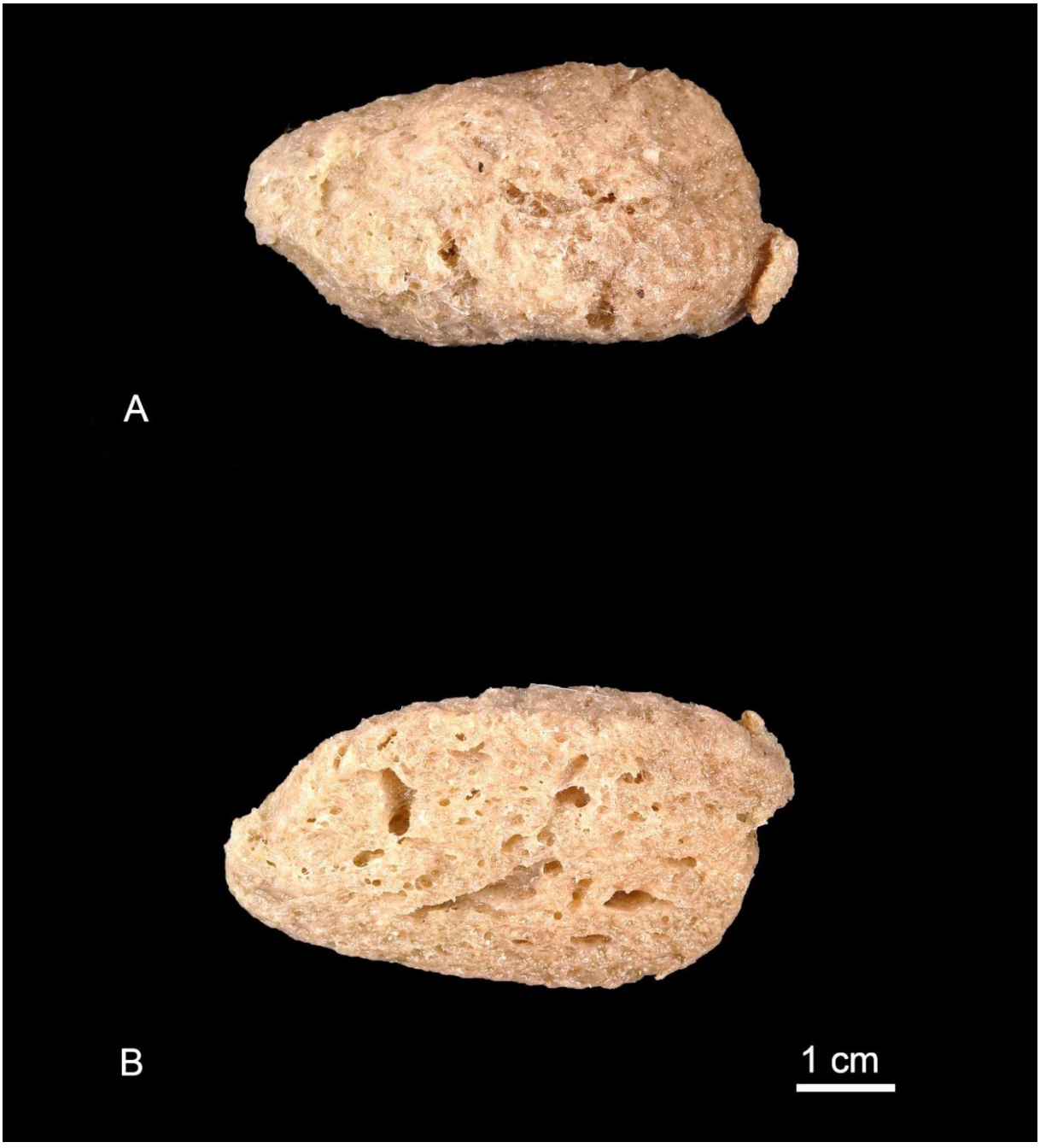

Figure 5. *Melonanchora* cf. *elliptica* specimen PA2013-8 Set 151 with the external (A) and internal (B) surfaces shown.

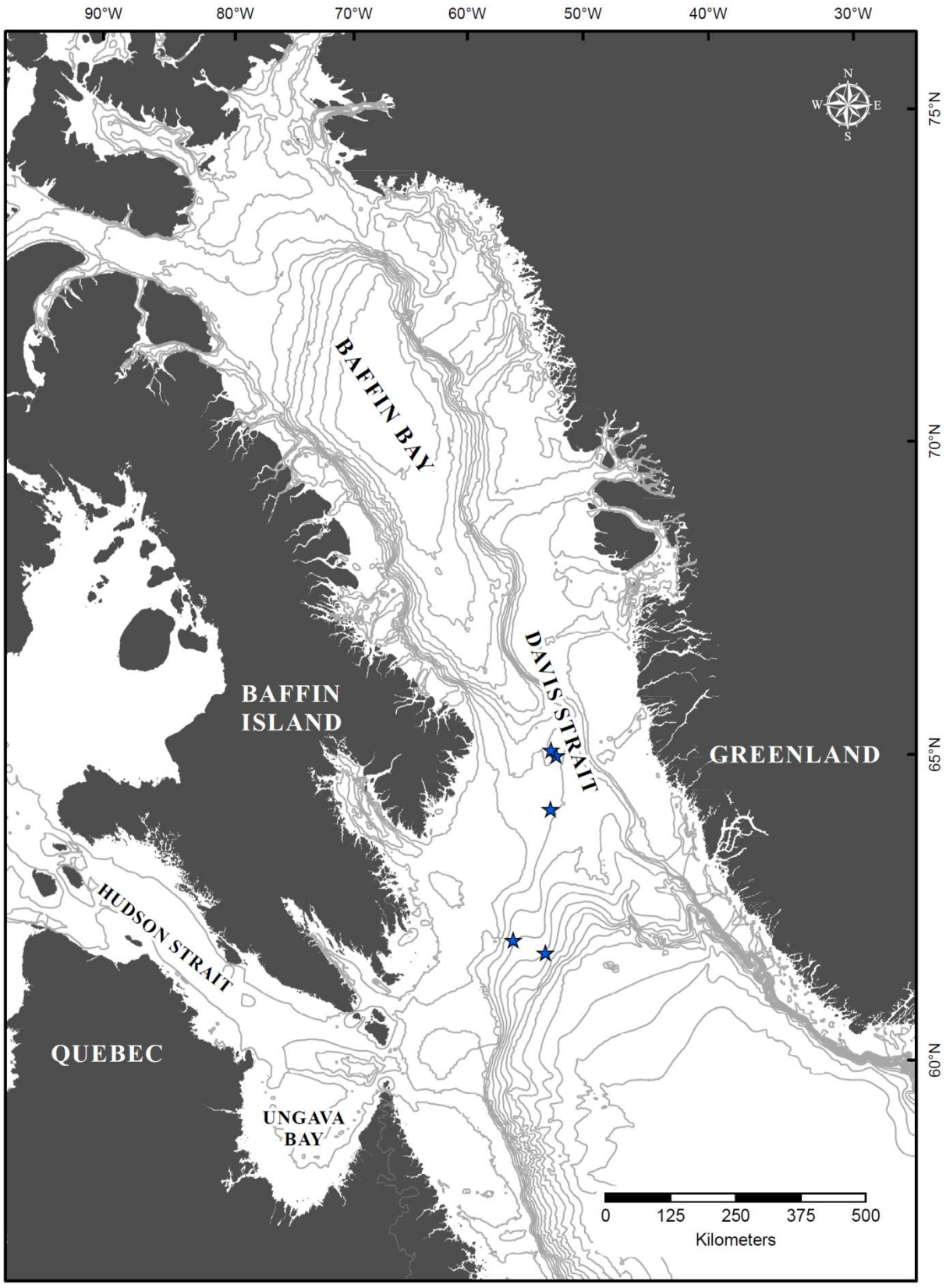

Figure 6. *Melonanchora* cf. *elliptica* collection locations.

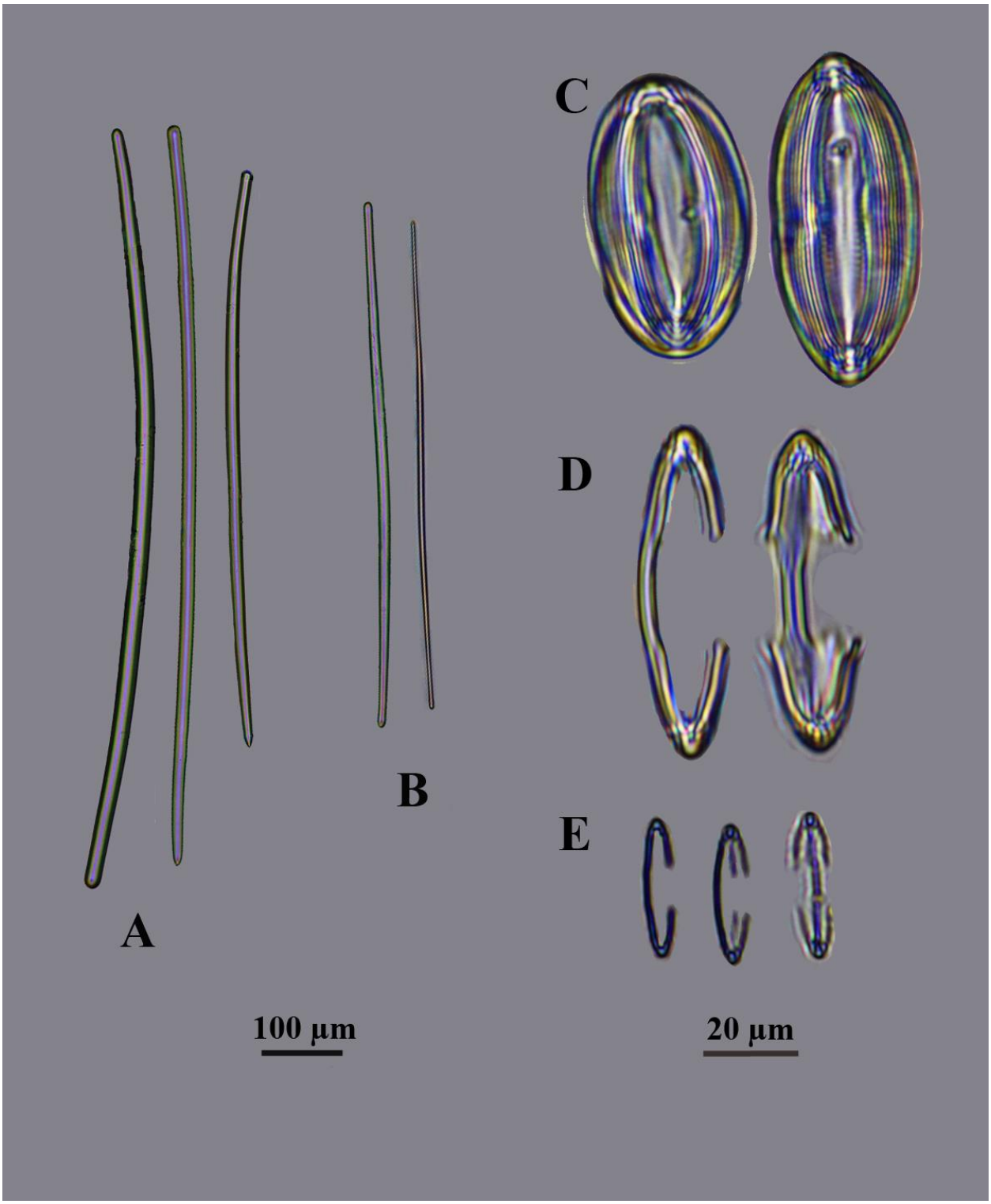

Figure 7. *Melonanchora* cf. *elliptica* spicules from specimen PA2013-8 Set 151. Styles (A), Tylotes (B), Sphaerancoras (C), Isochelae I (D), Isochelae II (E). A and B same scale. C-E same scale.

Table 2. Measurements of spicules from specimens of *Melonanchora* cf. *elliptica* 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	Sphaerancoras	Isochelae I	Isochelae II
PA2013-8 Set 151	30	689.7-(842.8)- 902.8 x 14.2-(19.3)-23.9	528.1-(594.7)-655.5 x 11.1-(15.1)-21.1	48.0-(57.2)- 65.7 x 24.0-(29.7)- 35.9	40.4-(57.4)- 67.6 x 2.6-(3.8)- 5.2	23.1-(25.4)-28.8 x 1.1-(1.8)-2.4
PA2011-7 Set 131	10	730.2-(778.4)-822.4 x 18.3-(21.6)-24.8	575.9-(618.6)-661.5 x 13.3-(15.5)-17.9	54.1-(62.8)-68.0 x 26.9-(31.0)-36.9	44.7-(54.8)-61.6 x 3.2-(4.5)-6.4	22.7-(24.9)-27.0 x 1.3-(1.7)-2.3
PA2011-7 Set 167	10	701.8-(759.8)-827.4 x 15.7-(19.5)-22.2	497.4-(613.1)-725.5 x 12.0-(14.5)-19.0	51.2-(57.9)-63.4 x 23.7-(30.1)-37.5 N = 30	50.9-(56.9)-60.8 x 4.1-(6.4)-8.4	21.4-(25.1)-29.1 x 1.3-(1.7)-2.1
PA2014-7 Set 155	10	743.5-(814.3)-879.1 x 16.0-(19.2)-22.7	504.4-(568.0)- 629.1 x 11.3-(14.4)-18.8	46.3-(55.8)-61.7 x 25.6 -(29.0)-33.2	48.2-(52.5)-57.7 x 4.6-(5.4)-6.6	23.2-(26.0)-27.2 x 1.6-(2.0)-2.3
PA2014-7 Set 158	10	682.2-(758.4)-835.4 x 15.7-(18.6)-22.3	498.4-(553.0)-603.0 x 13.5-(17.4)-20.5	41.5-(49.5)-57.5 x 27.8-(31.8)- 37.9 N = 30	42.1-(59.0)-82.8 x 3.3-(5.6)-8.9	21.5-(24.4)-26.3 x 1.6-(2.0)-2.3

ITIS TSN 203976

***Melonanchora* cf. *emphysema* (Schmidt, 1875)** WORMS AphiaID 133869

Species description

The sponge is massive and somewhat fist-shaped in form, light beige in colour, with a soft and compressible consistency. The surface is fairly smooth and composed of a mesh-like network of spicules. It is covered with numerous pores that range from < 0.1 cm to 0.5 cm in diameter. Multiple papilla-like projections can be seen on the reference specimen (Figure 8). These are thin and they become increasingly translucent toward the endpoints. Three specimens, 3.5 to 6.5 cm long, were examined.

Habitat information

Davis Strait and south of Davis Strait, at 542-1064 m depth (Figure 9).

Spicules (Table 3, Figure 10)

Megascleres: Strongyles are 673-982 x 14-24 μm, some with thinner, tapered ends. Tylotes are 485-673 x 11-20 μm. The swellings on the ends of the tylotes are not particularly prominent, and there appears to be some overlap between tylotes and strongyles in our specimens.

Microscleres: Sphaerancoras are 53-65 x 23-36 μm, ranging from oval to elliptical in shape. There are two sizes classes of anchorate isochelae. Isochelae I are 43-66 x 3-7 μm. Isochelae II are 21-32 x 1-3 μm.

Distinguishing characteristics

This species can be distinguished from other sponge genera by the presence of a dermal membrane, as well as its spicule complement. The dermal membrane is similar in appearance to that of *M. elliptica*, and it is also easily detached from the main body (Lundbeck 1905). None of our specimens have one, so it may have been lost during collection at sea. It is possible that the papillate projections found on the surface of our specimen (Figure 8) may have served as attachment points for the membrane. Ultimately, the spicule complement is a more reliable indicator of species than the presence of a dermal membrane. The prevalence of sphaerancora spicules indicates that the sponge belongs to genus *Melonanchora*, and the lack of clearly-defined styles within the spicule complement suggests that these specimens are more similar to *Melonanchora emphysema* than to *M. elliptica*.

Taxonomic remarks

Melonanchora emphysema was first described by Schmidt in 1875, under the name *Desmacidon emphysema*. Schmidt described a sponge with a bumpy surface and numerous projections. He

did not provide measurements of the spicules, nor did he describe them as such. However, he did mention ‘needles’ with two rounded ends, some with ‘barely perceptible swelling’ and ‘a thicker middle shaft’. This description fits that of a tylote, or possibly a strongyle. Schmidt (1875) also reported seeing numerous examples of a “curiously quadrangular diatom, which is so regularly inserted between the hooks that it appears to belong to the [sponge]”. Given the regular arrangement he described, and the fact that he had not found this diatom in any of the other sponges that he had examined, it seems likely that these were sphaerancora spicules, and that the ‘hooks’ were anchorate isochelae (Figure 10). Lundbeck (1905) reached the same conclusion, noting in his description of *M. emphysema* that Schmidt (1875) had mistaken the sphaerancora spicules for diatoms. Lundbeck (1905) noted that *M. emphysema* was similar to its sister species *M. elliptica* in both external morphology and spicule morphology. The chief difference between the two was the lack of styles in *M. emphysema*. Lundbeck (1905) found only tylotes, including tylotes that graded into strongyles or strongyle-like spicules.

Our specimens have been designated *Melonanchora* cf. *emphysema* due to the lack of clear distinction between the styles, strongyles, and tylotes of both *M. emphysema* and *M. elliptica*. As noted above and in the previous entry, *M. elliptica* has styles that are described as pointed (Carter 1874) or that range from pointed to quite rounded (Lundbeck 1905), or strongyle-like. *M. emphysema* is described as lacking styles, but possessing tylotes with terminal swellings so slight that they too can resemble strongyles (Lundbeck 1905). The strongyles in our specimen (673-982 µm) are larger than the ambiguous tylotes measured by Lundbeck (440-610 µm), perhaps indicating that our specimens belong to *M. elliptica*. However, these strongyles are also larger than the style measurements given for *M. elliptica* by up to 100 µm. Given that the styles in our *M.* cf. *elliptica* specimens are skewed similarly larger, it is possible that all of our specimens are *M. elliptica*, and that they display the gradation of style shapes described by Lundbeck (1905). However, all of the specimens that are called *M.* cf. *elliptica* have styles that are very clearly pointed among their spicules. The specimens that we are calling *M.* cf. *emphysema* lack these clearly pointed styles, possessing only strongyles. For this reason, we are keeping these taxa separate, and have given each species epithet the *cf.* designation. These taxa are good candidates for DNA barcoding, which could help to validate species identification.

Figure 8. *Melonanchora* cf. *emphysema* specimen PA2013-8 Set 10 showing opposite surfaces.

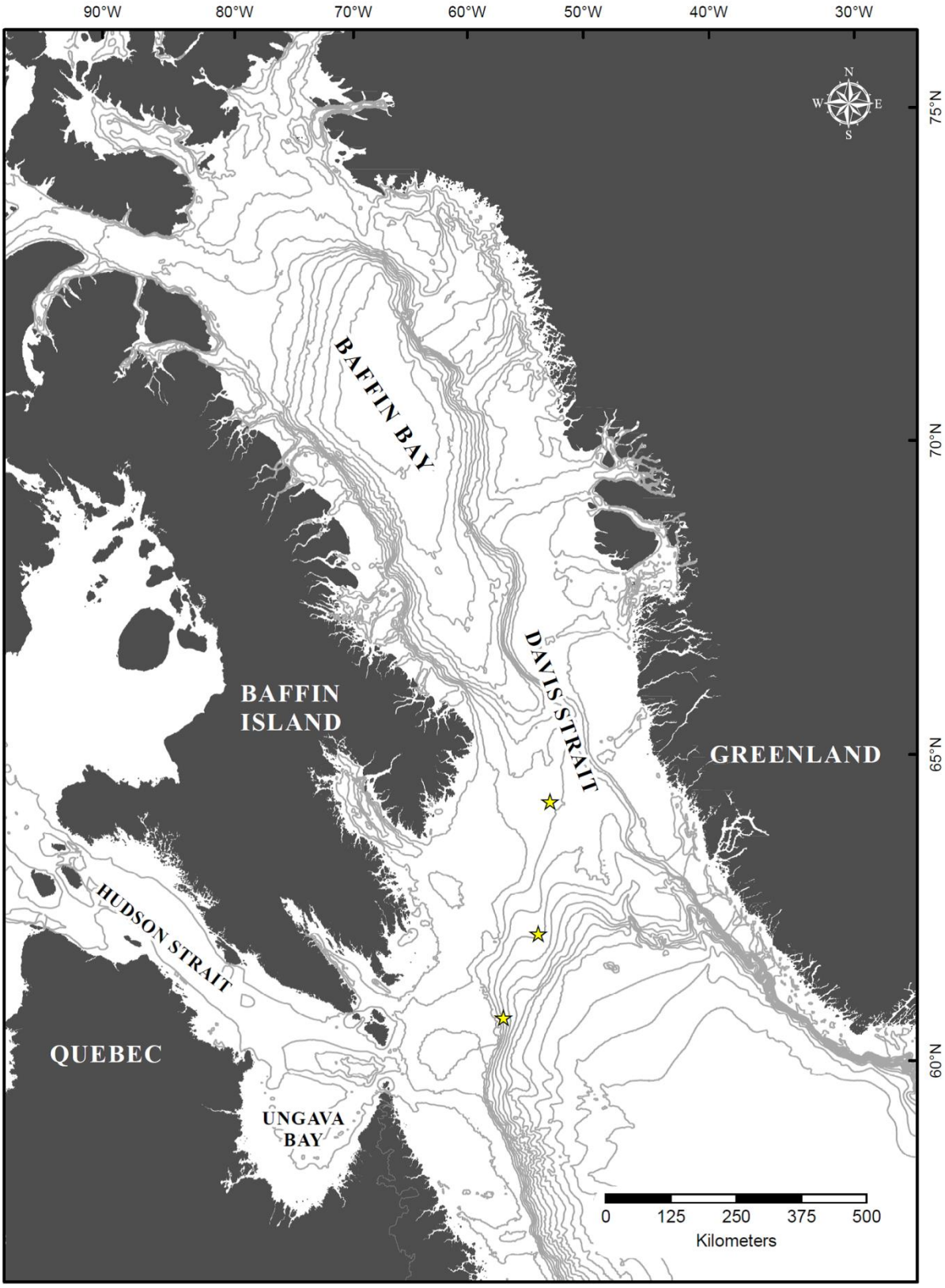

Figure 9. *Melonanchora* cf. *emphysema* collection locations.

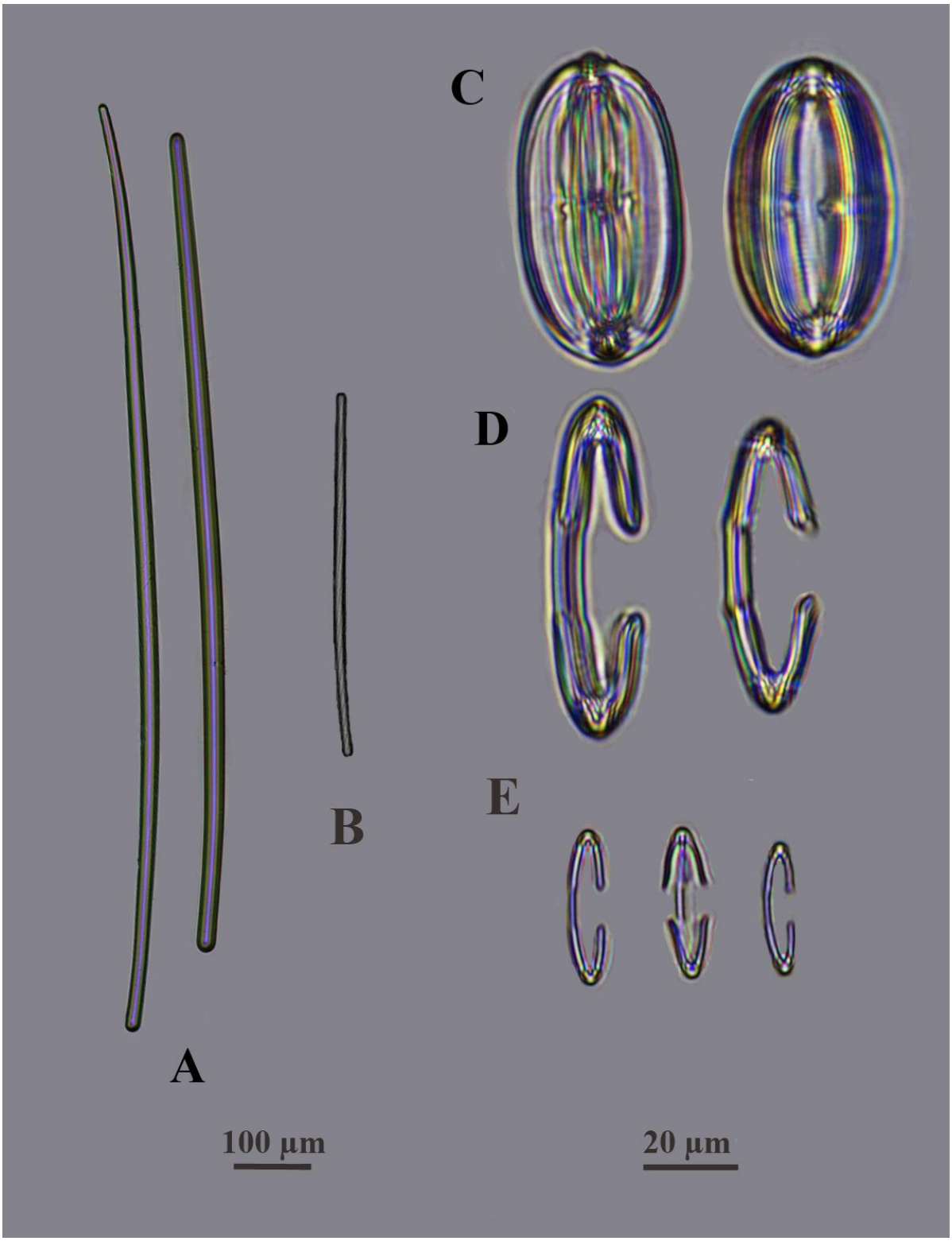

Figure 10. *Melonanchora* cf. *emphysema* spicules from PA2013-8 Set 10. Strongyles (A), Tylotes (B), Sphaerancoras (C), Isochelae I (D), Isochelae II (E). A and B same scale. C-E same scale.

Table 3. Measurements of spicules from specimens of *Melonanchora cf. emphysema* 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	Strongyles	Tylotes	Sphaerancoras	Isochelae I	Isochelae II
PA2013-8 Set10	30	831.1-(913.6)-981.6 x 15.7-(19.5)-22.7	485.1-(599.8)-673.3 x 12.7-(15.6)-20.0	53.2-(57.5)-63.7 x 23.1-(27.7)-35.3	43.3-(59.0)-66.4 x 2.7-(4.4)-6.9	22.6-(25.8)-32.2 x 1.2-(1.9)-2.7
PA2014-7 Set 109	10	823.5-(884.6)-957.8 x 13.5-(19.2)-24.0	537.5-(582.6)-670.8 x 12.0-(14.4)-17.4	52.8-(54.9)-59.3 x 24.9-(30.4)-36.0	44.0-(49.5)-56.8 x 2.9-(4.1)-5.1	22.2-(24.3)-27.1 x 1.1-(1.6)-2.1
PA2014-7 Set 133	10	672.6-(770.9)-860.1 x 17.4-(20.0)-23.9	509.9-(569.8)-611.6 x 11.3-(14.7)-17.9	57.5-(61.7)-65.1 x 23.9-(26.9)-28.8	49.5-(52.3)-56.3 x 3.9-(5.0)-6.9 N = 4	20.5-(22.7)-25.4 x 1.3-(1.8)-2.2

Myxilla

ITIS TSN 48088 (genus)

***Myxilla brunnea* (Hansen, 1885)** WORMS AphiaID 133874

Species description

The sponge is irregular, massive, and somewhat lobate in shape, with a compressible consistency. The colour ranges from medium brown to dark brown. A dermal membrane can be present, although it is lacking in our specimens. The skeleton is mesh-like, with spicules arranged in longitudinal parallel tracts, and the surface of the sponge can have a rough or fuzzy appearance (Figure 11). The surface is marked with numerous grooves and channels, as well as openings that are either oscula or pores. These openings range in size, but are typically no greater than 0.25 cm in diameter. Four specimens, the largest of which measures 8.5 cm at its widest point, were examined.

Habitat information

Davis Strait and Hudson Strait at 242-717 m depth. Only three sites are present, as two of our specimens were found at the same location (Figure 12).

Spicules (Table 4, Figure 13)

Megascleres: Acanthostyles 278-497 x 7-21 μm with a gradually tapered endpoint and a higher concentration of spines on the rounded end. Acanthostrongyles 285-416 x 10-18 μm with a slightly higher concentration of spines on the ends. Smooth tornotes 119-337 x 2-7 μm with swollen ends that terminate with two to four teeth in a somewhat mucronate fashion.

Microscleres: Isochelae are anchorate and come in two size classes (I and II). Isochelae I 51-89 x 4-10 μm. Isochelae II 25-36 x 2-5 μm.

Distinguishing characteristics

This species is distinguished by its uneven outer surface and (when present) the dermal membrane, although Lundbeck (1905) noted that this is easily separated from the main body. When intact, specimens are often leaf-shaped and stalked (Lundbeck 1905). The spicule complement itself is somewhat distinctive; sigmas are absent and the acanthostrongyles are monactinal. Most notably, the tornotes are multidentate, possessing slightly swollen endpoints with multiple teeth (between two and four) on each one. These teeth can be quite fine and are best viewed at 400X magnification on a light microscope.

Taxonomic remarks

Myxilla brunnea was first described by Hansen in 1885. He described a sponge that was large, brown, and leaf-like in form with a surface that was heavily channeled and covered with pores. The spicule complement included a mixture of styles and strongyles that were slightly spined, diactinal spicules, and anchorate isochelae. Lundbeck's 1905 description expanded upon Hansen's work to include additional detail regarding external morphology and skeletal structure. According to Lundbeck (1905), the dermal membrane consisted of tornotes, while the main skeleton consisted of acanthostyles and acanthostrongyles. Unfortunately, our specimens are missing their dermal membranes and consist only of fragments from the main body. This makes it difficult to say with certainty where the different spicule types are located within the sponge; however, the skeletal framework itself appears to consist primarily of acanthostyles and acanthostrongyles that are arranged in a reticulate fashion. This skeletal structure is consistent with that of the Myxillidae (Dendy 1922, Hooper and Van Soest 2002).

The spicule complement in question (acanthostyles, acanthostrongyles, multidentate tornotes, and two size classes of anchorate tridentate isochelae) matches those described by Hansen and Lundbeck, as well as Koltun (1959). However, the sizes of our spicules are larger than those of Lundbeck and Koltun, with the exception of our small class of isochelae (Isochelae II). Lundbeck's ranges were 238-380 µm for the acanthostyles and acanthostrongyles, 200-290 µm for the tornotes, 53-64 µm for the large chelae, and 27-34 µm for the small chelae (1905). Koltun in turn provided measurements of 210-380 µm for the acanthose spicules, 150-290 µm for the tornotes, 44-84 µm for the large chelae, and 23-37 µm for the small chelae (1959). However, Lundbeck (1905) did note that a specimen collected from the Davis Strait had acanthose spicules of up to 440 µm in length, tornotes that reached 350 µm, and large isochelae that were 69 µm long. Since our specimens were also collected from the Davis Strait, it is unsurprising that our spicule measurements are similarly large. Given this information, as well as the fact that our specimens possess the multidentate tornotes that distinguish *M. brunnea*, we have assigned them to this species.

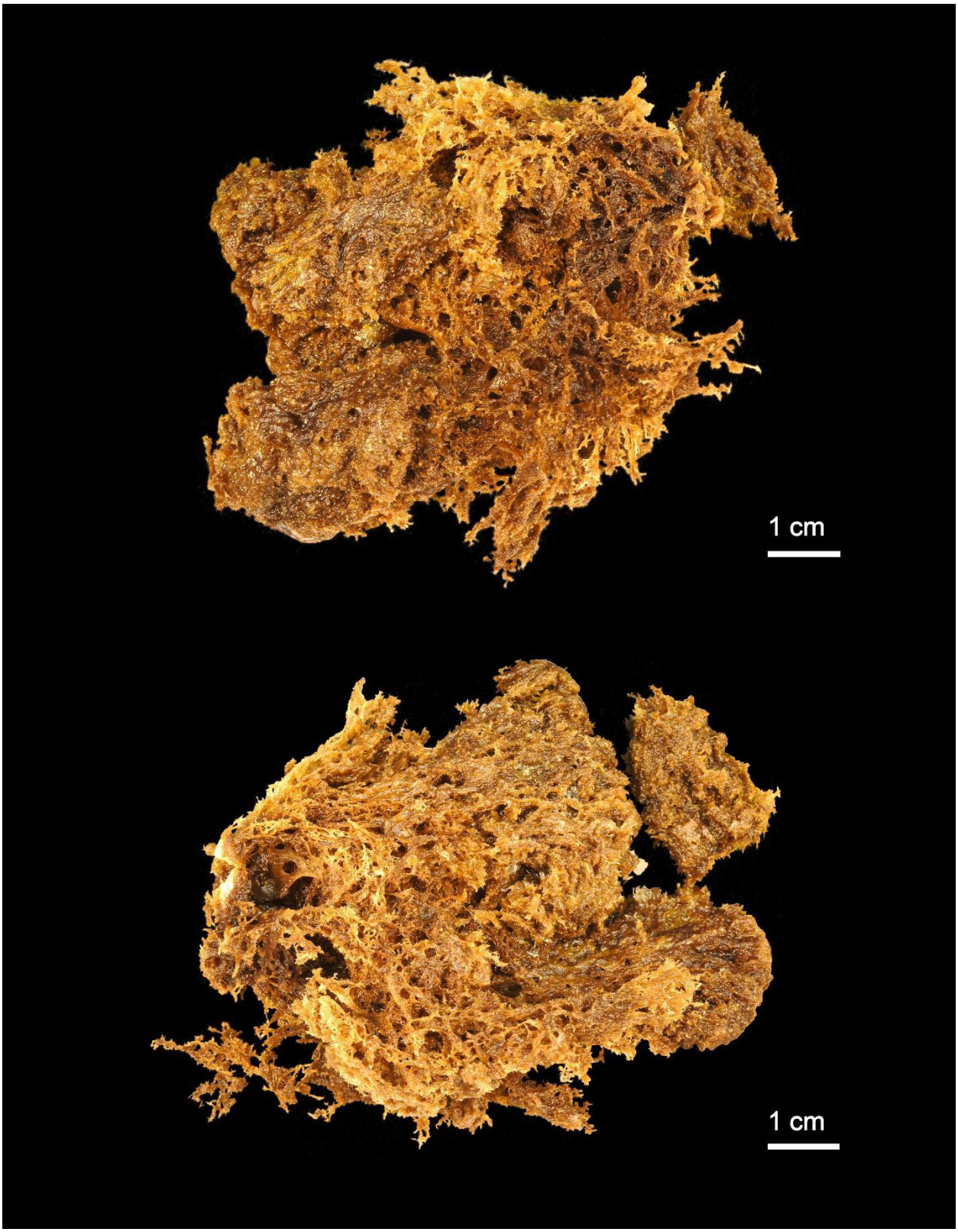

Figure 11. *Myxilla brunnea* specimen PA2013-8 Set 128 showing opposite surfaces.

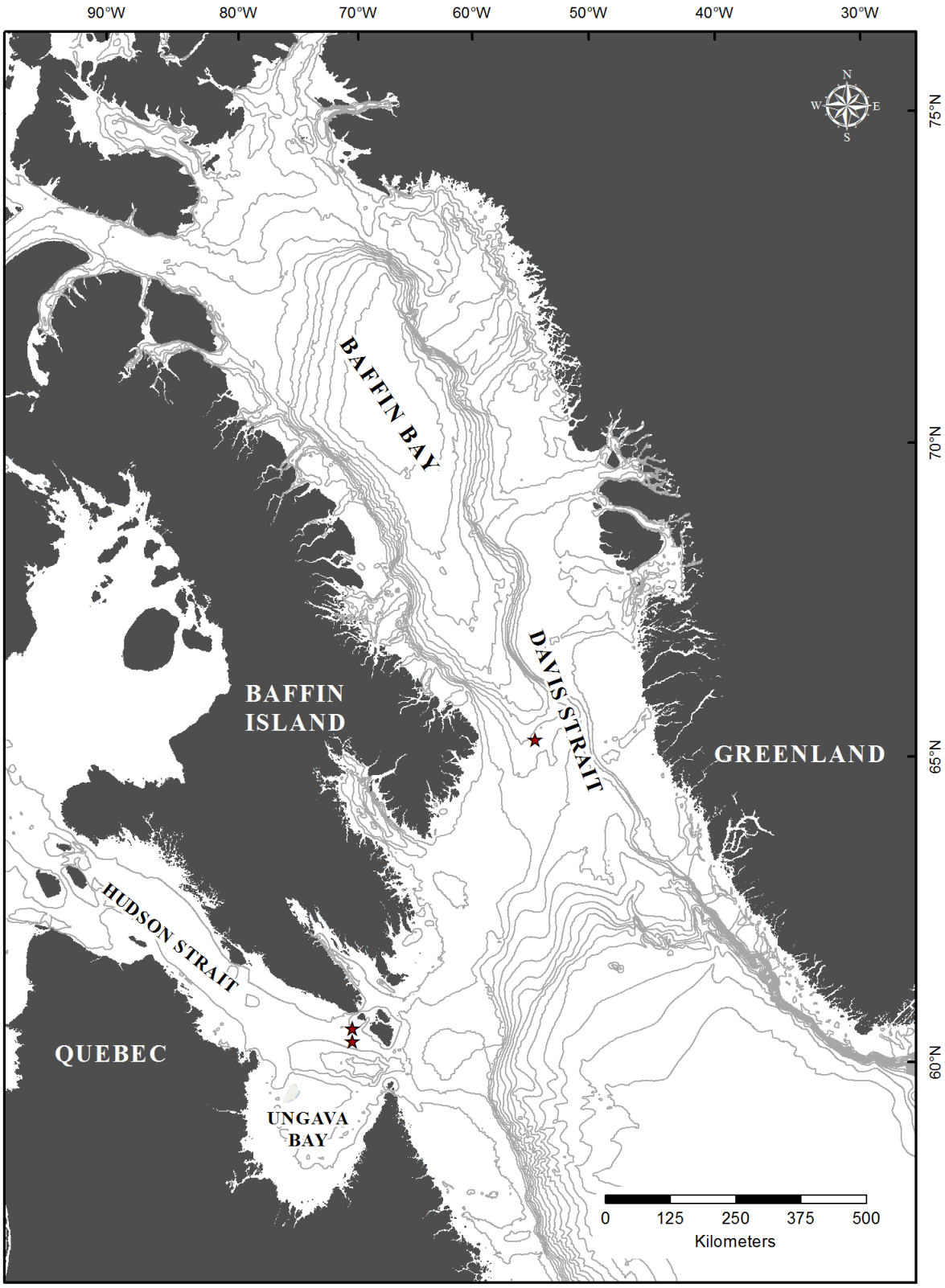

Figure 12. *Myxilla brunnea* collection locations. Note that two specimens are from the same site.

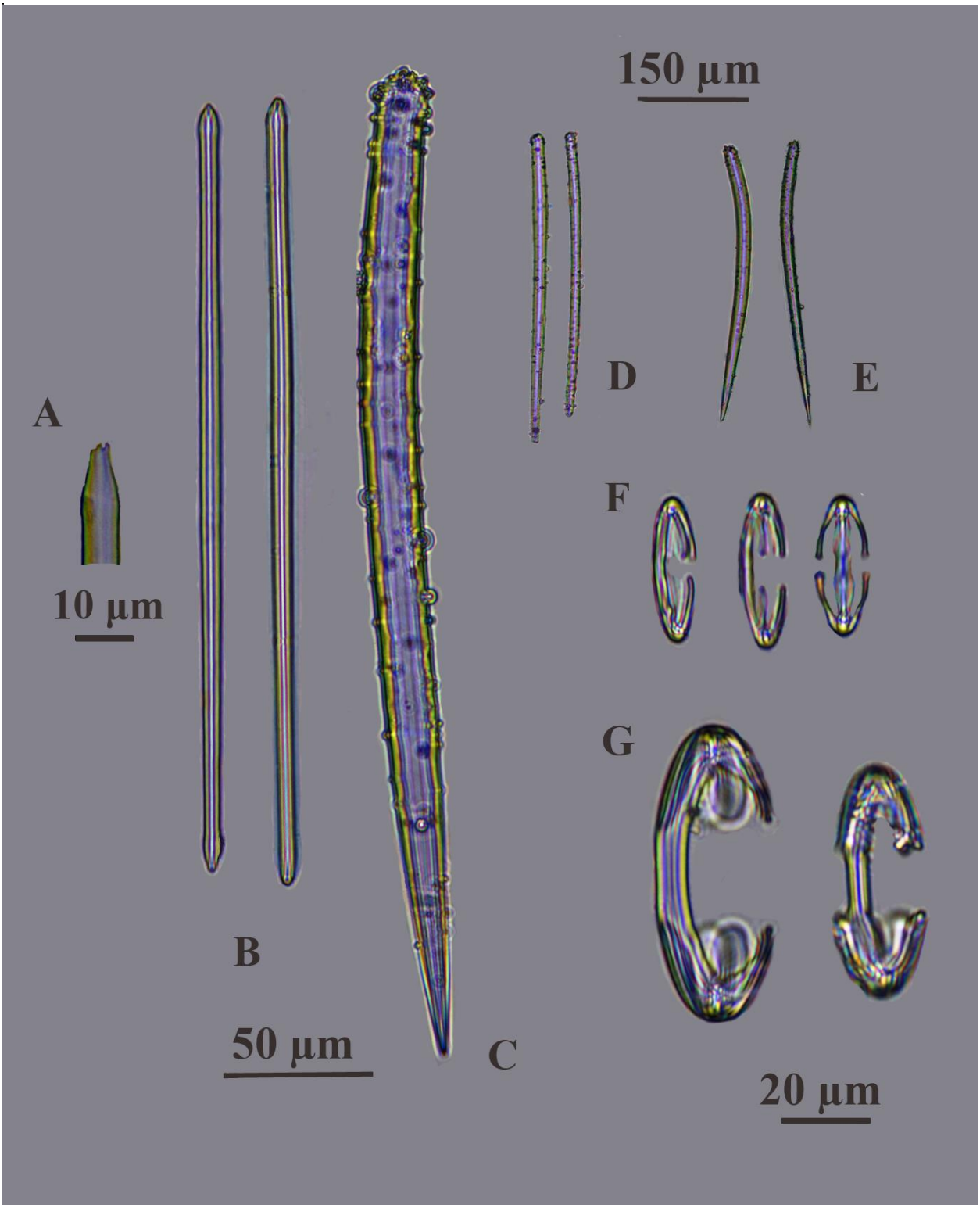

Figure 13. *Myxilla brunnea* spicules from PA2013-7 Set 128. Tornote end (A), Tornotes (B), Acanthostyles (C and E), Acanthostrongyles (D), Isochelae II (F), Isochelae I (G). B and C same scale. D and E same scale. F and G same scale.

Table 4. Measurements of spicules from specimens of *Myxilla brunnea* 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	Acanthostyles	Acanthostrongyles	Tornotes	Isochelae I	Isochelae II
PA2013-8 Set 128	30	277.7-(353.6)-412.2 x 7.1-(14.4)-19.6	307.5-(368.7)-407.8 x 11.1-(14.4)-18.1	206.3-(267.4)-318.1 x 3.9-(5.3)-7.1	50.7-(61.9)-74.2 x 4.3-(5.9)-7.7	25.2-(31.0)-36.3 x 1.8-(2.5)-3.2
PA2013-8 Set 128	10	313.0-(369.8)-425.9 x 8.3-(14.1)-17.9	294.4-(327.4)-363.5 x 12.6-(13.9)-15.9	119.4-(267.6)-337.4 x 2.3-(4.8)-6.0	57.3-(65.6)-89.1 x 5.8-(7.1)-8.2	28.9-(31.7)-35.7 x 1.9-(2.6)-3.6
PA2013-8 Set 133	10	304.1-(366.5)-458.9 x 14.8-(17.8)-21.3	284.7-(320.8)-366.3 x 11.1-(14.3)-17.0	222.3-(265.6)-307.0 x 4.0-(5.3)-6.4	52.7-(60.0)-69.9 x 5.1-(7.0)-8.7	27.4-(30.3)-33.4 x 2.1-(2.8)-3.6
PA2014-7 Set 90	10	298.9-(377.8)-497.0 x 9.1-(15.6)-18.8	344.2-(375.5)-416.0 x 10.2-(14.1)-15.9	231.2-(251.7)-280.6 x 3.4-(4.2)-5.9	54.0-(58.4)-61.7 x 6.3-(7.8)-9.5	28.1-(32.8)-36.4 x 2.9-(3.8)-4.6

ITIS TSN 48093

***Myxilla (Myxilla) fimbriata* (Bowerbank, 1866)** WORMS AphiaID 169461

Species description

The sponge is brown in colour, and massive and somewhat irregular in shape, with several thin foliose lobes projecting from the body that give the sponge a flakey appearance (Figure 14). It is somewhat compressible, and has a very fibrous consistency; the main body is composed of numerous spicule tracts that are visible to the naked eye and fairly dense. Some openings, < 0.5 cm in diameter, are visible on the surface. The sponge has a dermal membrane, which is smooth with a dull sheen. It is cohesive but still easily-torn, with a consistency similar to parchment. Three specimens, the largest measuring ~10 cm in length, were examined.

Habitat information

Located in the Davis Strait at 487-695 m depth (Figure 15).

Spicules (Table 5, Figure 16)

Megascleres: Acanthostyles 292-481 x 12-27 μm. Spines are small and quite short, and tend to be concentrated on the round ends, although on some styles they are found all along the shaft. Tornotes are 236-370 x 4-12 μm, slightly thicker toward the middle of the shaft, and with mucronate endpoints.

Microscleres: The isochelae are anchorate with curved shafts, and come in two size classes (I and II). Isochelae I are 60-91 x 4-13 μm. Isochelae II are 29-42 x 2-6 μm.

Distinguishing characteristics

This species can be distinguished by characteristics of both its external and spicule morphologies. When intact, the sponge's shape is rather distinctive, appearing to consist of several lobes, and its colour reportedly varying from light brown to dark purple (Lundbeck 1905). However, the dermal membrane is arguably the most useful external feature for identifying the sponge as *Myxilla (Myxilla) fimbriata*. It is fairly tough and does not seem prone to separating from the specimen. Its texture is smooth and paper-like, reminiscent of a paper wasp nest, and this, along with the dull sheen noted in the species description above, makes it fairly distinctive. Indeed, we have not seen a dermal membrane of this nature in any of the other taxa in our collections, although it is possible that other *Myxilla* species could possess membranes similar to it. The spicule complement is also useful in identifying the species. The combination of acanthostyles, mucronate tornotes, and anchorate isochelae is relatively uncommon, signalling that the sponge belongs to the genus *Myxilla*. The isochelae have a small line running along the edge of their shafts as well, although this trait can be difficult to see.

Additionally, the lack of sigmas among the spicules indicates that the specimen is likely *M. (M.) fimbriata*.

Taxonomic remarks

This species was first described by Bowerbank in 1866 as *Isodictya fimbriata*, and was based on a collection consisting of approximately two dozen specimens, all of which appear to have been dredged off the coast of the Shetland Islands. The specimens in question were rather small; the largest measurement that Bowerbank gave was ~1.25 cm (0.5 inches) and his qualitative size descriptions suggest that the largest sponge in his collections was no more than 5 cm in diameter (1866). Bowerbank also noted the sponges' smooth surfaces and their dermal membranes, which he described as 'pellucid'. The spicules found in his specimens were called 'tension spicula', 'skeleton spicula', and 'anchorate spicula'. He did not include measurements, but the written descriptions accompanying his spicule categories indicate that the spicules corresponding to them are mucronate tornotes, acanthostyles, and anchorate isochelae, respectively. Lundbeck (1905) reached this conclusion as well in his description of *M. (M.) fimbriata*; in particular he noted that it seemed most likely that the 'tension spicula' were mucronate tornotes, as their uneven ends suggested that the apex had been pulled or stretched away from the base during development. Lundbeck's description, based on his own similarly-sized collection of around twenty specimens, generally corroborated and expanded upon Bowerbank's. He observed that his specimens appeared somewhat lump-like, and became more irregular in form as they increased in size, with his largest specimen 8 cm in length. Lundbeck also described his specimens as having dermal membranes, characterising the membrane as film-like and solid, attached to the body of the sponge with close-set bundles of dermal spicules (tornotes). As in Bowerbank's specimens, the spicule complement included acanthostyles found in the main skeleton, mucronate tornotes with uneven ends located on the outer surface, and anchorate isochelae of two size classes found in the membrane tissue (Lundbeck 1905). Lundbeck's acanthostyles ranged from 260-430 x 10-24 µm, and spines were typically small and numerous. The tornotes were 230-320 x 5-12 µm, and the chelae ranged from 22-35 x 2.1-2.8 µm (the small size class) to 64-90 x 5.7-8 µm (the large size class).

The spicules from our specimens align well with the physical descriptions provided by Lundbeck and Bowerbank, as do the measurements themselves. However, the measurement ranges of our styles and tornotes extend 50 µm longer than those of Lundbeck's. This discrepancy may be due to the sponges' Arctic origins; Arctic specimens of *M. brunnea* have been observed to have longer spicules (Lundbeck 1905), and it is possible that *M. (M.) fimbriata* does as well. Upon examination, the dermal membrane was found to be composed of tornotes and the choanosome primarily of acanthostyles. Generally, our specimens conform to descriptions of *M. (M.) fimbriata* with regards to their external morphology, including colour, consistency, sizes, and shapes. Therefore, we have diagnosed our specimens as *M. (M.) fimbriata*.

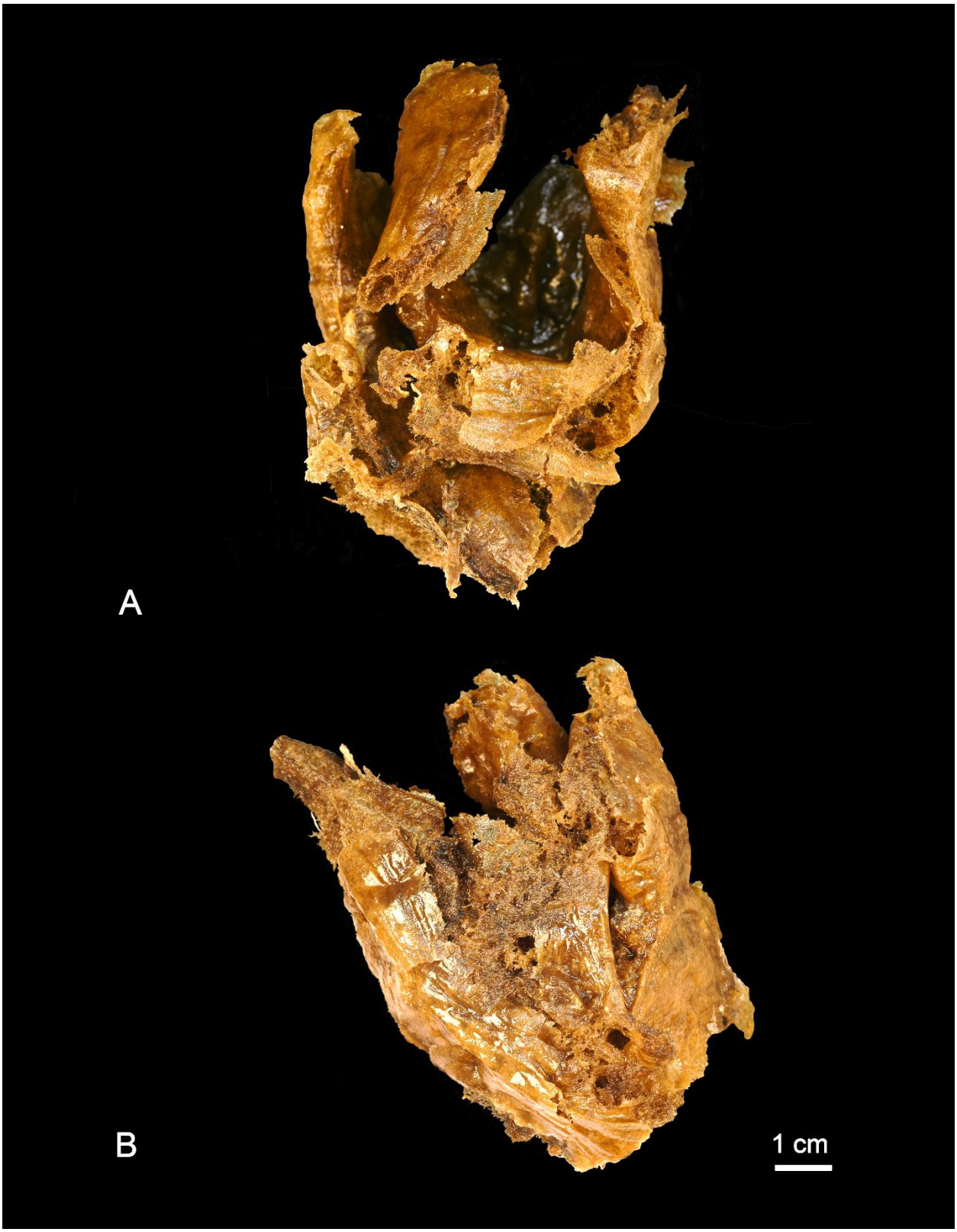

Figure 14. *Myxilla (Myxilla) fimbriata* specimen PA2012-7 Set 152, with A and B showing opposite surfaces.

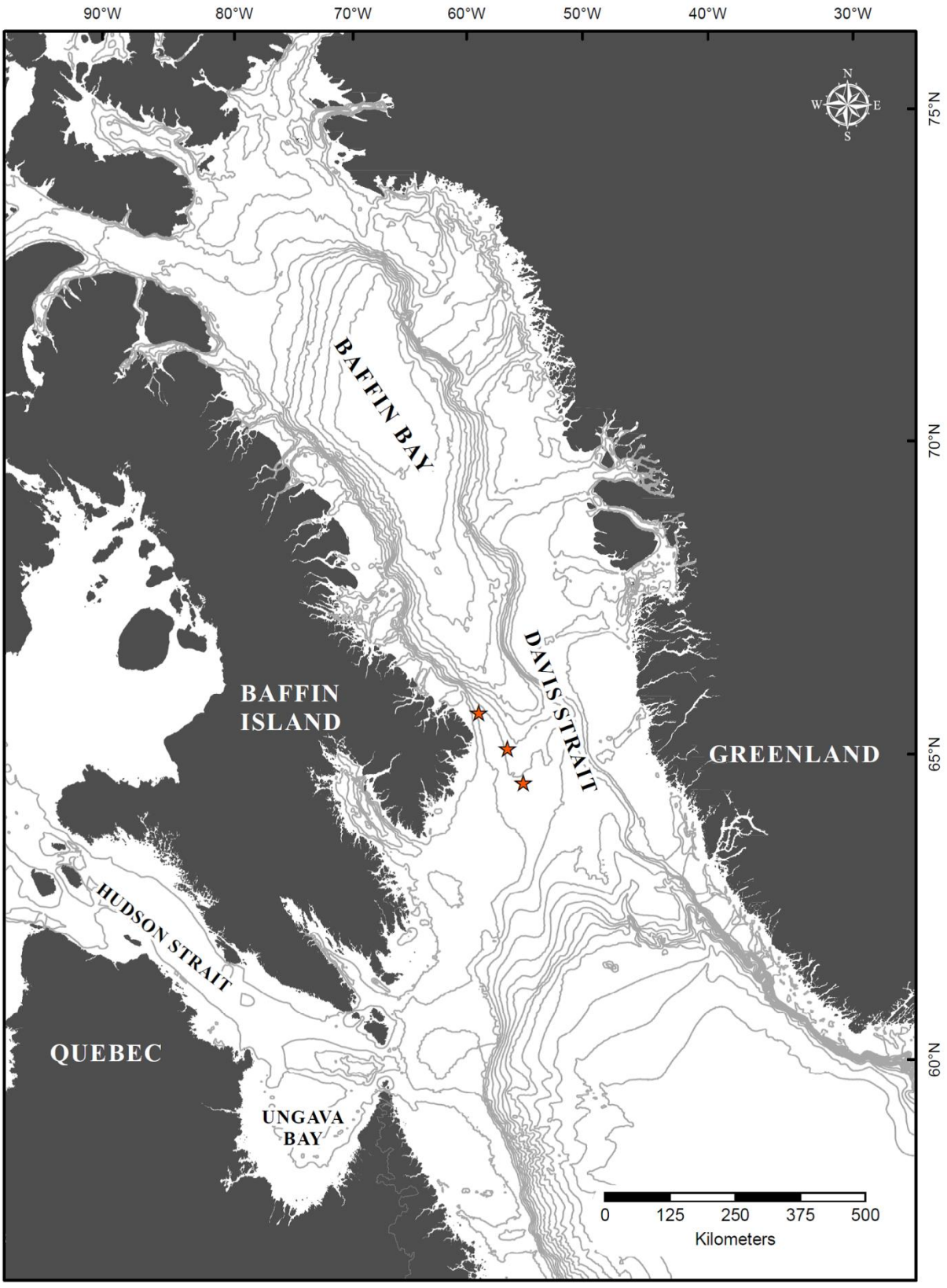

Figure 15. *Myxilla (Myxilla) fimbriata* collection locations.

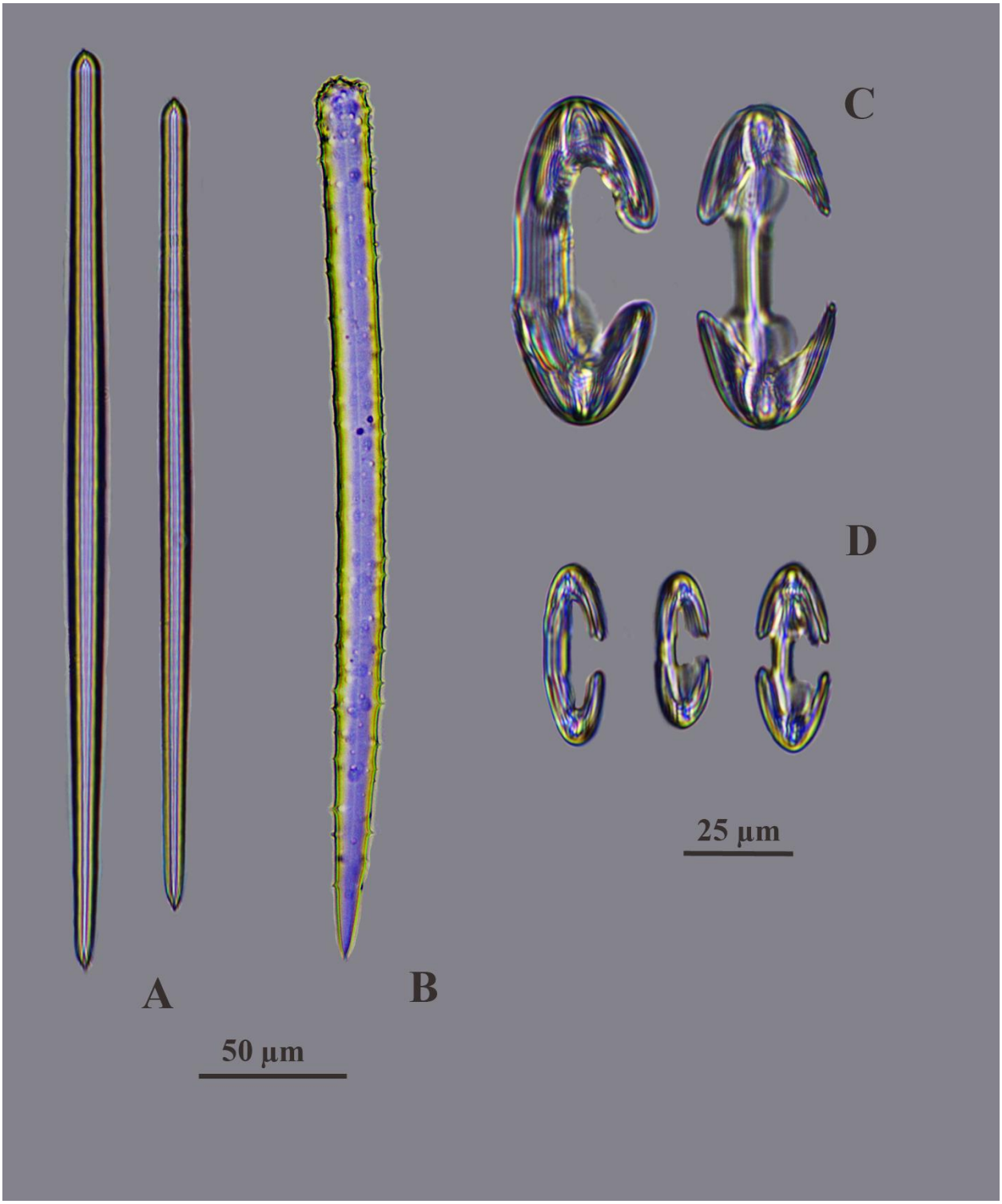

Figure 16. *Myxilla (Myxilla) fimbriata* spicules from PA2012-7 Set 152. Tornotes (A), Acanthostyles (B), Isochelae I (C), Isochelae II (D). A and B same scale; C and D same scale.

Table 5. Measurements of spicules from specimens of *Myxilla (Myxilla) fimbriata* 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	Acanthostyles	Tornotes	Isochelae I	Isochelae II
PA2012-7 Set 152	30	292.0-(403.6)-480.6 x 15.7-(20.6)-27.3	235.6-(276.1)-324.5 x 7.0-(10.1)-12.3	62.3-(73.3)-80.6 x 3.5-(7.9)-11.8	30.3-(34.8)-40.5 x 2.3-(3.6)-5.0
PA2014-7 Set 164	10	296.4-(353.8)-393.2 x 15.3-(17.8)-22.0	248.4-(276.4)-295.4 x 3.6-(6.6)-8.2	60.3-(72.9)-77.6 x 7.6-(9.7)-12.7 N = 30	28.6-(35.7)-40.6 x 2.5-(4.2)-5.5 N = 30
PA2012-7 Set 162	30	293.8-(400.3)-444.2 x 12.2-(20.9)-25.3	278.4-(316.8)-370.1 x 5.9-(8.4)-10.9	69.4-(81.0)-91.3 x 5.0-(9.1)-11.7	29.9-(36.5)-42.4 x 2.6-(3.7)-4.6

ITIS TSN 48089

***Myxilla (Myxilla)* cf. *incrustans* (Johnston, 1842)** WORMS AphiaID 169466

Species description

Our collection for this species consists of two specimens measuring approximately 2.5 cm and 5.5 cm in length. The smaller specimen is a fragment, light brown in colour, and has a soft and slightly shaggy surface that appears somewhat channeled (Figure 17A). Numerous small pores and/or oscula are present, none exceeding 0.1 cm in diameter. The larger specimen is beige and mound-shaped, also possessing numerous oscula that typically measure 0.2 cm across. The surface is channeled, giving the sponge a rippled appearance (Figure 17B). Both specimens have a soft and compressible consistency, and both are lacking a dermal membrane.

Habitat information

Hudson Strait and the mouth of Ungava Bay at 129-266 m depth (Figure 18).

Spicules (Table 6, Figure 19)

Megascleres: Acanthostyles are 273-396 x 7-15 μm with evenly spaced spines. Tornotes are 230-344 x 5-9 μm with the width even along the length of the spicule. The ends of the tornotes have multiple short spines.

Microscleres: Isochelae are anchorate and spatuliferous, and found in two size classes (I and II). Isochelae I are 56-73 x 4-9 μm. Isochelae II are 19-27 x 1-3 μm. Sigmas occur in two size classes (I and II). Sigmas I are 47-79 x 3-7 μm. Sigmas II are 21-40 x 2-4 μm.

Distinguishing characteristics

This species, when intact, has several distinctive external morphological features that aid in its identification, including numerous oscula, a highly channeled surface, and a thin dermal membrane (Lundbeck 1905). While our larger specimen displays the former two traits (Figure 17B), neither of our specimens possesses the latter. Given the membrane's delicate nature (Lundbeck 1905), it is possible that it was lost during collection. This, in combination with our specimens' small sizes and discrepancies in their shape and colour, renders characteristics of external morphology ineffective for diagnosing this species in our collection. It also makes the location of different spicule types difficult to determine. Therefore, we found the spicule complement to be a more reliable means of identification. The presence of tornotes, acanthostyles, and anchorate isochelae among the spicules indicates that the species is of the genus *Myxilla*. The specimen also has sigmas. While not unique to this species of *Myxilla*, their presence differentiates it from some other *Myxilla* species, including *M. brunnea* and *M. (M.) fimbriata* (Lundbeck 1905). However, the tornotes, with their heavily-spined ends, are the

critical feature in identifying these specimens. The spines, which are best viewed at higher microscope magnifications, are short and can make the ends of the tornote appear fuzzy, jagged, or even artichoke-like. The choanosomal spicule arrangement was examined; it consists primarily of acanthostyles arranged in a net-like fashion with sigmas and isochelae scattered throughout. Tornotes were also present, typically in bundles.

Taxonomic remarks

Originally named *Halichondria incrustans*, this sponge was first described in 1842 by Johnston, and subsequently by others, including Bowerbank in 1866 and 1874, and Lundbeck in 1905. The sponge is described as irregular, and is capable of growing on numerous substrate types, including on shell rubble and the remains of macroalgae (Johnston 1842, Lundbeck 1905, Topsent 1913). Johnston (1842) wrote that it was both brittle and porous, with pores and oscula that could be hard to differentiate. The spicules were not measured or described in any detail; he included only megascleres and stated that these were needle-like and could be either straight or somewhat curved. Bowerbank (1866 and 1874) described the spicule complement in more detail, noting that it included acanthostyles (in the main skeleton), mucronate tornotes (in the dermal membrane), and two size classes of both sigmas and anchorate isochelae. Bowerbank refered to the chelae as bidentate, an error later corrected by Lundbeck (1905). Lundbeck noted that his specimens varied in shape and that the largest was around 11 cm across and 9 cm wide, which appeared to corroborate Johnston's observation that his largest specimen was roughly the size of a goose egg (Johnston 1842; Lundbeck 1905). A thin, transparent dermal membrane was present on both Bowerbank's and Lundbeck's specimens, supported by fan-shaped bundles of dermal spicules (Bowerbank 1866; Lundbeck 1905). They described the sponge's colour as light yellow, as did Stephens (1912, 1921), who stated in both of her descriptions that the species could be distinguished when alive by its grooved surface and light yellow colouring. The spicule complement noted in Lundbeck's description contained acanthostyles (190-350 x 8-15 µm), tornotes (170-260 x 5.7-10 µm), two size classes of anchorate isochelae (38-74 x 14-25 µm and 17-28 x 5.7-8.5 µm), and sigmas (24-75 x 1-5 µm). The endpoints of the tornotes were typically covered in small spines, but Lundbeck found some that appeared smooth or nearly smooth amongst his specimens. The isochelae and sigmas were found throughout the sponge, including in the membrane (Lundbeck 1905).

Morphologically, our larger specimen (Figure 17B) is similar to the descriptions mentioned above. Our smaller specimen appears different (Figure 17A); its small size prevents us from deducing its shape, but its colour is quite dark. The spicules in our specimens correspond to those described by Bowerbank and Lundbeck, and Lundbeck's spicule measurements are fairly compatible with ours; the primary difference being that our megasclere measurements are roughly 50-80 µm larger than his. Like Bowerbank (1874), we divided the sigmas into two size classes, but this distinction may be arbitrary as all of the sigma measurements from our

specimens match the range that Lundbeck provided. While it is likely that our specimens are *Myxilla (Myxilla) incrustans*, we have chosen to retain the *cf.* designation before the species epithet, as our specimens are incomplete fragments and this makes it difficult to determine whether their external morphology and spicule arrangement are consistent with the descriptions of Johnston(1942), Bowerbank (1866, 1874), Lundbeck (1905), and Stephens (1912, 1921).

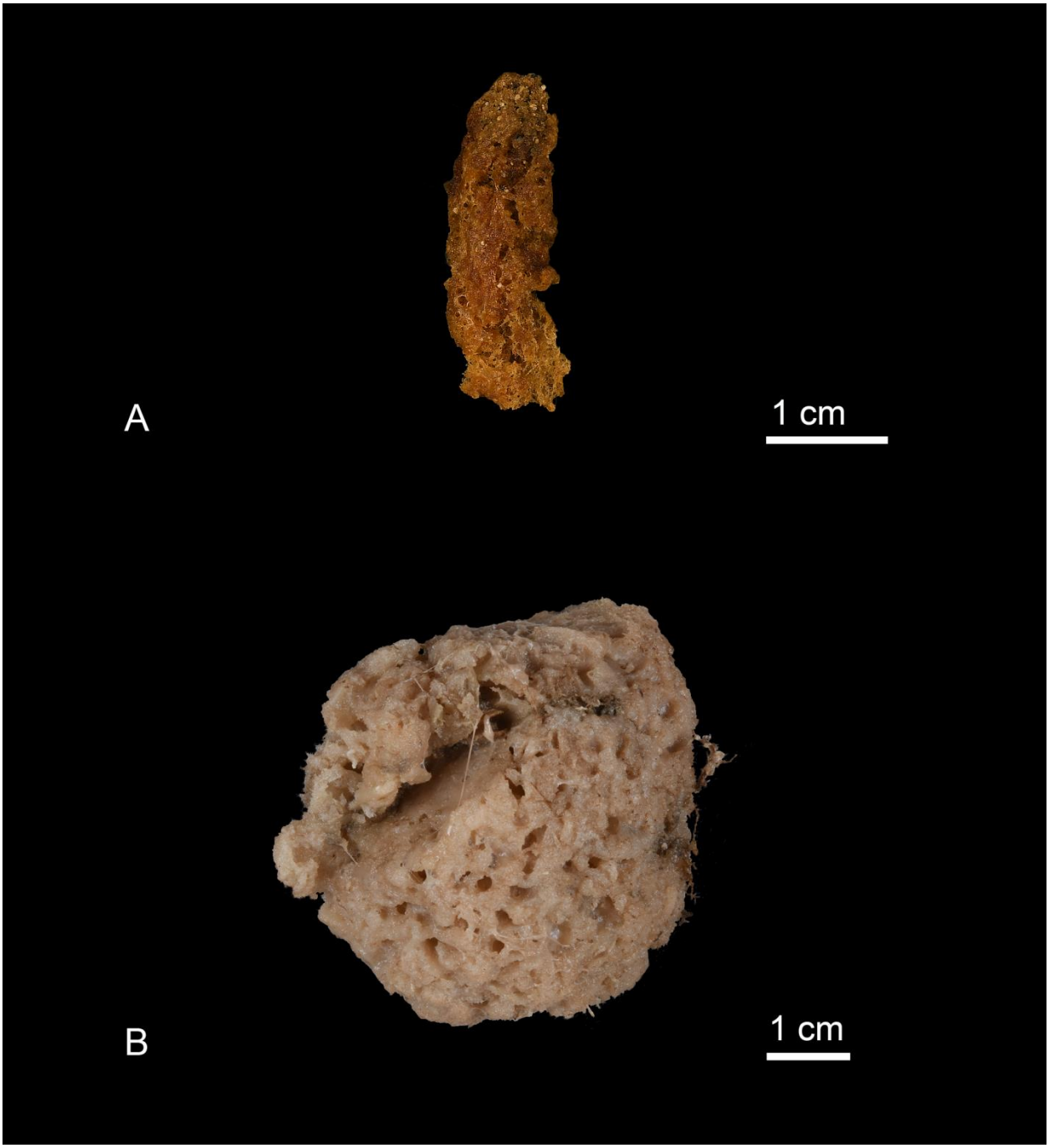

Figure 17. *Myxilla (Myxilla)* cf. *incrustans* specimen PA2013-8 Set 92 (A), and specimen PA2011-7 Set 80 (B).

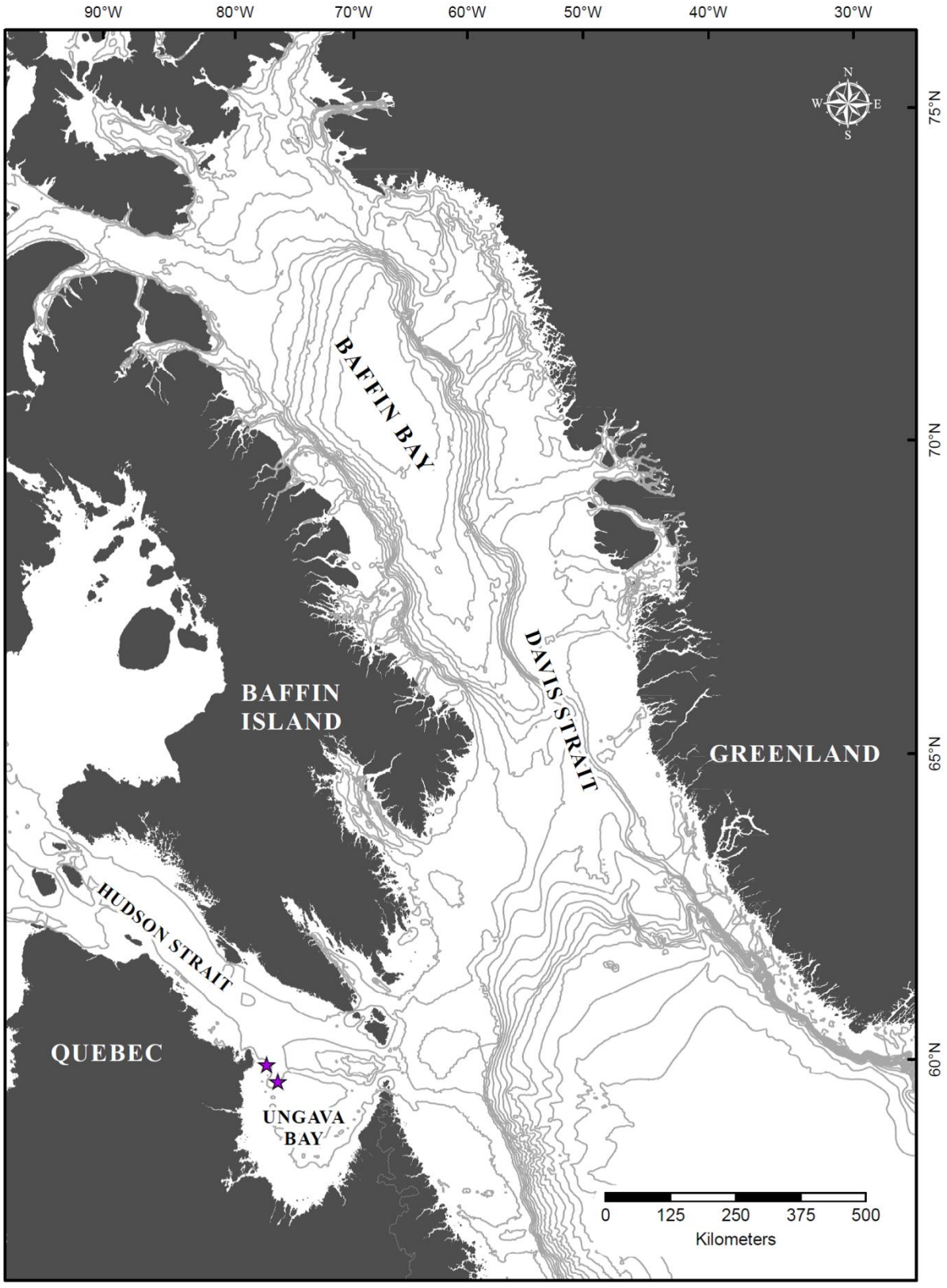

Figure 18. *Myxilla (Myxilla)* cf. *incrustans* collection locations.

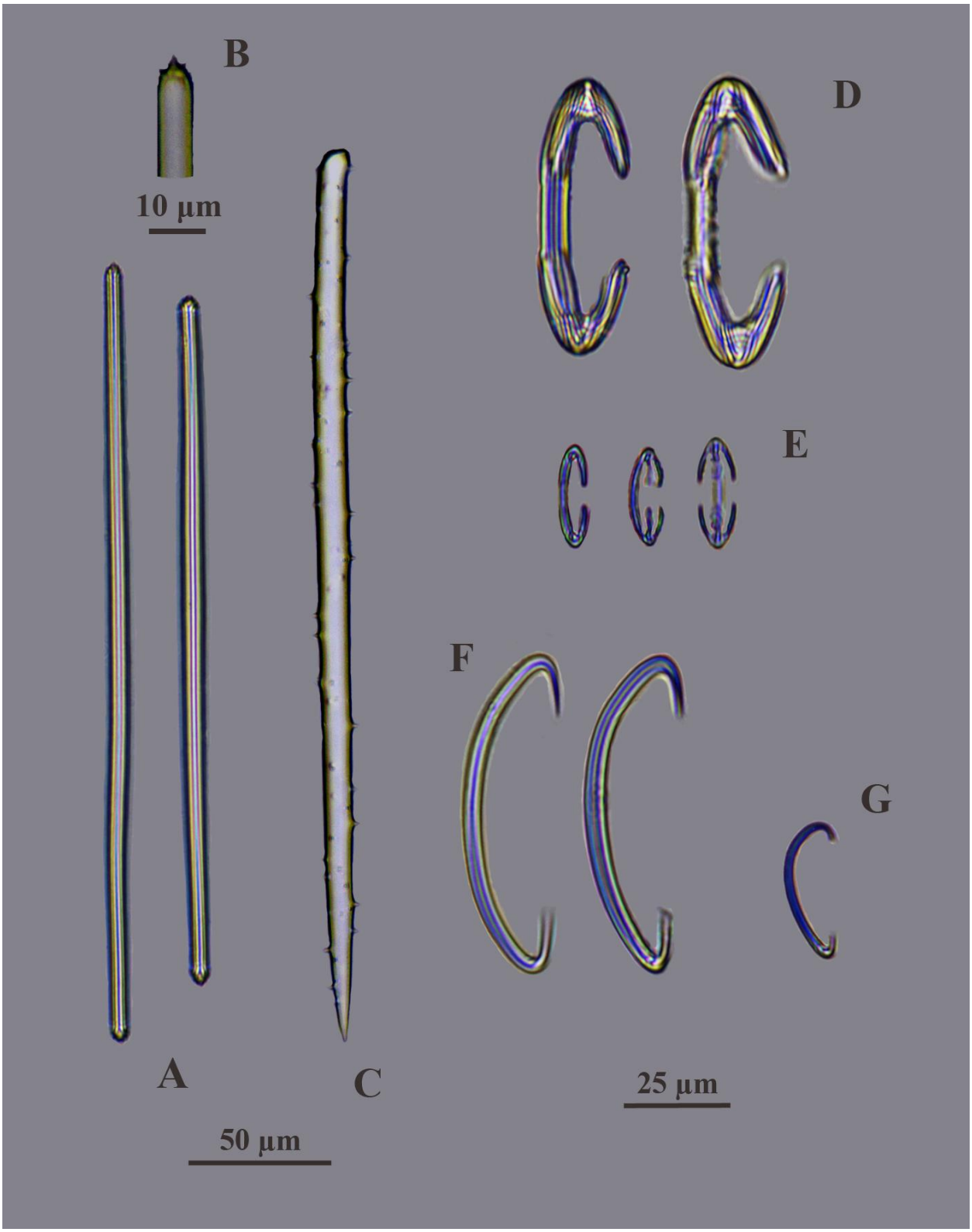

Figure 19. *Myxilla (Myxilla)* cf. *incrustans* spicules from PA2013-8 Set 92. Tornotes (A), Tornote end (B), Acanthostyles (C), Isochelae I (D), Isochelae II (E), Sigmas I (F), Sigmas II (G). D-G same scale.

Table 6. Measurements of spicules from specimens of *Myxilla (Myxilla)* cf. *incrustans* 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	Acanthostyles	Tornotes	Isochelae I	Isochelae II	Sigmas I	Sigmas II
PA2013-8 Set 92	30	272.6-(320.1)-364.4 x 6.8-(9.6)-13.6	230.0-(255.3)-279.6 x 4.7-(6.0)-7.3	56.3-(65.5)-71.8 x 4.2-(6.1)-8.6	20.3-(22.6)-26.3 x 1.3-(1.9)-2.6	58.5-(69.7)-79.0 x 3.4-(4.9)-6.9	27.5-(32.2)-40.4 x 2.4-(3.0)-3.6
PA2011-7 Set 80	30	347.0-(369.2)-396.1 x 10.2-(12.7)-15.4	254.7-(284.6)-343.9 x 4.6-(6.9)-9.0	56.9-(66.6)-73.2 x 4.5-(5.9)-7.1	19.1-(22.2)-27.4 x 2.1-(2.4)-2.9	46.6-(69.0)-77.7 x 3.4-(4.4)-5.4	21.2-(28.8)-37.3 x 2.1-(2.6)-3.3

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