Identification guide to skates (Family Rajidae) of the Canadian Atlantic and adjacent regions

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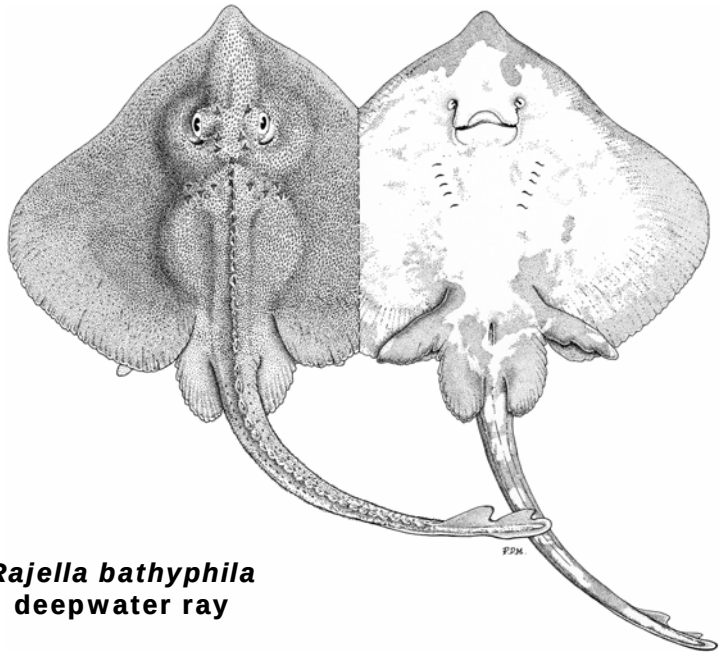

Rajella bathyphila
deepwater ray

2009

Canadian Technical Report of Fisheries and Aquatic Sciences 2850

Fisheries and Oceans Canada | Pêches et Océans Canada

Canada

Canadian Technical Report of Fisheries and Aquatic Sciences

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Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457-714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715-924 were issued as Department of Fisheries and Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Rapport technique canadien des sciences halieutiques et aquatiques

Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. II n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques de Pêches et Océans Canada, c'est-à-dire les sciences halieutiques et aquatiques.

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Les numéros 1 à 456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

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Ecosystem-based management requires sound information on the distribution and abundance of species both common and rare. Therefore, the accurate identification for all marine species has assumed a much greater importance. The identification of many skate species is difficult as several are easily confused and has been found to be problematic in both survey data and fisheries data collection. Identification guides, in combination with training and periodic validation of taxonomic information, improve our accuracy in monitoring data required for ecosystem-based management and monitoring of populations. This guide offers a comparative synthesis of skate species known to occur in Atlantic Canada and adjacent regions. The taxonomic nomenclature and descriptions of key morphological features are based on the most up-to-date understanding of diversity among these species. Although this information will aid the user in accurate identification, some features vary geographically (such as colour) and others with life stage (most notably the proportion of tail length to body length; the presence of spines either sharper in juveniles or in some cases not yet present; and also increases in the number of tooth rows as species grow into maturity). Additional information on juvenile features are needed to facilitate problematic identifications (e.g. *L. erinacea vs. L. ocellata*). Information on size at maturity is still required for many of these species throughout their geographic distribution.

Résumé

Sulak, K.J., MacWhirter P.D., Luke K.E., Norem A.D., Miller J.M., Cooper J.A., and Harris L.E. 2009. Identification guide to skates (Family Rajidae) of the Canadian Atlantic and adjacent regions. Can. Tech. Rep. Fish. Aquat. Sci. 2850: viii + 34 p.

La gestion écosystémique exige des renseignements très précis sur la distribution et l'abondance de toutes les espèces présentes dans l'écosystème, qu'elles soient communes ou rares. Par conséquent, il devient encore plus important d'identifier toutes les espèces aquatiques marines avec exactitude. Or, il est très difficile d'identifier de nombreuses espèces de raie car elles sont facilement confondues, ce qui pose un problème pour la collecte de données dans le cadre des relevés et des activités de pêche. Des guides d'identification, utilisés conjointement avec une formation pertinente et la validation périodique de l'information taxonomique, permettent d'accroître la précision des données nécessaires à la gestion écosystémique et à la surveillance des populations aquatiques. Le présent guide présente une synthèse comparative des espèces de raies réputées être présentes au Canada atlantique et dans les régions adjacentes. La nomenclature taxonomique ainsi que les descriptions des principaux caractères morphologiques des espèces qu'on y retrouve sont fondées sur les renseignements les plus récents à notre disposition au sujet de la diversité de ces espèces. Les utilisateurs du guide le trouveront certainement utile pour les aider à identifier avec précision les espèces observées, mais ils doivent se rappeler que certains caractères varient selon la zone géographique (la couleur, par exemple) et d'autres selon l'étape de vie (en particulier, le rapport entre la longueur de la queue et la longueur du corps, l'absence d'épines chez les juvéniles ou la présence d'épines plus acérées, ainsi que le nombre accru de rangées de dents à mesure que l'espèce devient mature). Il nous manque encore des renseignements au sujet des juvéniles pour pouvoir faciliter certaines identifications plus problématiques (par exemple, pour distinguer l'espèce L. erinacea de l'espèce L. ocellata). Il nous faut également plus d'information sur la taille à la maturité d'un grand nombre de ces espèces dans l'ensemble de leur aire de répartition géographique.

1.0 Introduction

This guide has been prepared to facilitate the identification of specimens of skates freshly-collected at sea, or recently landed. It is intended to assist scientific, fisheries, observer, port sampler, or other technical personnel working in the field. Several skate species are currently the targets of directed or by-catch fisheries in the Canadian Atlantic region. Thus, the accurate identification of species subject to commercial fisheries has assumed greater importance. Sixteen skate species are included in this guide, 14 known from within the Canadian Exclusive Economic Zone (EEZ, commonly referred to as the '200 mile limit'), plus two species that range almost into Canadian waters off Georges Bank and in the Gulf of Maine.

As far as possible, the differentiation of species in this guide depends on characters readily observable in the field, very importantly including shape and colour. Do not use colouration alone to identify species as this may vary geographically. Distinction of species by more technical characters, such as tooth row counts, is included only where essential to definitive identification. When feasible, illustrations of similar species that may readily be confused have been placed together on the same page, or in as close proximity as possible. Most descriptions are based on adults or larger-sized specimens as identification of small individuals (10-35 cm TL) can be problematic. It has been noted that not all features listed in this guide will be observed in smaller or immature specimens. This is most evident in the proportion of tail length to body length; the presence of spines are either sharper in juveniles or in some cases not yet present; and, also, the number of tooth rows increase with maturity. To assist in interpreting this variation, maximum total body length and total length at maturity are reported if known. Additional information on juvenile features are provided to facilitate some of the more problematic identifications (e.g. *L. erinacea* vs. *L. ocellata*). Future investigations of size at maturity is still required for many of these species throughout their geographic distribution.

The **common names** of many skate species, particularly those from deep water, have not been stabilised. Formally recognised common names are available for only a few shallow-living species (Nelson et al. 2004). The text treatment of each species is prefixed by the formal scientific name in bold italics (with synonyms still in use for a few species given in parentheses and regular font). The most frequently applied English and French common names used in Canada are then given in bold, with sources of common names specified in parentheses, and other vernacular names still in use given in brackets. Key to sources of common names in use is as follows: **AFS =** American Fisheries Society (Nelson et al. 2004), **FAO** = Food and Agiculture Organisation of the United Nations (McEachran and de Carvalho 2002), **FGOM** = Fishes of the Gulf of Maine (McEachran 2002), **FishBase** (online information resource for fishes, www.fishbase.com), **FNAM** = Fishes of the Northeastern Atlantic and Mediterranean (Stehmann and Bürkel 1984), **QV** = Quebec French language vernacular, **FWNA** = Fishes of the Western North Atlantic (Bigelow and Schroeder 1953b), **SS** = Atlantic Fishes of Canada (Scott and Scott 1988). Refer to **References** page; these references and other key references guide the reader to greater detail regarding species identities, life histories, and distribution. **Species illustrations** and their corresponding text treatments face each other in the guide. **Distribution maps** appear at the back of the guide. Geographic and bathymetric origins of a specimen may be critical in making a final identification. Often similar species do not overlap in geographic or depth range. The limits of the study area used in this guide are longitudes 40º to 85ºW (Cape Farvel, Greenland to central Hudson Bay and Lancaster Sound), and latitudes 38.5º to 85ºN

(Cape May, New Jersey to Smith Sound, northern Baffin Bay). With exceptions noted below, species occurrences within the study area came from records of identified specimens archived in zoological museum collections (**Acknowledgements**), and identified by experts. Additional records were included from the primary scientific literature, from 26 scientific cruise stations analyzed by K. Sulak, and from DFO and U.S. National Marine Fisheries Service (NMFS) survey cruises (records of *Amblyraja radiata* and *Dipturus laevis* only). The additional records for these two species were included since it was determined that the distribution based on vouchered collection material was not fully representative of the known distribution for these species. On the distribution maps, filled black diamonds, circles, and crosses (symbol code '1') represent museum and literature records of skates identified by an expert taxonomist or ichthyologist. Open symbols (symbol code '2') represent museum lots for which the identifier has not been listed. Grayscale filled triangles (symbol code '3') represent selected DFO and NMFS survey records. The species ***Distribution*** specified is its known range only within the Canadian EEZ portion of the study area. ***Depth*** and ***Temperature*** ranges similarly pertain only to study area records, unless insufficient primary data were available. Otherwise, depth or temperature data given in parentheses pertain to literature data for the species across its general range.

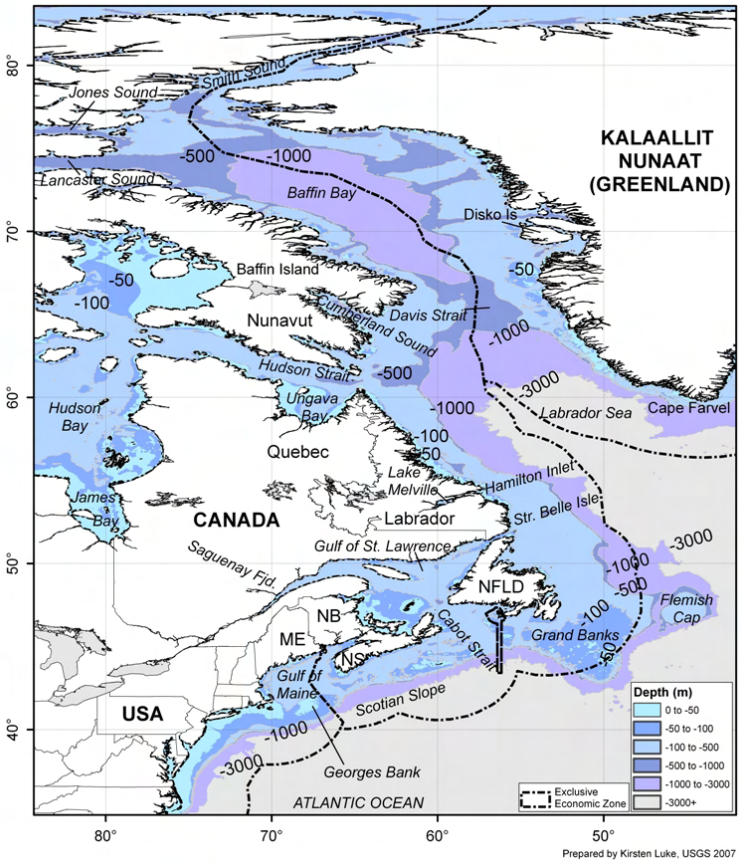


Figure 1. Map of Canadian Atlantic and adjacent regions. Limits of Study Area: Latitude 38.5º-85ºN; Longitude 40º-85ºW (Dashed boundary encloses EEZ of Canada, Greenland, and the U.S.)

2.0 Morphological Terminology and Measurements (as used in this guide)

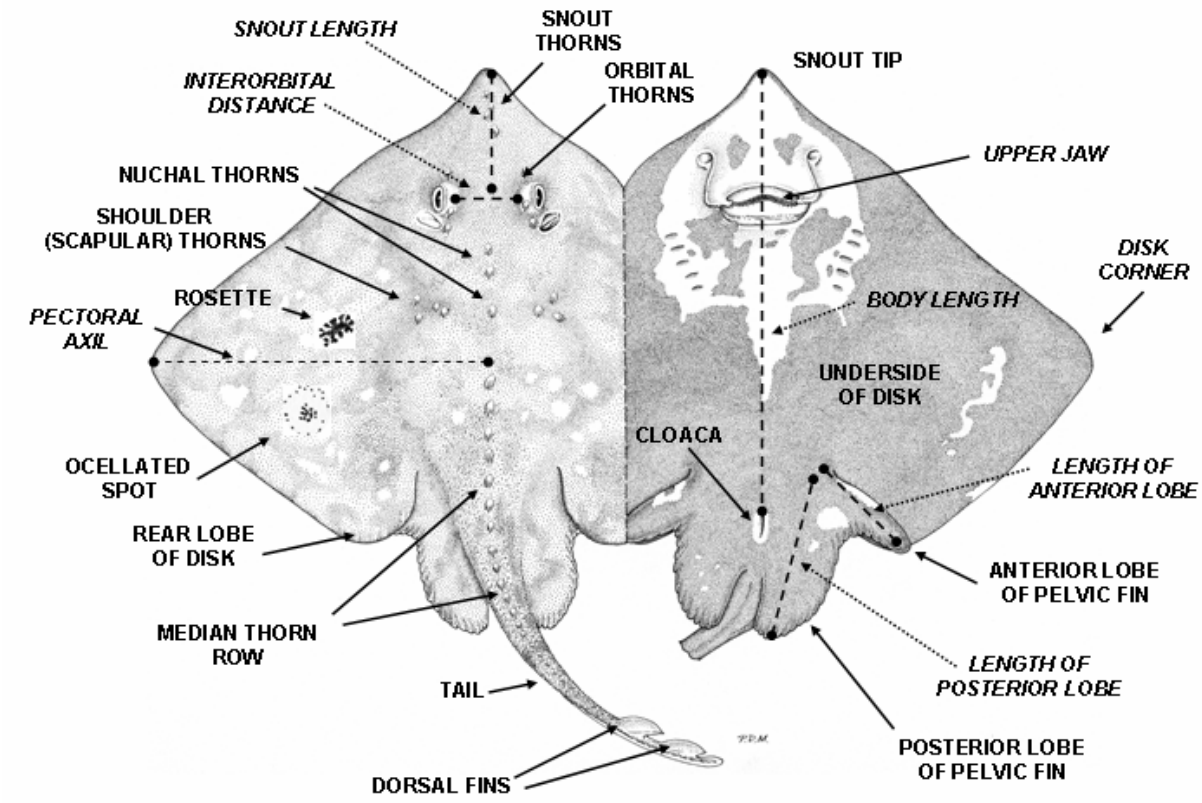


Figure 2. Illustration of general terminology and morphology used to differentiate skate species. NOTE: Sexually dimorphic features, including male alar and malar spines, and claspers, are not generally used as identification characters in this guide except to assist in differentiating small specimens of Leucoraja ocellata from L. erinacea.

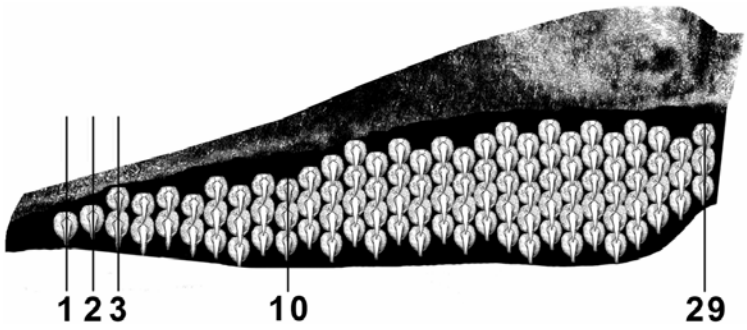


Figure 3. Illustration of tooth rows in upper jaw. Tooth rows are counted across the upper jaw as indicated here (only one-half of the jaw is shown; Total count would be ~58).

2.1 Selected terms

Alar spines = Spines on the upper surface of the pectoral fin near the tip.

Ampullary pores = A series of small openings connected to special sensory organs (ampullae of Lorenzini). These are typically located on the underside of the body between the mouth and anterior margins of the disk.

Body Length = Distance from tip of snout to centre of cloaca.

Cloaca = The opening on the underside of the body into which empty the urogenital and digestive canals. In skates this is found just in front of the base of the tail.

Denticle = A small tooth-like body emerging from the skin.

Disk Length = Distance from level of tip of snout to level of rear lobe of disk.

Interorbital = Region between eyes.

Nuchal = General area of the neck or nape.

Malar spines = Spines or thorns found close to the edge of the upper surface of the disc opposite the eye.

Ocellated = Markings or colourations that resemble eye-like spots.

Rostral = Relating to the snout or rostrum.

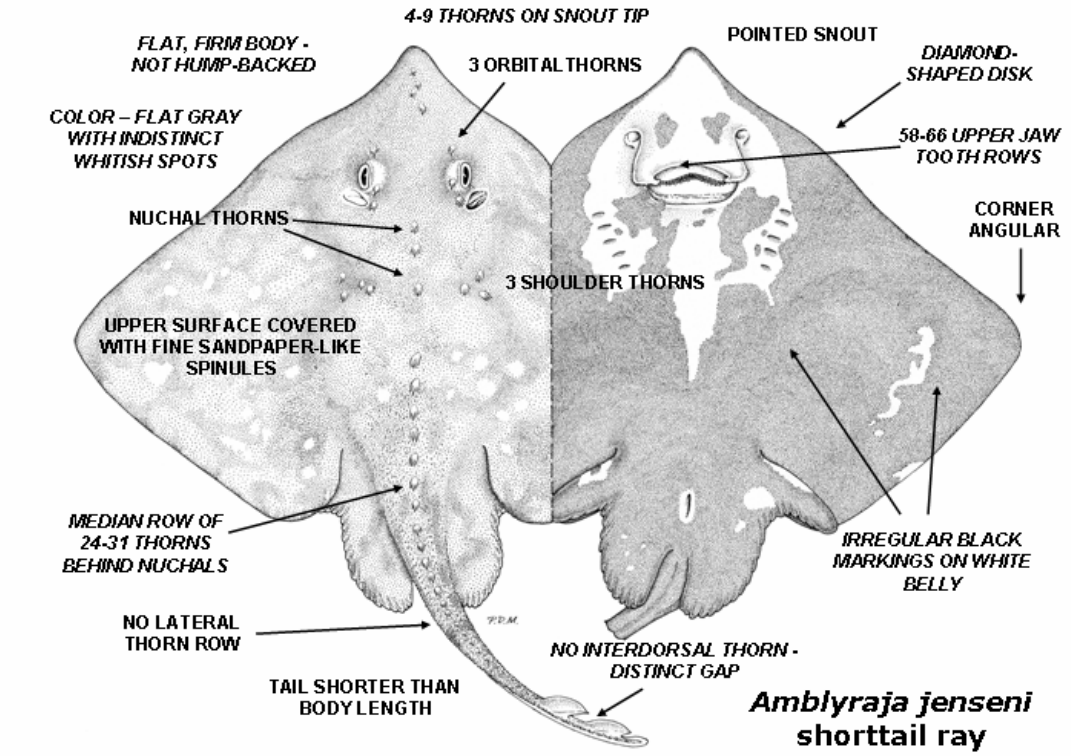
Spinules = Minute spines, sometimes projecting from a larger spine.

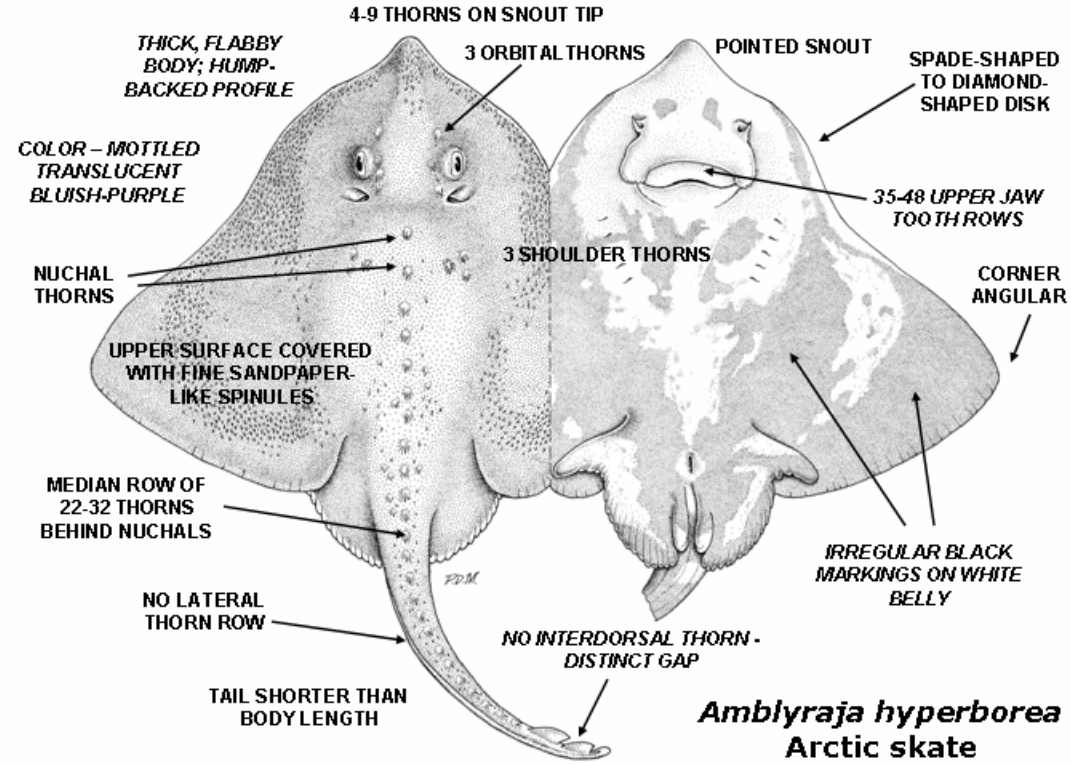
Stellate = Star-like, with radiating points.

Tail Length = Distance from centre of cloaca to tip of tail.

Wing = The enlarged pectoral fin joining the head and body found in skates and other cartilaginous fishes.

3.0 Species Descriptions





Amblyraja jenseni (Bigelow and Schroeder 1950)

shorttail skate (FAO, SS), Jensen's skate (FishBase, FWNA)
raie à queue courte (FAO, SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: to 85 cm TL.
- Disk neatly diamond-shaped with anterior margins straight.
- **Firm bodied, abdomen and wings relatively thin, not humpbacked.**
- **Dorsal fins separated by a narrow but distinct gap, no intervening thorn** (except a wide gap with 1-2 thorns in some juveniles).
- Tail short, 0.9-1.0 times body length.
- **58-66 rows of teeth in upper jaw** (compare with *A. hyperborea*).
- 24-31 mid-dorsal thorns behind nuchals; all large thorns distinctly white; fine sandpaper-like spinules in large symmetrical patches dorsally (especially on posterior part of disk) and in a broad band laterally along tail.
- **Upper surface medium gray with subdued dark blotches and tiny pale spots.**
- **Lower surface with variable, roughly symmetrical dark gray to black on white pattern** (juveniles are mostly white ventrally, large adults mostly dark).
- Distribution: **A boreal species:** continental slope and rise – from off Hamilton Inlet, Newfoundland, south to Georges Bank; **not known north of latitude 55ºN;** Depth 366-2,777 m; Temperature (2.7 to 4.0^{o}C).

NOTE: May be confused with A. hyperborea (in A. jenseni, note straight leading edges of disk, firm body, fairly flat back, gray color, and high number of tooth rows).

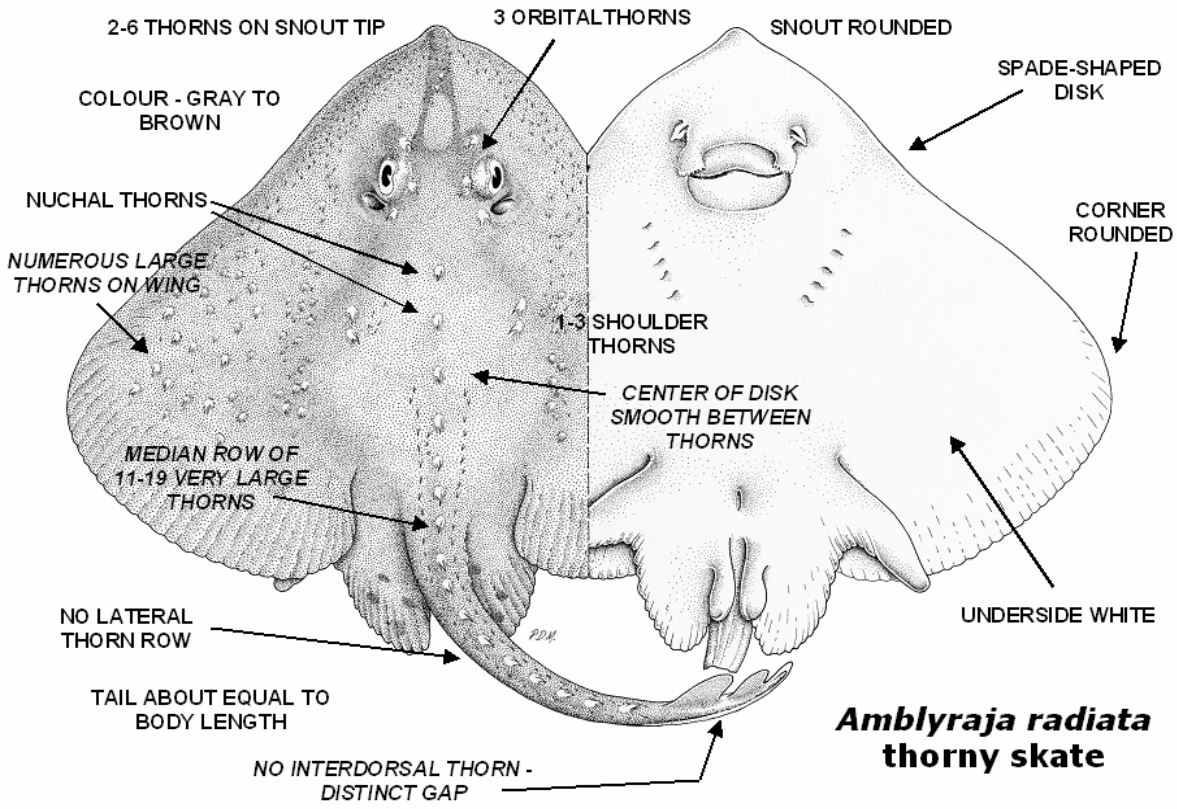
Amblyraja hyperborea (Collett 1879)

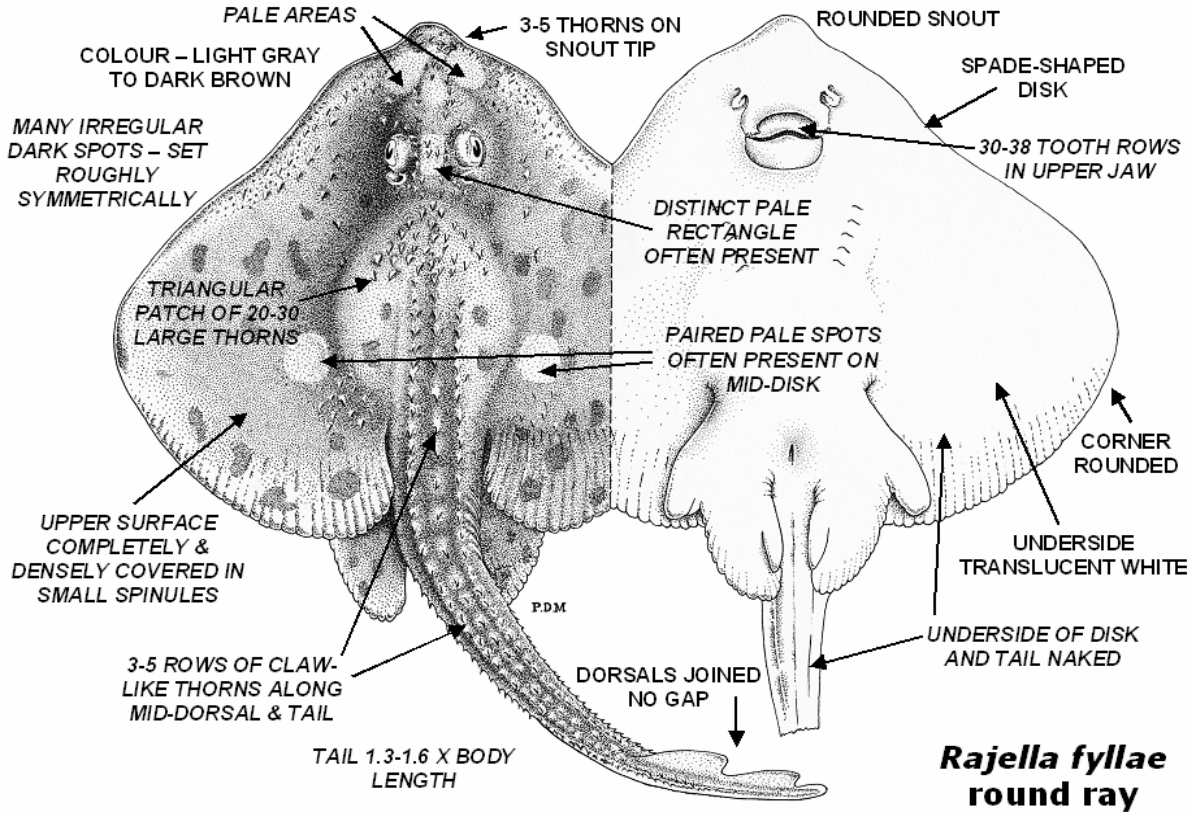
Arctic skate (FAO, FishBase) [blackbelly skate, darkbelly skate]
raie arctique (FAO, FNAM), raie boreale (SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: to 87 cm TL.
- Disk diamond-shaped (juveniles) to spade-shaped (adults); snout pointed.
- **Body flabby in adults, abdomen very thick (resulting in humpbacked appearance).**
- **Dorsal fins separated by a narrow but distinct gap, no intervening thorn** (wide gap with 1-2 thorns in some juveniles).
- Tail very short, 0.7-0.8 times body length.
- **35-48 rows of teeth in upper jaw** (compare with *A. jenseni*).
- 22-32 mid-dorsal thorns behind nuchals; fine sandpaper-like spinules cover most of disk; fine spinules widely-spaced and evenly distributed over whole disk in juvenile (neatly arrayed in parallel rows along pectoral radials); spinules present on snout tip, anterior disk margins, and in a circular or crescent pattern on each wing in adult.
- **Upper surface with distinct bluish-gray to bluish-purple cast, irregularly mottled.**
- **Lower surface with roughly symmetrical dark gray to black pattern on white**; juveniles are mostly white ventrally, larger fish mostly dark.
- Distribution: **A high Arctic species:** Jones Sound, Smith Sound, Baffin Bay, south to Davis Strait and northern Labrador Sea; **not known south of latitude 60ºN within Canada's EEZ;** Depth 275-1,600 m; Temperature -0.4 to 3.5^{o}C.

NOTE: May be confused with its closely-related sibling (cognate) species, A. jenseni (see above), but geographic ranges of the two species do not overlap.


2-6 THORNS ON SNOUT TIP
3 ORBITAL THORNS
SNOUT ROUNDED
SPADE-SHAPED DISK
COLOUR - GRAY TO BROWN
NUCHAL THORNS
CORNER ROUNDED
NUMEROUS LARGE THORNS ON WING
1-3 SHOULDER THORNS
CENTER OF DISK SMOOTH BETWEEN THORNS
MEDIAN ROW OF 11-19 VERY LARGE THORNS
UNDERSIDE WHITE
NO LATERAL THORN ROW
TAIL ABOUT EQUAL TO BODY LENGTH
NO INTERDORSAL THORN - DISTINCT GAP
Amblyraja radiata
thorny skate


PALE AREAS
3-5 THORNS ON SNOUT TIP
ROUNDED SNOUT
COLOUR – LIGHT GRAY TO DARK BROWN
SPADE-SHAPED DISK
MANY IRREGULAR DARK SPOTS – SET ROUGHLY SYMMETRICALLY
30-38 TOOTH ROWS IN UPPER JAW
DISTINCT PALE RECTANGLE OFTEN PRESENT
TRIANGULAR PATCH OF 20-30 LARGE THORNS
PAIRED PALE SPOTS OFTEN PRESENT ON MID-DISK
CORNER ROUNDED
UPPER SURFACE COMPLETELY & DENSELY COVERED IN SMALL SPINULES
UNDERSIDE TRANSLUCENT WHITE
P.D.M.
UNDERSIDE OF DISK AND TAIL NAKED
3-5 ROWS OF CLAW-LIKE THORNS ALONG MID-DORSAL & TAIL
DORSALS JOINED NO GAP
TAIL 1.3-1.6 X BODY LENGTH
Rajella fyllae
round ray

Amblyraja radiata (Donovan 1807)

thorny skate (AFS, FishBase, FWNA, FGOM), starry ray (FAO), starry skate (FNAM) [Arctic thorny skate, Atlantic prickly skate]
raie épineuse (AFS, SS), raie radiée (FAO, FNAM)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: to 102 cm TL, at least 10 kg weight; first maturity in females 43-46 cm TL, L_{50} 54-60 cm TL; in males 50cm TL, L_{50} 42-51cm TL.
- Disk spade-shaped to heart-shaped, corners rounded; snout rounded.
- **Dorsal fins separated by a distinct gap, no intervening thorn.**
- **Tail, 1.0-1.1 times body length.**
- **Single dominant mid-dorsal row with only 11-19 very large (exaggerated in juveniles)** thorns with stellate bases; **10 or fewer behind pectoral axil**; 3 large orbital thorns; 1-3 on shoulder; **variable patch of large thorns medially on each wing.**
- **Centre of disk smooth between large thorns**.
- Upper surface gray to brown, uniform or mottled; juvenile with tiny, sparsely-distributed dark spots and distinctive tail banding pattern.
- Distribution: southern Baffin Bay (latitude of Disko Island), the Gulf of St. Lawrence and St. Lawrence estuary to the Gulf of Maine and mid-Atlantic bight; Depth 5-1,232 m, commonly 100-500 m; Temperature (-1.4 to 14^{o}C, commonly 2 to 5^{o}C).

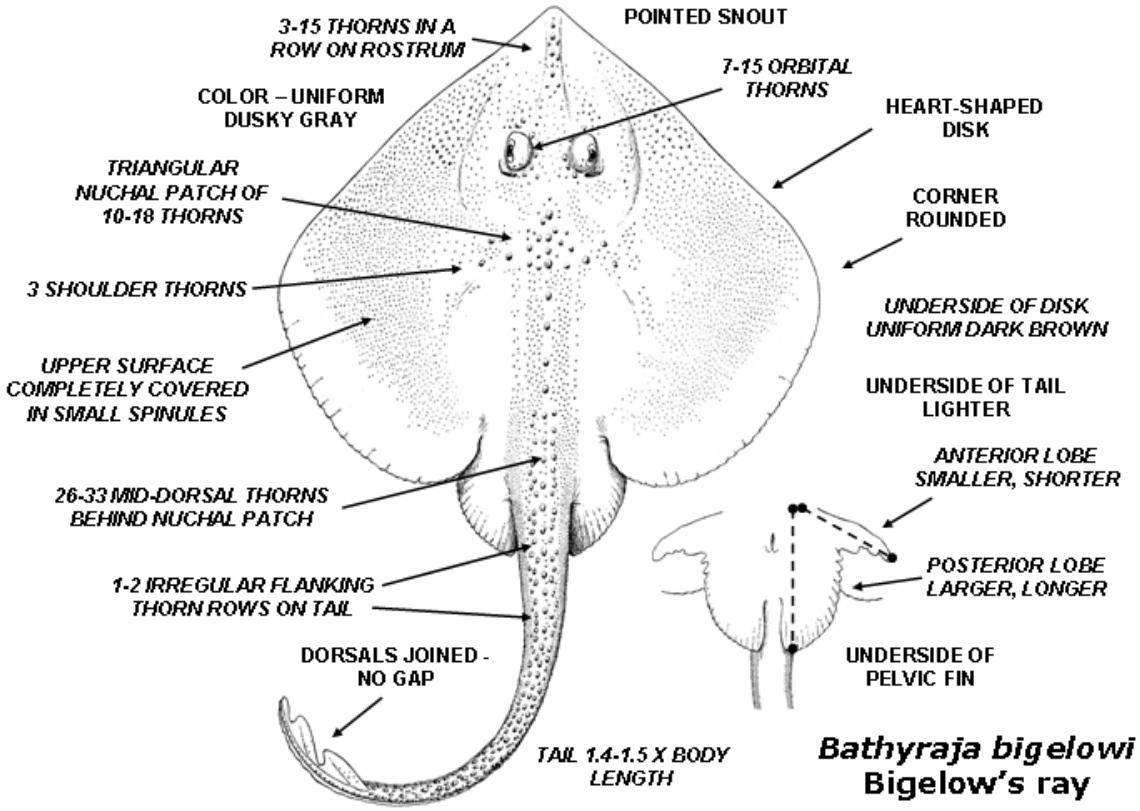
Rajella fyllae (Lütken 1888) (including *Breviraja marklei* McEachran and Miyake 1987)

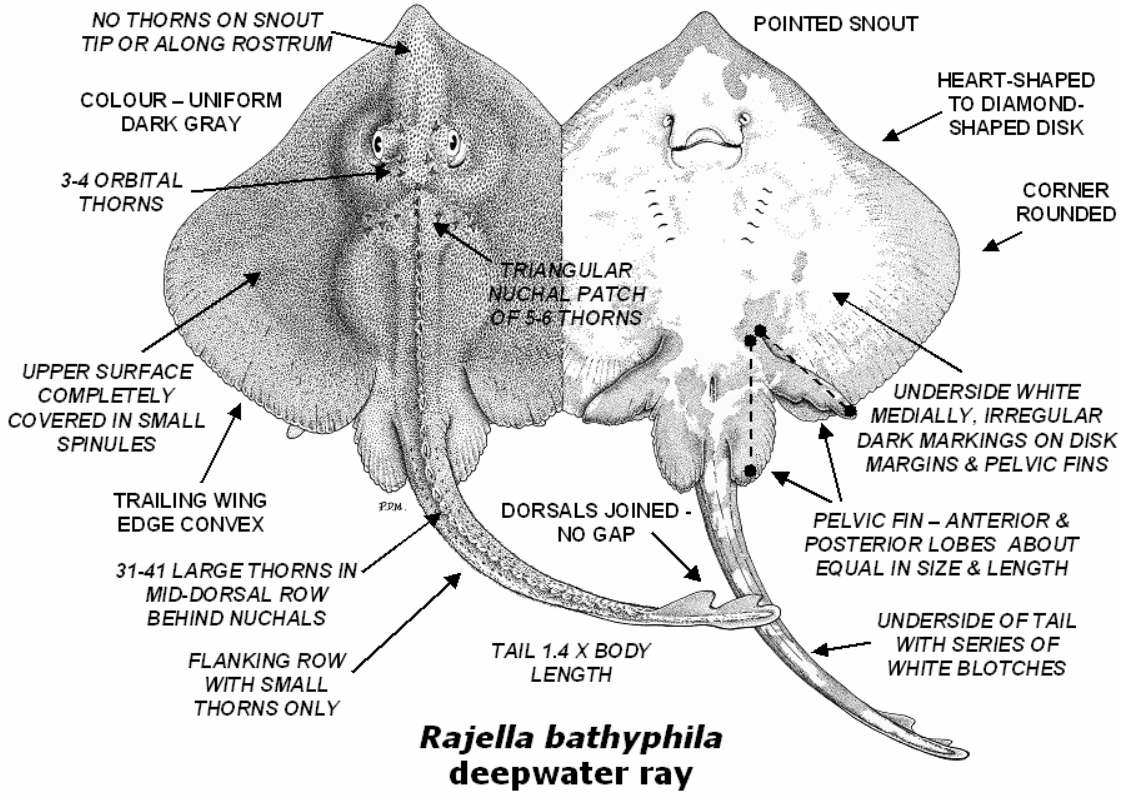
round ray (FAO, FishBase, SS, FNAM)
raie ronde (FAO, FishBase, SS, FNAM)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- **Size: a small species, to 55 cm TL.**
- Disk distinctly spade-shaped, outer corners rounded; snout rounded, small terminal point.
- Dorsal fins connected, no gap or intervening thorn.
- **Tail broad and long, 1.3-1.6 times body length.**
- **30-38 tooth rows in upper jaw** (versus more rows in *L. erinacea* and *L. ocellata*).
- **Prominent triangular patch of 20-30 large thorns on nuchal-shoulder region, continuing as 3-5 parallel mid-dorsal rows of roughly equal, claw-like thorns.**
- 3-5 thorns on snout tip, but no regular row of thorns along rostral ridge; broad, prickly thorn patches along anterior margins of disk and next to pectoral axils.
- Upper surface entirely covered with tiny, densely-distributed, randomly placed spinules; **no bare areas on disk or between thorns**; dorsal fins spinulose along upper margins.
- **Lower surface bare, including underside of tail.**
- Upper surface light gray to dark brown, variously spotted and mottled; often with a distinct pale rectangle between eyes, plus pair of pale spots adjacent to pectoral axils; a translucent teardrop-shaped area on each side of rostral ridge at snout tip.
- Underside whitish, often with variable dark blotching marginally and on pelvic fins.
- Distribution: southern Baffin Bay (latitude of Disko Island), the Gulf of St. Lawrence to Georges Bank; Depth 70-1,240 m (commonly 300-800 m); Temperature (1 to 7^{o}C).

NOTE: Juveniles have a proportionately longer tail, and may be misidentified as Fenestraja plutonia, a very similar species (colour and spine pattern) that does not occur north of Virginia.


3-15 THORNS IN A ROW ON ROSTRUM
POINTED SNOUT
7-15 ORBITAL THORNS
COLOR – UNIFORM DUSKY GRAY
HEART-SHAPED DISK
TRIANGULAR NUCHAL PATCH OF 10-18 THORNS
CORNER ROUNDED
3 SHOULDER THORNS
UNDERSIDE OF DISK UNIFORM DARK BROWN
UPPER SURFACE COMPLETELY COVERED IN SMALL SPINULES
UNDERSIDE OF TAIL LIGHTER
ANTERIOR LOBE SMALLER, SHORTER
26-33 MID-DORSAL THORNS BEHIND NUCHAL PATCH
POSTERIOR LOBE LARGER, LONGER
1-2 IRREGULAR FLANKING THORN ROWS ON TAIL
UNDERSIDE OF PELVIC FIN
DORSALS JOINED - NO GAP
TAIL 1.4-1.5 X BODY LENGTH
Bathyraja bigelowi
Bigelow's ray


NO THORNS ON SNOUT TIP OR ALONG ROSTRUM
POINTED SNOUT
COLOUR – UNIFORM DARK GRAY
HEART-SHAPED TO DIAMOND-SHAPED DISK
3-4 ORBITAL THORNS
CORNER ROUNDED
TRIANGULAR NUCHAL PATCH OF 5-6 THORNS
UPPER SURFACE COMPLETELY COVERED IN SMALL SPINULES
UNDERSIDE WHITE MEDIALLY, IRREGULAR DARK MARKINGS ON DISK MARGINS & PELVIC FINS
TRAILING WING EDGE CONVEX
DORSALS JOINED - NO GAP
PELVIC FIN – ANTERIOR & POSTERIOR LOBES ABOUT EQUAL IN SIZE & LENGTH
31-41 LARGE THORNS IN MID-DORSAL ROW BEHIND NUCHALS
UNDERSIDE OF TAIL WITH SERIES OF WHITE BLOTCHES
FLANKING ROW WITH SMALL THORNS ONLY
TAIL 1.4 X BODY LENGTH
Rajella bathyphila
deepwater ray

Rajella bigelowi Stehmann 1978

Bigelow's ray (FAO, FNAM)
raie de Bigelow (FNAM)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: to 50 cm TL.
- Disk spade-shaped, outer corners rounded; **tail long, 1.4-1.5 times body length; anterior pelvic fin lobe narrow, smaller and shorter than posterior lobe.**
- Dorsal fins connected, no gap or intervening thorn.
- **3-15 prominent thorns in a row along rostrum; 7-15 orbital thorns; 10-18 thorns in triangular nuchal-shoulder patch, mid-dorsal row of 26-33 (usually less than 30) thorns** (versus 40-45 in *D. linteus*); **1-2 very irregular flanking rows on each side of tail, with thorns often larger on tail than those of mid-dorsal row**.
- Upper surface entirely covered by very fine spinules, except along trailing edge margins.
- Upper surface uniform dusky gray (light gray in young).
- **Lower surface (disk and pelvic fins) uniform dark brown, darker than upper surface; underside of tail distinctly lighter than underside of disk *(but no white blotches as in R. bathyphila).***
- Distribution: continental slope – southern Baffin Bay, Davis Strait, Grand Banks, Flemish Cap, Scotian Slope, Georges Bank; Depth 823-2,172 m (typically below 1,500 m); Temperature: no data (approximately 2.5 to 4^{o}C by correspondence with depth).

NOTE: May be confused with R. bathyphila (in R. bigelowi, note lower number of mid-dorsal row thorns, patch of thorns along rostrum at snout tip, uniformly dark underside).

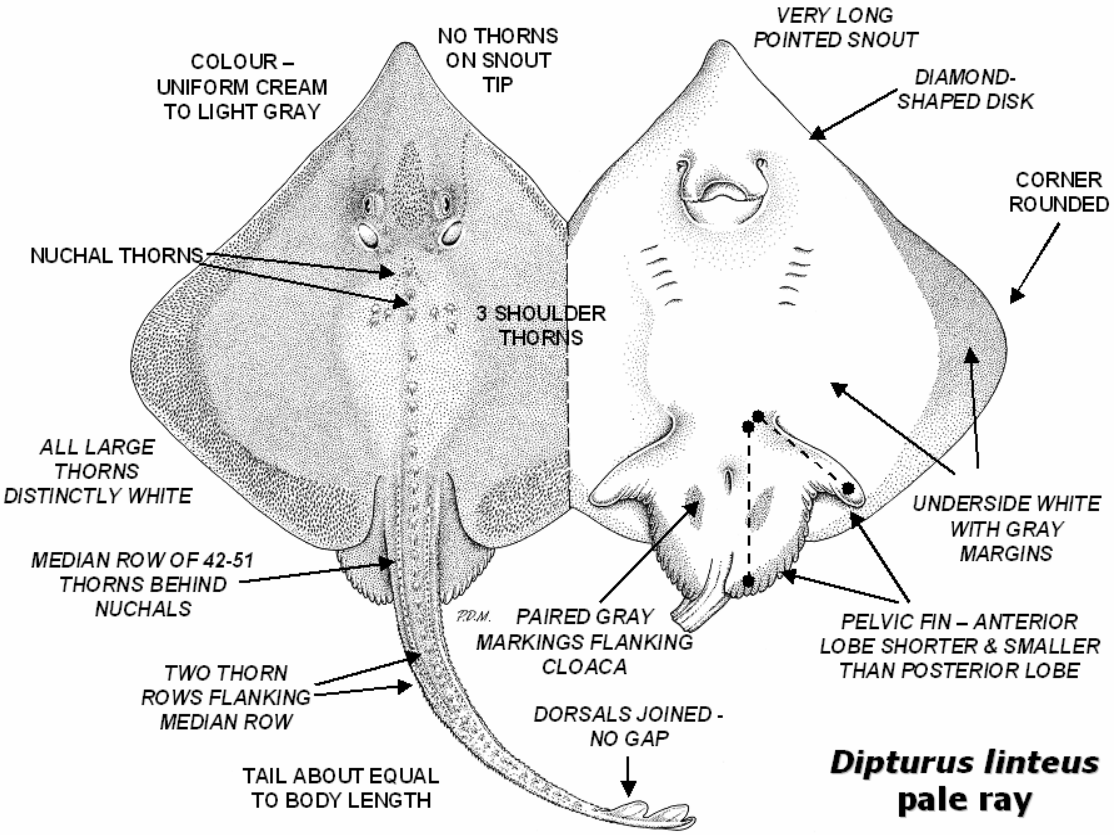
Rajella bathyphila (Holt and Byrne 1908)

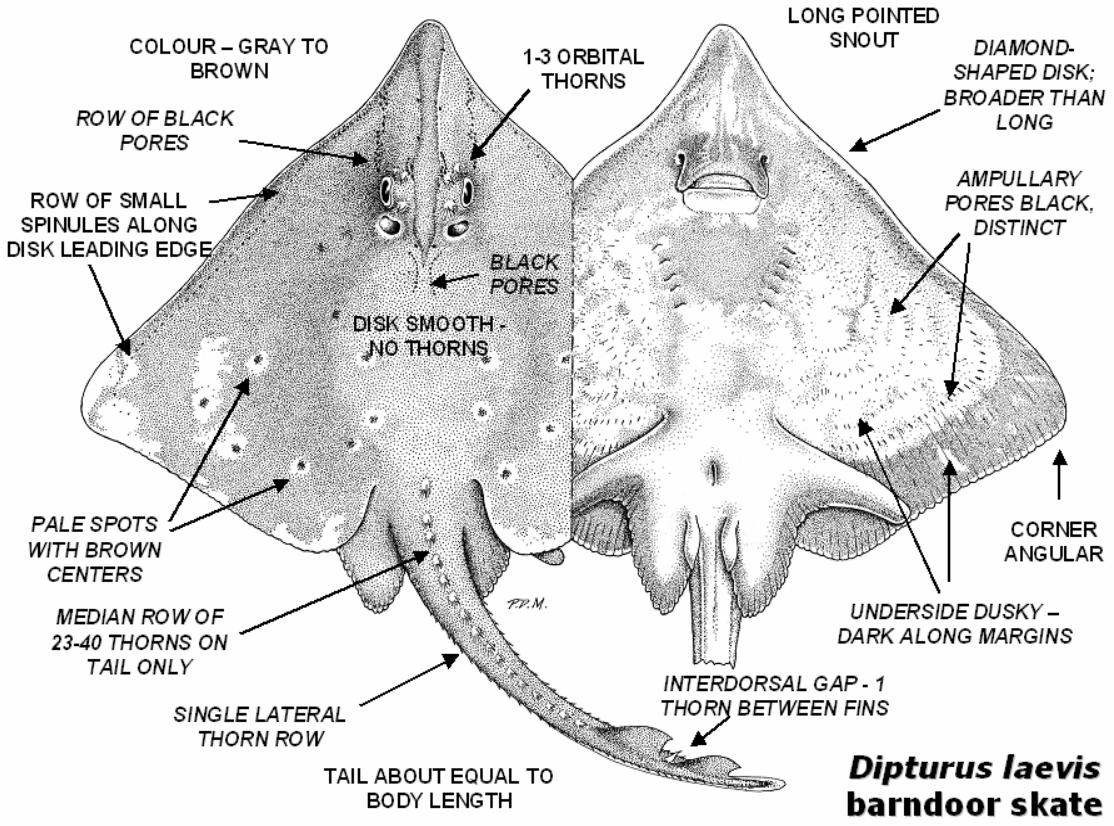
deepwater ray (FAO, FNAM), abyssal skate (FWNA), chocolate skate (SS)
raie bathyale (FishBase, FNAM), raie chocolat (SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: to 90 cm TL.
- Disk heart-shaped (juveniles) to diamond-shaped (large adults); **tail long, 1.4 times body length; anterior and posterior pelvic fin lobes about equal in size and length.**
- Dorsal fins connected, no intervening gap or thorn.
- **No thorns on snout tip; only 3-4 orbital thorns, 5-6 thorns in a triangular nuchal-shoulder thorn patch, mid-dorsal row of 31-41 thorns** (versus 40-45 in *Dipturus linteus*); two fairly regular flanking rows present on each side of tail behind pectoral axil.
- Upper surface entirely covered by very fine spinules.
- Upper surface uniform dark gray, except darker along posterior disk and pelvic fin margins (especially in juveniles).
- Lower surface dark brown in juveniles, **but always with a large white area along midline**; entirely or mostly white with dark markings marginally in adults, underside of tail dark (same shade as disk underside), with irregular whitish patches.
- Distribution: continental slope – northern Labrador Sea, east of Newfoundland, Flemish Cap, Grand Banks, Georges Bank; Depth 686-2,293 m (typically occurs below 1,400 m); Temperature: no data (approximately 2.5 to 4^{o}C by correspondence with depth).

NOTE: May be confused with D. linteus, particularly as a juvenile [in R. bathyphila, note irregular dark markings (versus very symmetrical in D. linteus), series of white blotches on underside of tail, absence of paired spots flanking cloaca, fewer mid-dorsal spines, roughly equal size anterior and posterior pelvic lobes.


COLOUR – UNIFORM CREAM TO LIGHT GRAY
NO THORNS ON SNOUT TIP
VERY LONG POINTED SNOUT
DIAMOND-SHAPED DISK
CORNER ROUNDED
NUCHAL THORNS
3 SHOULDER THORNS
ALL LARGE THORNS DISTINCTLY WHITE
UNDERSIDE WHITE WITH GRAY MARGINS
MEDIAN ROW OF 42-51 THORNS BEHIND NUCHALS
PAIRED GRAY MARKINGS FLANKING CLOACA
PELVIC FIN – ANTERIOR LOBE SHORTER & SMALLER THAN POSTERIOR LOBE
TWO THORN ROWS FLANKING MEDIAN ROW
DORSALS JOINED - NO GAP
TAIL ABOUT EQUAL TO BODY LENGTH
Dipturus linteus
pale ray


COLOUR – GRAY TO BROWN
1-3 ORBITAL THORNS
LONG POINTED SNOUT
DIAMOND-SHAPED DISK; BROADER THAN LONG
ROW OF BLACK PORES
ROW OF SMALL SPINULES ALONG DISK LEADING EDGE
AMPULLARY PORES BLACK, DISTINCT
BLACK PORES
DISK SMOOTH - NO THORNS
PALE SPOTS WITH BROWN CENTERS
CORNER ANGULAR
MEDIAN ROW OF 23-40 THORNS ON TAIL ONLY
UNDERSIDE DUSKY – DARK ALONG MARGINS
INTERDORSAL GAP - 1 THORN BETWEEN FINS
SINGLE LATERAL THORN ROW
TAIL ABOUT EQUAL TO BODY LENGTH
Dipturus laevis
barndoor skate

Dipturus linteus (Fries 1838)

pale ray (AFS), sailray (FAO, FishBase) [white skate, linen skate]
raie linon (SS), raie voile (FAO)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: a large species, to 112 cm TL, first maturity in males 97 cm TL.
- Disk diamond-shaped; **snout long and pointed, snout length 3.2-4.4 x interorbital distance** (compare with 2.0-2.4 x in *A. hyperborea* and *A. jenseni*).
- **Dorsal fins either connected or separated by a very short gap, no intervening thorn.**
- Tail, 0.9-1.0 times body length.
- **Anterior pelvic fin lobe shorter and smaller than posterior lobe.**
- **Dominant mid-dorsal thorn row with two flanking rows along tail; 42-51 total thorns in mid-dorsal row, about 35-36 on tail proper.**
- Upper surface uniform cream color to light gray; **all large thorns distinctly white, contrasting with background color.**
- Lower surface mostly white with symmetrically arrayed gray areas along margin of trailing edge of disk, tail and pelvic fins, **plus a pair of symmetrical gray blotches flanking cloaca; underside of tail with a continuous medial gray band.**
- Distribution: Baffin Bay, Davis Strait, off Strait of Belle Isle, Flemish Cap, eastern Grand Banks; Depth 410-2,117 m; Temperature (3.3 to 6.0^{o}C).

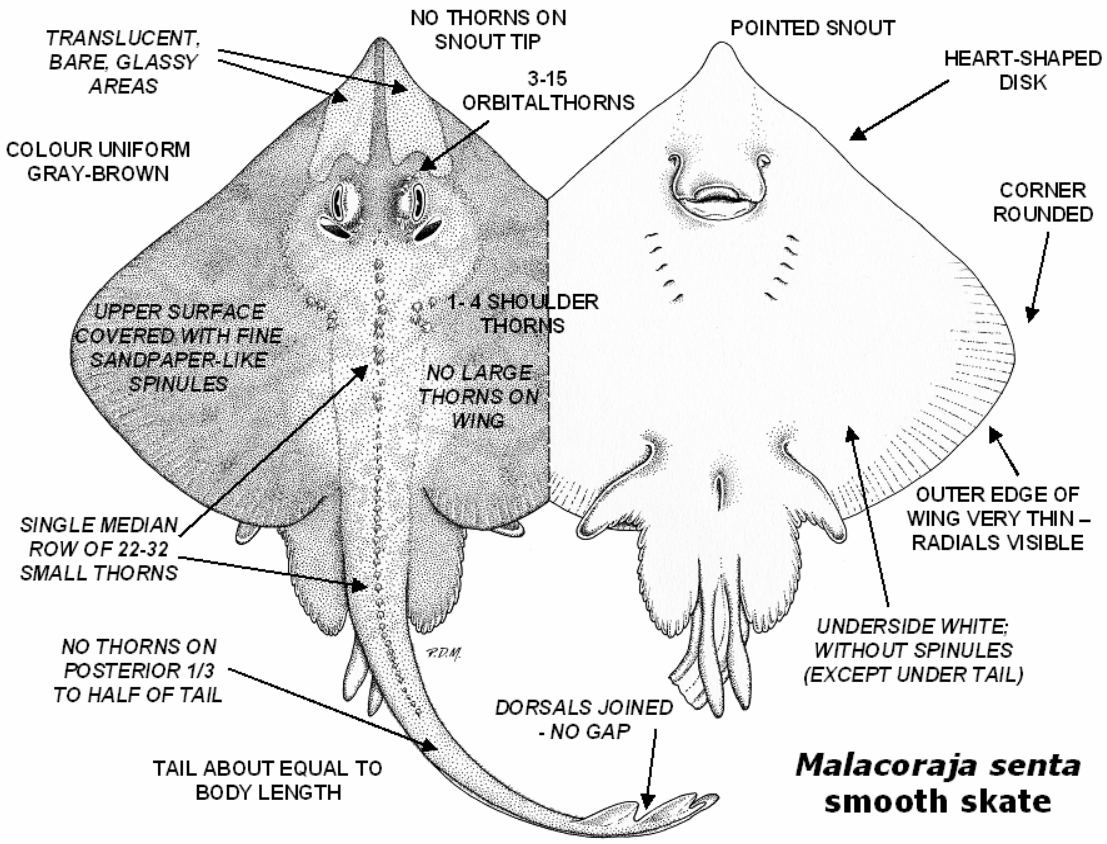
NOTE 1. May be confused with A. hyperborea or A. jenseni (in D. linteus, note much longer pointed snout, absence of dark markings on centre of ventrum). NOTE 2: May be confused with R. bathyphila (in D. linteus, note anterior pelvic fin lobe much smaller and shorter than posterior lobe).

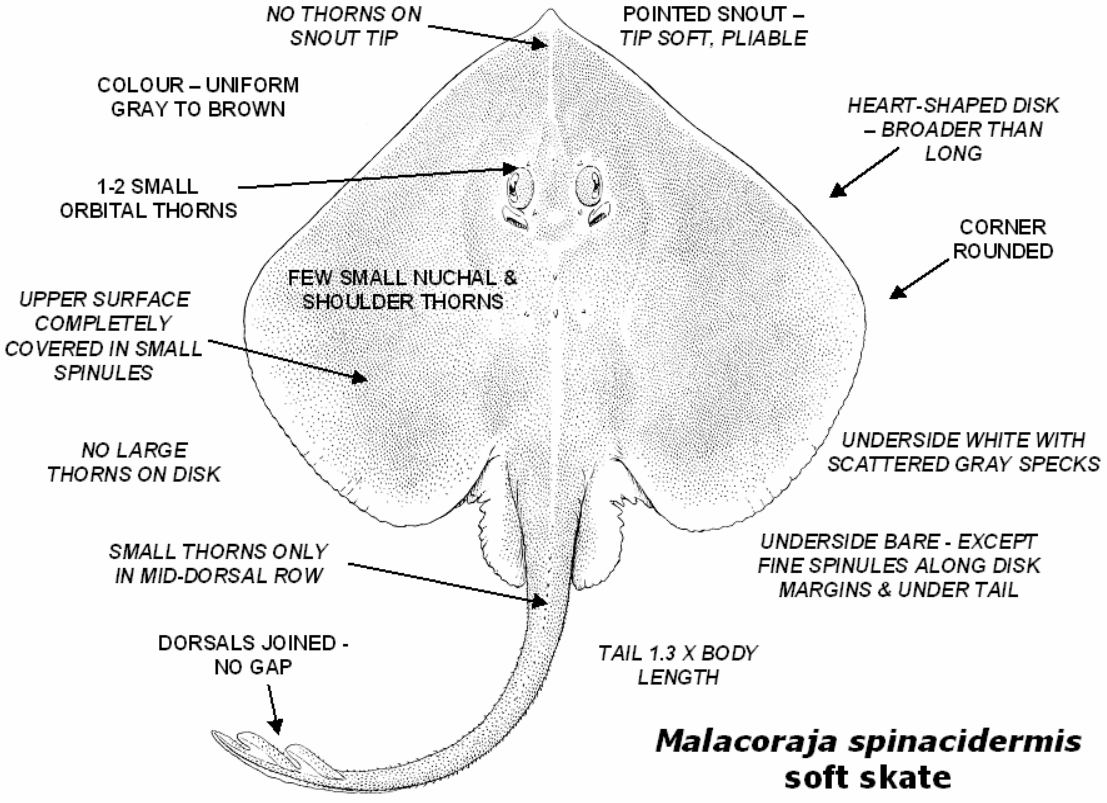
Dipturus laevis (Mitchell 1817)

barndoor skate (AFS, Fishbase, SS, FGOM) [sharpnosed ray]
grand raie (AFS, FAO, SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: largest shelf-dwelling species in the Canadian Atlantic, to 150 cm TL and 18 kg; first maturity in females 96-105 cm TL; in males 100 cm TL.
- Disk diamond-shaped, **noticeably broader than long**, **snout tip and disk corners distinctly pointed (acutely angled)**, anterior disk margins concave; body and wings low and thin.
- **Dorsal fins distinctly separated, with one intervening thorn.**
- Tail short, 0.9-1.0 times body length.
- **Upper surface smooth and lacking large thorns on disk, except 1-3 orbital thorns; 23-40 thorns in mid-dorsal row on tail only, often irregularly set**; an additional thorn row along lower margin on each side of tail; if present, small spinules in marginal patch at snout tip continuing outward along anterior margins.
- Upper surface gray to brown, **marked with pale spots with brown centres**; **prominent black pores in series ahead of eyes**; 3-4 widely spaced pores along rostral ridge; pair of crescent-shaped rows of black pores in nuchal region.
- **Lower surface dusky; darker along fin margins; ampullary pores evident as rows of very distinct black dots and dashes.**
- Distribution: south of Newfoundland, Scotian shelf and slope, Gulf of Maine and Bay of Fundy; Depth 51-788 m (commonly 10-145 m); Temperature (1.2 to 20^{o}C).


TRANSLUCENT, BARE, GLASSY AREAS
NO THORNS ON SNOUT TIP
POINTED SNOUT
HEART-SHAPED DISK
3-15 ORBITALTHORNS
COLOUR UNIFORM GRAY-BROWN
CORNER ROUNDED
UPPER SURFACE COVERED WITH FINE SANDPAPER-LIKE SPINULES
1- 4 SHOULDER THORNS
NO LARGE THORNS ON WING
OUTER EDGE OF WING VERY THIN – RADIALS VISIBLE
SINGLE MEDIAN ROW OF 22-32 SMALL THORNS
UNDERSIDE WHITE; WITHOUT SPINULES (EXCEPT UNDER TAIL)
NO THORNS ON POSTERIOR 1/3 TO HALF OF TAIL
DORSALS JOINED - NO GAP
TAIL ABOUT EQUAL TO BODY LENGTH
Malacoraja senta
smooth skate


NO THORNS ON SNOUT TIP
POINTED SNOUT – TIP SOFT, PLIABLE
COLOUR – UNIFORM GRAY TO BROWN
HEART-SHAPED DISK – BROADER THAN LONG
1-2 SMALL ORBITAL THORNS
CORNER ROUNDED
FEW SMALL NUCHAL & SHOULDER THORNS
UPPER SURFACE COMPLETELY COVERED IN SMALL SPINULES
NO LARGE THORNS ON DISK
UNDERSIDE WHITE WITH SCATTERED GRAY SPECKS
SMALL THORNS ONLY IN MID-DORSAL ROW
UNDERSIDE BARE - EXCEPT FINE SPINULES ALONG DISK MARGINS & UNDER TAIL
DORSALS JOINED - NO GAP
TAIL 1.3 X BODY LENGTH
Malacoraja spinacidermis
soft skate

Malacoraja senta (Garman 1885)

smooth skate (AFS, FAO, FishBase, SS) [smooth-tailed skate, prickly skate]
raie à queue de velours (AFS, FAO), **raie lisse** (QV) [raie lisse américaine]

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: to 61 cm TL, first maturity in females 33-48 cm TL, in males 50 cm TL.
- Disk heart-shaped, **margins very thin, radials show; snout distinctly pointed.**
- **Large glassy translucent areas flank rostral cartilage, from orbits to tip of snout.**
- Dorsal fins connected, no gap or intervening thorn.
- **Tail 1.1 times body length.**
- **Single row of 22-32 small thorns mid-dorsally from nuchal area onto tail, no thorns on posterior 1/2 to 1/3 of tail in adults** (complete row in juveniles); 1-4 shoulder thorns; 3-15 orbital thorns.
- **Except for glassy areas, upper surface covered with fine, sandpaper-like spinules;** lower surface smooth, **except underside of tail wholly or marginally spinulose**.
- Except for glassy areas, upper surface gray-brown with dark mottling and spots; juveniles often with a pale, dark-bordered rectangle or hourglass behind nuchal spine, 2-4 pale bands across tail (often incomplete); **small evenly-spaced dark spots in arcs parallel to disk margin.**
- **Lower surface entirely white.**
- Distribution: Strait of Belle Isle, Flemish Cap, Grand Banks, Gulf of St. Lawrence, St. Lawrence River to Saguenay Fjord, Scotian Shelf, Bay of Fundy, Georges Bank; Depth 72-777 m (commonly 73-163 m); Temperature (0.5 to 10^{o}C, commonly 3 to 8^{o}C).

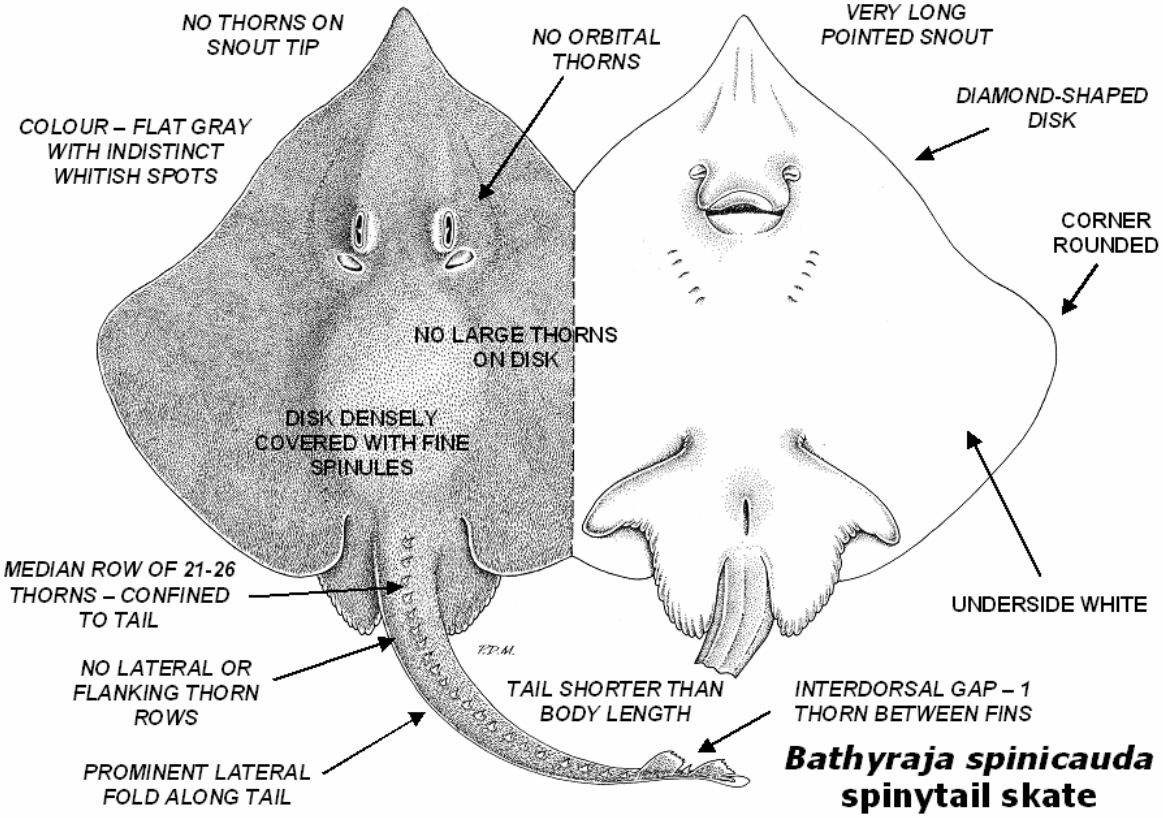
Malacoraja spinacidermis (Barnard 1923) (= *Raja mollis* Bigelow and Schroeder 1950)

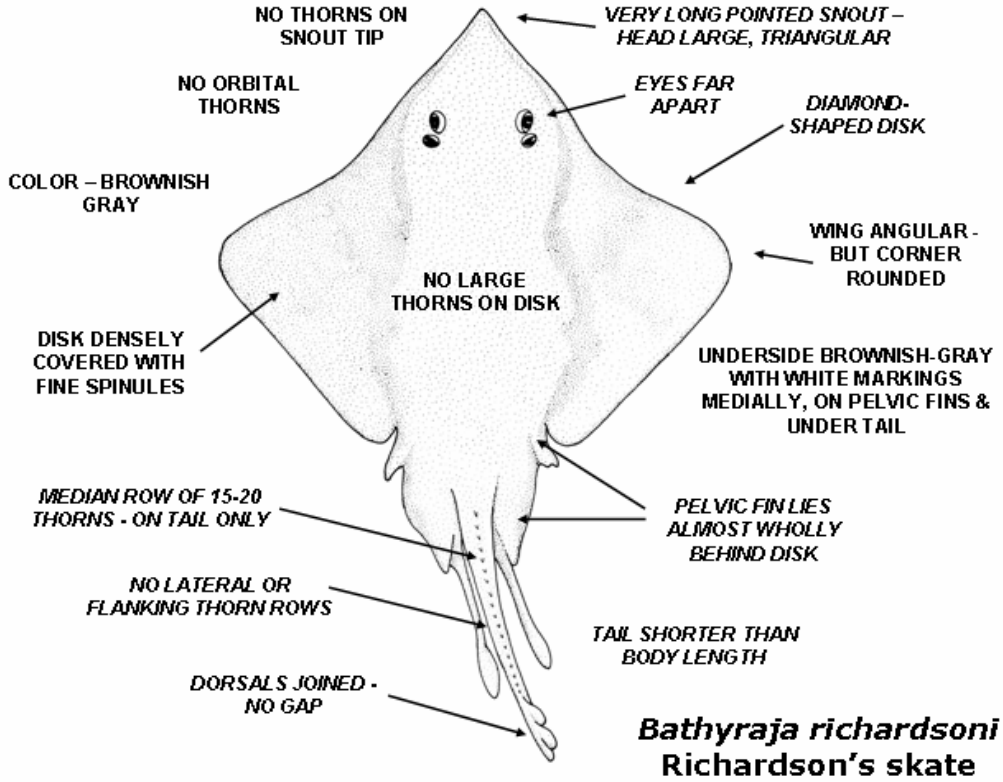
soft skate (FAO, SS), prickled ray (FNAM), roughskin skate (FishBase)
raie molle (SS, QV), raie peau de hérissée (FAO), raie profonde (FNAM)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: to 48 cm TL (all fish in region may be juveniles; elsewhere adults attain 70 cm TL).
- Disk spade-shaped, broader than long, outer corners broadly rounded.
- **Tip of snout soft; underlying rostral cartilage very pliable.**
- **Dorsal fins connected, no gap or intervening thorn** (compare with *B. spinicauda*).
- **Tail long, 1.3 times body length.**
- **No large thorns anywhere on disk behind nuchal-shoulder area;** 1-2 small orbital thorns, first unique in being depressible and lying in a groove; 1 small nuchal thorn, 1-2 small shoulder thorns.
- **Upper surface completely covered in minute densely-spaced spinules.**
- **Lower surface bare, except fine spinules along disk margins and entire underside of tail. Covered by fine spinules** (compare with *B. spinicauda*).
- Upper surface uniform gray-brown; translucent along each side of rostral ridge.
- **Lower side whitish with scattered gray specks, except underside of tail uniformly gray**; large specimens becoming dark ventrally with remnant white patches medially.
- Distribution: Davis Strait, off Grand Banks, Scotian Slope, and Georges Bank; Depth 475-1,570 m (adults usually occur below 1,500 m); Temperature: no data.

NOTE. Similar to B. spinicauda (in M. spinacidermis, note absence of prominent dorsal thorns, presence of spinules on underside of tail, underside of tail gray, longer tail, no gap or thorn between dorsal fins, different snout shape).


NO THORNS ON SNOUT TIP
NO ORBITAL THORNS
VERY LONG POINTED SNOUT
DIAMOND-SHAPED DISK
COLOUR – FLAT GRAY WITH INDISTINCT WHITISH SPOTS
CORNER ROUNDED
NO LARGE THORNS ON DISK
DISK DENSELY COVERED WITH FINE SPINULES
MEDIAN ROW OF 21-26 THORNS – CONFINED TO TAIL
UNDERSIDE WHITE
NO LATERAL OR FLANKING THORN ROWS
TAIL SHORTER THAN BODY LENGTH
INTERDORSAL GAP – 1 THORN BETWEEN FINS
PROMINENT LATERAL FOLD ALONG TAIL
Bathyraja spinicauda
spinytail skate


NO THORNS ON SNOUT TIP
VERY LONG POINTED SNOUT – HEAD LARGE, TRIANGULAR
NO ORBITAL THORNS
EYES FAR APART
DIAMOND-SHAPED DISK
COLOR – BROWNISH GRAY
WING ANGULAR - BUT CORNER ROUNDED
NO LARGE THORNS ON DISK
DISK DENSELY COVERED WITH FINE SPINULES
UNDERSIDE BROWNISH-GRAY WITH WHITE MARKINGS MEDIALLY, ON PELVIC FINS & UNDER TAIL
MEDIAN ROW OF 15-20 THORNS - ON TAIL ONLY
PELVIC FIN LIES ALMOST WHOLLY BEHIND DISK
NO LATERAL OR FLANKING THORN ROWS
TAIL SHORTER THAN BODY LENGTH
DORSALS JOINED - NO GAP
Bathyraja richardsoni
Richardson's skate

Bathyraja spinicauda (Jensen 1914)

spinytail skate (AFS, SS), spinetail ray (FAO, FNAM, FishBase)
raie à queue épineuse (FAO, FNAM, SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: a very large deep-water species, to 170 cm TL.
- Disk spade-shaped to diamond-shaped, anterior margins almost straight to slightly concave; **very long pointed snout.**
- **Dorsal fins distinctly separated, with one intervening thorn (absent in small juveniles).**
- **Tail short, 0.9 times body length** (compare with *M. spinacidermis*); **with prominent lateral fold all along lower margins.**
- **No large thorns anywhere on disk (except alar thorns in mature males); mid-dorsal row with 21-26 large thorns – on tail only.**
- **Lower surface and underside of tail smooth** (no spinules between lateral folds) (compare with *M. spinacidermis*).
- Upper surface uniform gray, including tail; juveniles shorter than 25 cm TL with 2-4 narrow dark bands on tail (upper surface).
- **Lower surface uniform white, no markings.**
- Distribution: Davis Strait, off Hamilton Inlet to Flemish Cap, Scotian Slope, Gulf of St. Lawrence, Georges Bank; Depth 111-2,949 m; Temperature (-1.5 to 7.5^{o}C, commonly below 3^{o}C).

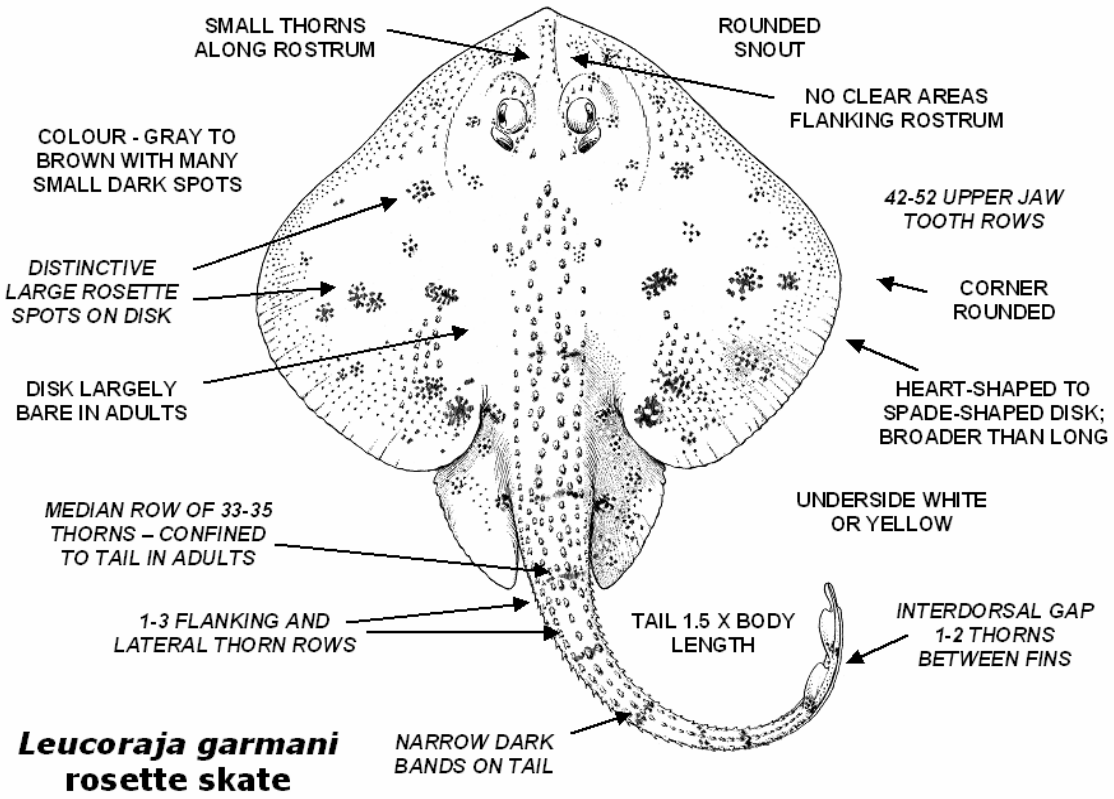
NOTE: May be confused with M. spinacidermis (in B. spinicauda, note short tail, underside of tail smooth, gap between dorsal fins with intervening thorn, very long pointed snout).

Bathyraja richardsoni (Garrick 1961)

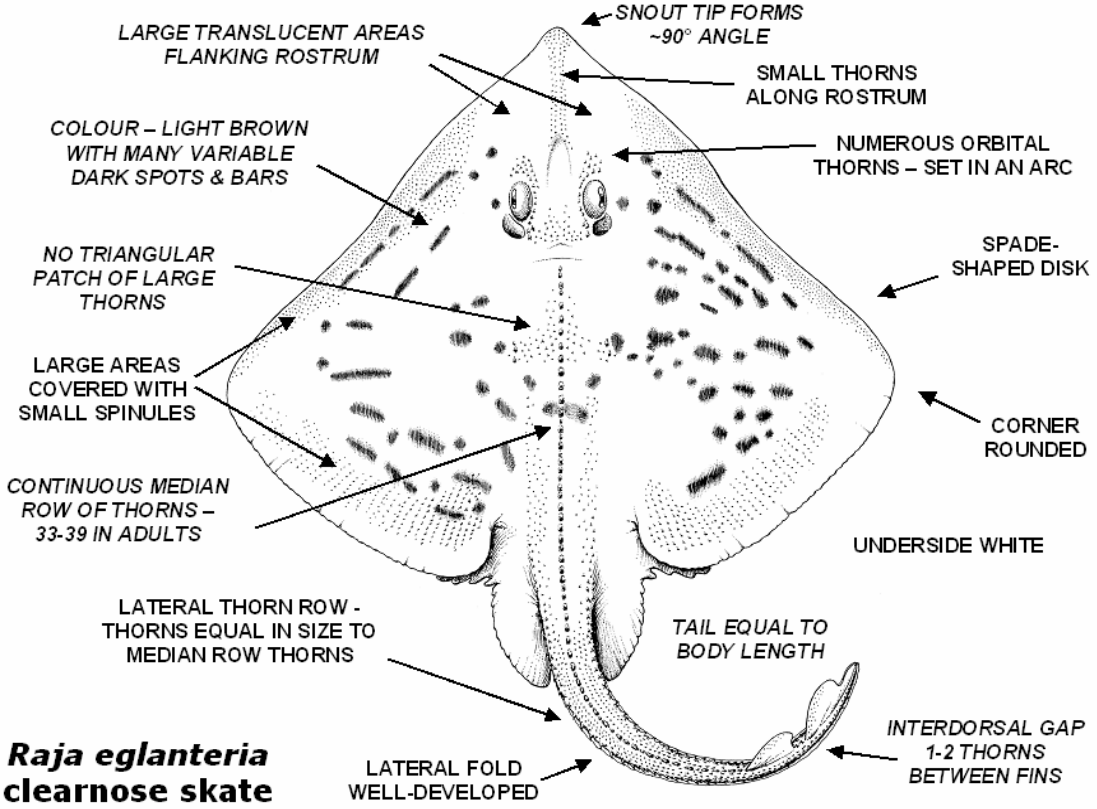
Richardson's ray (FAO, Fishbase, FNAM), deepwater skate (FGOM)
raie de Richardson (FNAM), raie de profundeur (SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: a very large species, to 174 cm TL, first maturity in females 159-174 cm TL, in males 120-142 cm TL.
- Disk diamond-shaped, but deeply incised behind level of eyes; **pelvic fin protruding very noticeably, placed almost wholly behind disk.**
- **Head a broad triangle; mouth very wide, eyes far apart; snout length/interorbital distance ratio 1.2-1.7** (compared to 2.0-2.5 in short-snouted species with normal interorbital span, 3.0-4.5 in long-snouted skates with normal interorbital span).
- **Dorsal fins joined; no gap or intervening thorn.**
- **Tail very short, 0.7-0.8 times body length.**
- **No large thorns on disk; mid-dorsal row with 15-20 thorns on tail only.**
- **Upper surface entirely covered by fine spinules;** lower surface covered with fine spinules on snout, abdomen, and underside of tail.
- Upper surface uniform brownish-gray.
- Lower surface brownish-gray with white markings along midline, on pelvic fins, and underside of tail.
- Distribution: off southern Labrador, Flemish Cap, Grand Banks, Scotian Slope, northern Georges Bank; Depth 1,500-2,360 m; Temperature (2.7 to 3.8^{o}C).



Leucoraja garmani
rosette skate



Raja eglanteria
clearnose skate

Leucoraja garmani (Whitley 1939)

rosette skate (AFS, FAO, FGOM) , rosetted skate (FWNA), freckled skate (FishBase) [leopard skate]
raie rosette (FAO, SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: **a small species, to 44 cm TL, first maturity in females 33-35 cm TL, in males 33 cm TL**.
- Disk heart-shaped to spade-shaped; snout rounded.
- **Dorsal fins separate; 1-2 intervening thorns** *(*compare with *L. ocellata, L. erinacea)*.
- **Upper jaw with 42-52 tooth rows.**
- **33-35 thorns in median row (confined to tail); 1-3 lateral and flanking thorn rows parallel to median row along tail; triangular patch nuchal-shoulder thorns; disk largely bare; small thorns in an arcing row along rostral ridge.**
- Upper surface gray to brown, **with distinctive large dark rosette spots on disk (not always present); tail with narrow cross-bands;** numerous small dark spots in addition to rosettes.
- Lower surface white or yellow, with occasional gray-brown blotches on disk and tail.
- Distribution: not confirmed from Canadian waters, a southern species found primarily up the U.S. East Coast as far north as Cape Cod, perhaps southern Gulf of Maine; putative records from Scotian region probably pertain to *L. erinacea*; Depth (66-366 m); Temperature (5.3 to 17^{o}C, commonly 9 to 13^{o}C). **[Fished commercially in the U.S.]**

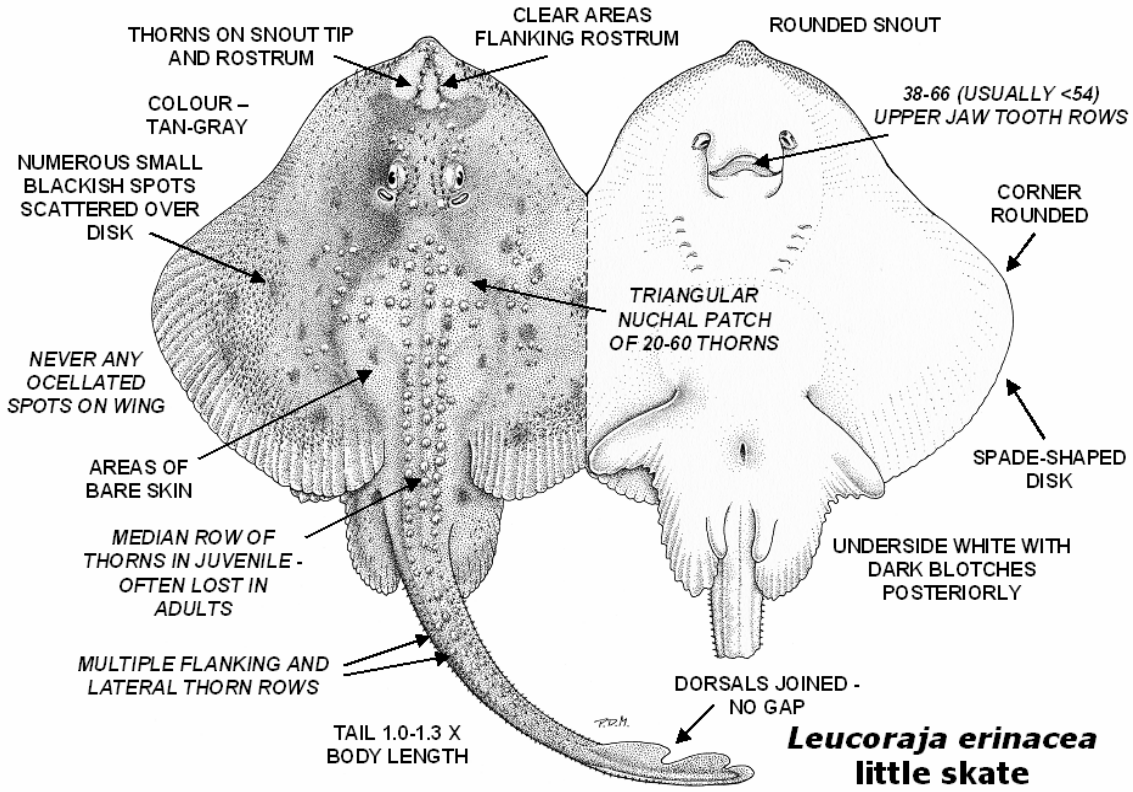
NOTE: If rosette spots are not developed, L. garmani may be confused with L. erinacea, L. ocellata, or R. fyllae (in L. garmani, note separate dorsal fins with 1-2 intervening thorns).

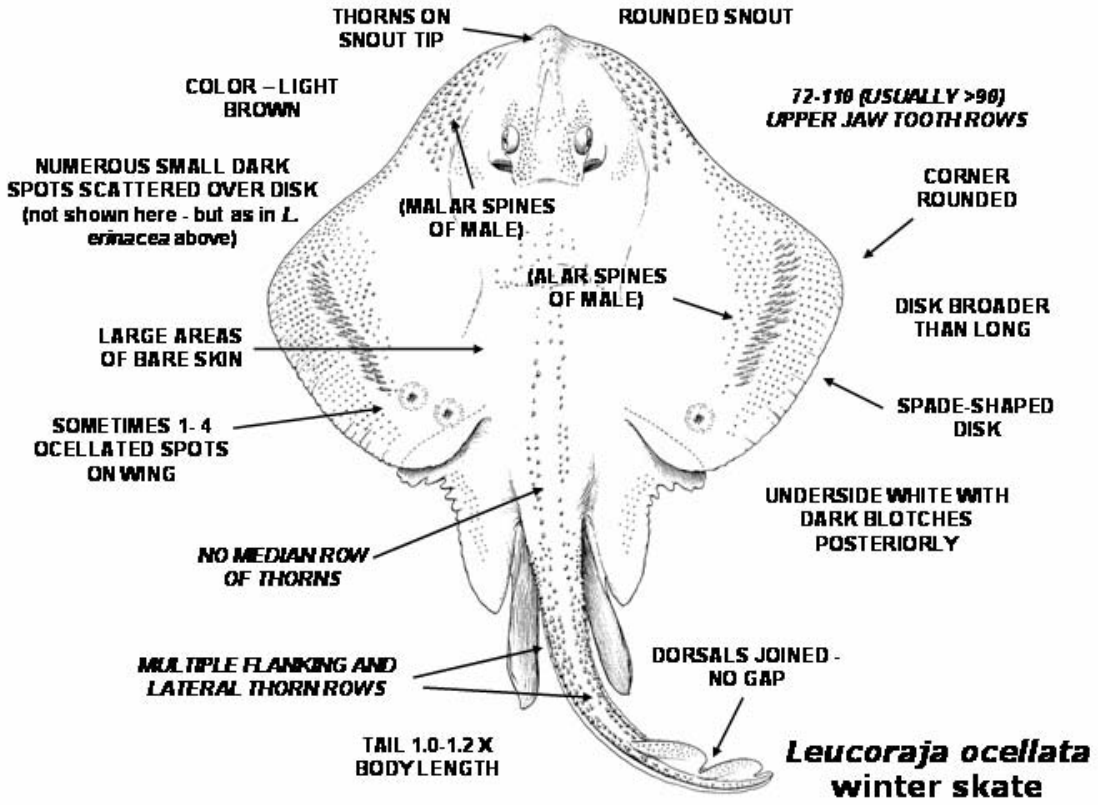
Raja eglanteria Bosc 1802

clearnose skate (AFS, FAO, FishBase, FGOM), brier skate (FWNA) [clear-nosed skate, summer skate]
raie blanc nez (FAO, SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: to 79 cm TL, first maturity in females 59-65 cm TL, in males 56 cm TL.
- Disk spade-shaped to diamond-shaped; snout long and pointed**; leading edges meet at approximately a 90^{o} angle**.
- Dorsal fins separate; 1-2 intervening thorns.
- **Anterior lobe or pelvic fin about one-half the length of posterior lobe.**
- **Tail about equal to body length; well-developed lateral fold.**
- **Large thorns of nuchal-shoulder patch never form a triangular patch; 33-39 (14-16 in juveniles) smallish thorns in continuous median row**; lateral rows present along tail. **Thorns of all three rows equal in size.**
- **Upper surface light brown with numerous dark spots and transverse dark bars of variable size and shape.**
- Lower surface white.
- Distribution: not confirmed from Canadian waters, found as far north as southern Georges Bank, southern Gulf of Maine in summer; Depth 18-430 m in study area (commonly shallower than 110 m); Temperature (5 to 27^{o}C, commonly 9 to 20^{o}C).


THORNS ON SNOUT TIP AND ROSTRUM
CLEAR AREAS FLANKING ROSTRUM
ROUNDED SNOUT
COLOUR – TAN-GRAY
38-66 (USUALLY <54) UPPER JAW TOOTH ROWS
NUMEROUS SMALL BLACKISH SPOTS SCATTERED OVER DISK
CORNER ROUNDED
TRIANGULAR NUCHAL PATCH OF 20-60 THORNS
NEVER ANY OCELLATED SPOTS ON WING
SPADE-SHAPED DISK
AREAS OF BARE SKIN
MEDIAN ROW OF THORNS IN JUVENILE - OFTEN LOST IN ADULTS
UNDERSIDE WHITE WITH DARK BLOTCHES POSTERIORLY
MULTIPLE FLANKING AND LATERAL THORN ROWS
DORSALS JOINED - NO GAP
TAIL 1.0-1.3 X BODY LENGTH
Leucoraja erinacea
little skate


THORNS ON SNOUT TIP
ROUNDED SNOUT
COLOR – LIGHT BROWN
72-119 (USUALLY >90) UPPER JAW TOOTH ROWS
NUMEROUS SMALL DARK SPOTS SCATTERED OVER DISK (not shown here - but as in L. erinacea above)
CORNER ROUNDED
(MALAR SPINES OF MALE)
(ALAR SPINES OF MALE)
DISK BROADER THAN LONG
LARGE AREAS OF BARE SKIN
SPADE-SHAPED DISK
SOMETIMES 1- 4 OCELLATED SPOTS ON WING
UNDERSIDE WHITE WITH DARK BLOTCHES POSTERIORLY
NO MEDIAN ROW OF THORNS
MULTIPLE FLANKING AND LATERAL THORN ROWS
DORSALS JOINED - NO GAP
TAIL 1.0-1.2 X BODY LENGTH
Leucoraja ocellata
winter skate

Leucoraja erinacea (Mitchill 1825)

little skate (AFS, FAO, FishBase, FGOM, SS, FWNA) [common skate, summer skate, hedgehog skate, tobacco box]
raie hérisson (AFS, FAO, SS)

DISTINGUISHING CHARACTERISTICS (bold font denotes key characters):

- Size: **a small species, to 54 cm TL, commonly 42-48 cm; weight to 0.9 kg; first maturity in females 40-48 cm TL; in males 39 cm TL**. Larger skates of similar morphology probably pertain to *L. ocellata*.
- Disk spade-shaped, corners rounded; snout broadly rounded, tip short and blunt; translucent areas of variable extent flank rostral ridge at tip of snout.
- **Dorsal fins joined, relatively large, no gap or intervening thorn.**
- **Tail 1.0-1.3 times body length; lateral folds prominent.**
- **30-66 upper jaw tooth rows in small (juvenile) specimens <35 cm TL** (generally fewer when compared with *L. ocellata* of similar size, see table on p. 22)**, usually <54 rows (never more than 66) when mature.**
- **Triangular patch of 20-60 thorns on nuchal-shoulder region** (fewer and smaller in large adults), continuing onto tail as 3-6 parallel rows with smaller thorns laterally (juveniles with 3 neat dorsal rows of roughly equal thorns, **<21 (usually 15–17) in median row behind pectoral axil**; median thorn row reduced or absent in adult); underside of tail bare.
- Patch of thorns on snout tip, plus row of small thorns along rostral ridge to orbit; patch of smaller thorns between orbits.
- Upper surface between thorns smooth, particularly around eyes, centre of disk, and along midline (contrast spinulose in *R. fyllae*).
- Upper surface tan-gray with 50-300 small dark spots; ocelli usually absent.
- Lower surface white, sometimes with irregular dark patches posteriorly, and along tail.
- **Juveniles (<21 cm TL) snout obtuse, extending clearly beyond anteriormost pectoral fins.**
- Distribution: Scotian Shelf, Gulf of Maine, Bay of Fundy, Georges Bank; Depth 10-914 m (generally <111 m, most commonly <25 m); Temperature 1.2 to 21^{o}C, but generally <15^{o}C. **Reports of L. erinacea from the Gulf of St. Lawrence and estuary are probably immature L. ocellata.*
- **Secondary sexual features: Pelvic denticles in females appear at 36-44 cm TL, claspers in males appear at 36-50 cm TL, alar spines in males appear at 40-45 cm TL.**

NOTE 1. Immature specimens (<35 cm TL) easily confused with its geographic cognate, L. ocellata (in L. erinacea usually <21 thorns in median row behind pectoral axil to origin of dorsal fin and obtuse snout in specimens <21 cm TL). NOTE 2. Specimens <9 cm TL are virtually indistinguishable from L. ocellata when using external features only.

Leucoraja ocellata (Mitchill 1815)

winter skate (AFS, FAO, FishBase, FGOM, SS), big skate (FWNA) [eyed skate]
raie tachetée (AFS, FAO, SS)

DISTINGUISHING CHARACTERISTICS [Identical to *L. erinacea* (above), except]:

- Size: **attains a much larger size than *L. erinacea*, to 109 cm TL;** weight to 3 kg; **first maturity in females 65-73 cm TL; in males 53-58 cm TL**. Known to mature at a smaller size (~42 cm TL) in southern Gulf of St. Lawrence. Similar but smaller males with mature claspers probably pertain to *L. erinacea.*
- **Tail 1.0-1.2 times body length.**
- **44 – 63 upper jaw tooth rows in small (juvenile) specimens < 53 cm TL** (generally greater when compared to *L. erinacea* of similar size, see table on p. 22)**, usually 90-100, maximum 110 when mature.**
- **Juveniles usually 21 or more thorns in median row behind pectoral axil to dorsal fin origin,** median thorn row reduced or absent in adults.
- **Upper surface often with 1-8 ocellated spots,** centres brown, margins pale – in addition to small dark spots.
- **Juveniles (<21 cm TL) snout blunt, extending little beyond anterior-most margin of pectoral fins.**
- Distribution: off southeastern Newfoundland, Gulf of St. Lawrence, Scotian Shelf, Gulf of Maine, Bay of Fundy; Depth 10-723 m (commonly <110 m, typically 37-90 m on Scotian Shelf); Temperature (-1.2 to 19^{o}C; typically 5 to 9^{o}C on Scotian Shelf).
- **Secondary sexual features: Pelvic denticles in females appear at 54-72 cm TL, pelvic denticles and claspers in males appear at 54-82 cm TL, alar spines in males appear at 55-60 cm TL.**

NOTE 1. The most common skate in the Gulf of St. Lawrence; also very common throughout remainder of Canadian Atlantic range. NOTE 2. Immature specimens (< 53 cm TL) commonly confused with its geographic cognate, L. erinacea (in L. ocellata secondary sexual features appear at a larger size, pelvic denticles are further from the cloaca and not as prominent, usually 21 or more thorns in median row behind pectoral axil to origin of dorsal fin, snout blunt in specimens < 21 cm TL). NOTE 3. Specimens <9 cm TL are virtually indistinguishable from L. erinacea when using external features only.

Table 1. Changes in the number of upper tooth rows that are observed within *Leucoraja erinacea* compared with *L. ocellata* against total length (TL) (from McEachran and Musick, 1973).

	Size			
	9-16 cm TL	16-21 cm TL	21-35 cm TL	>35 cm TL
Leucoraja erinacea (little skate)	30-48	36-53	43-52	usually<54,
Leucoraja ocellata (winter skate)	44-55	50-60	58-70	63 or more

4.0 Distribution Maps

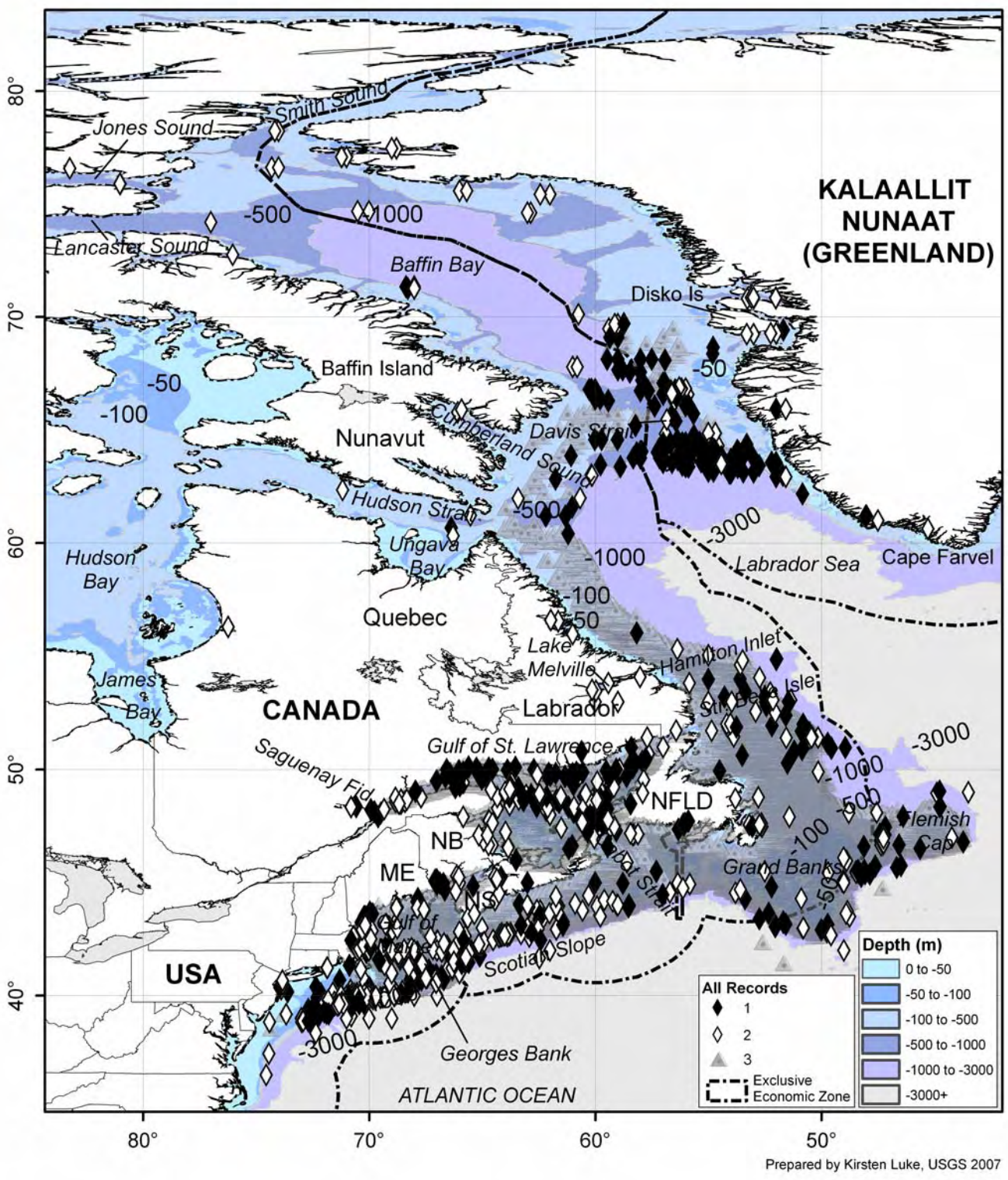
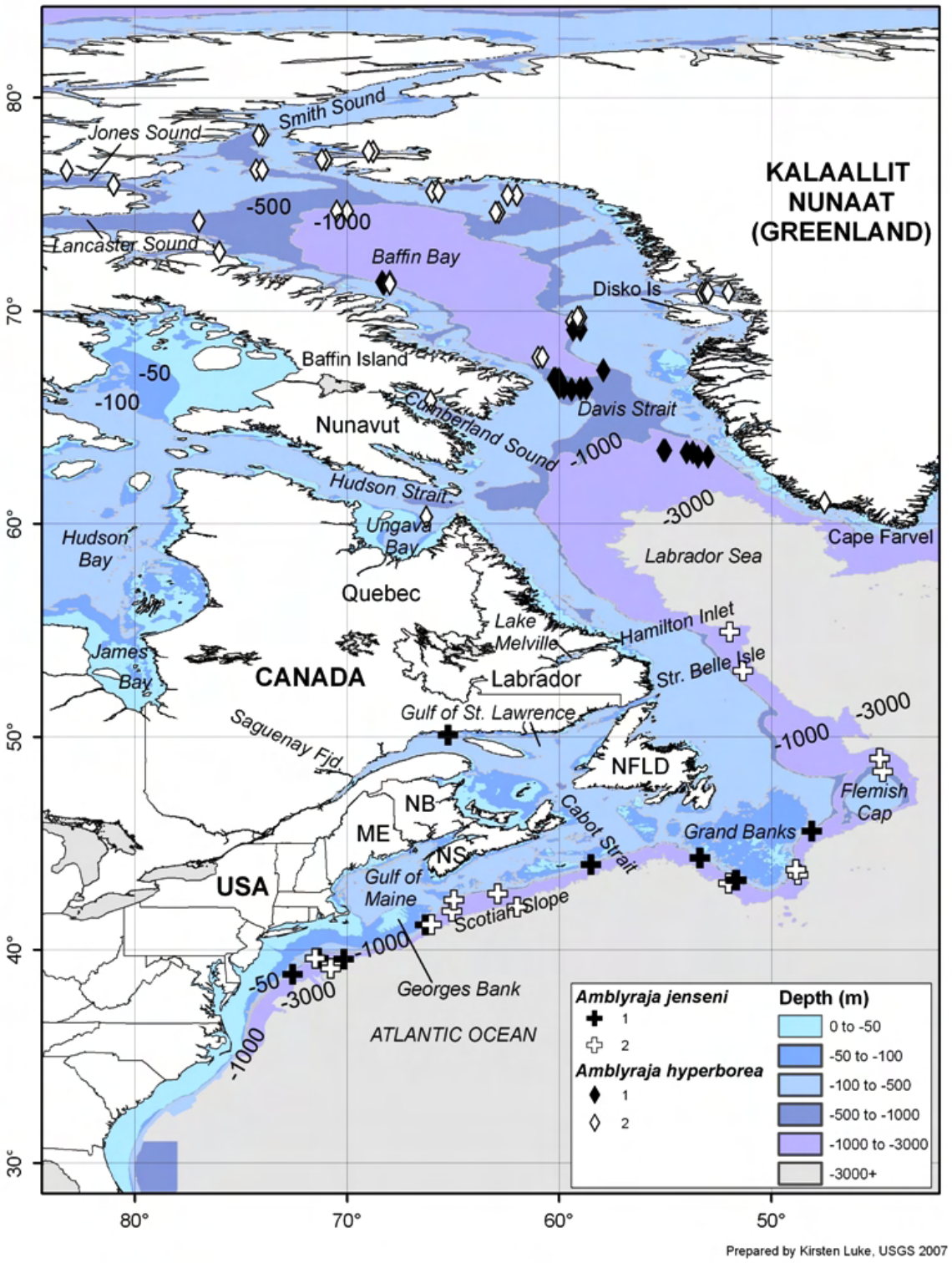
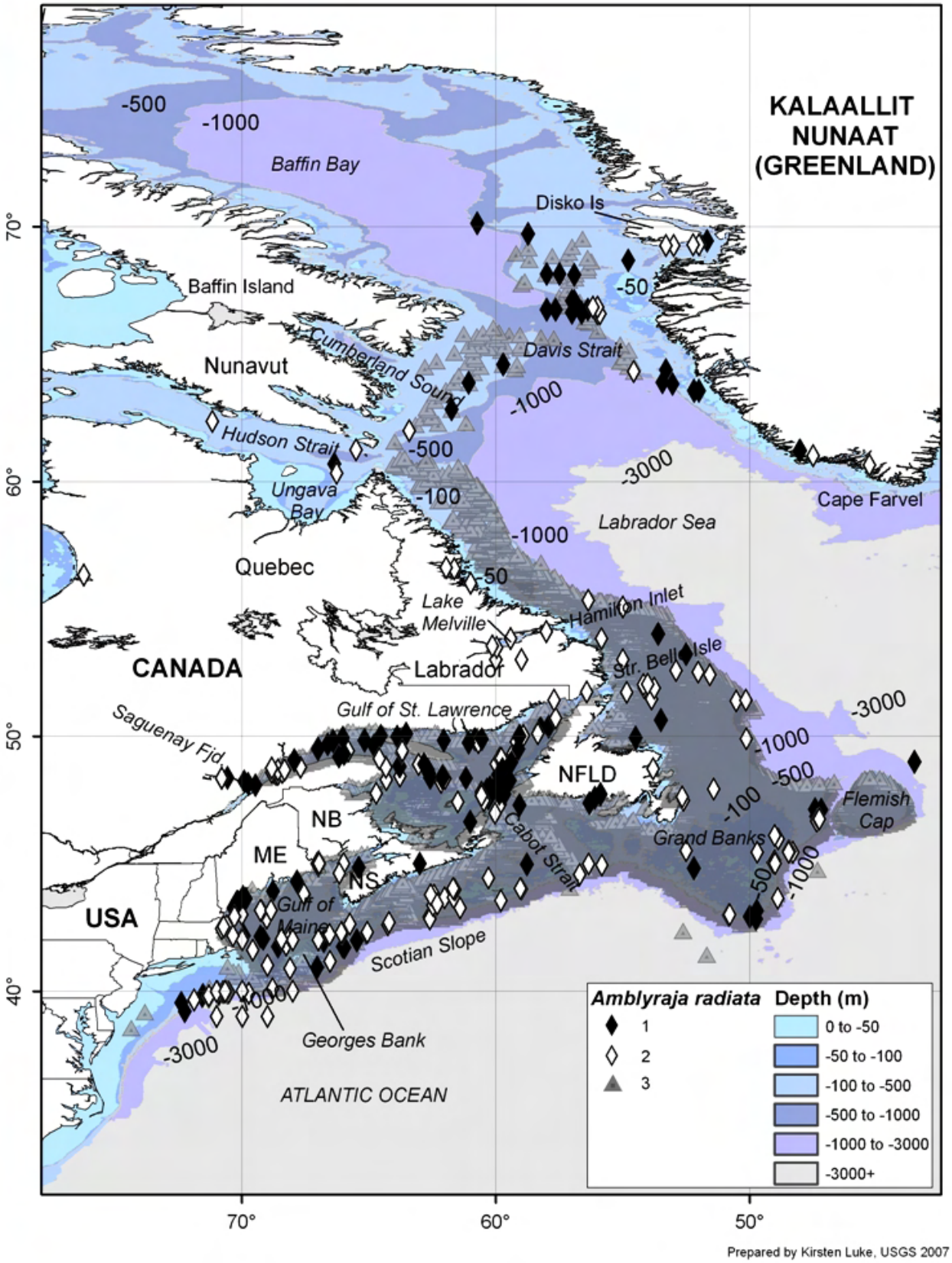


Figure 4. Distribution of all skate species from all known valid records in the Canadian Atlantic region.

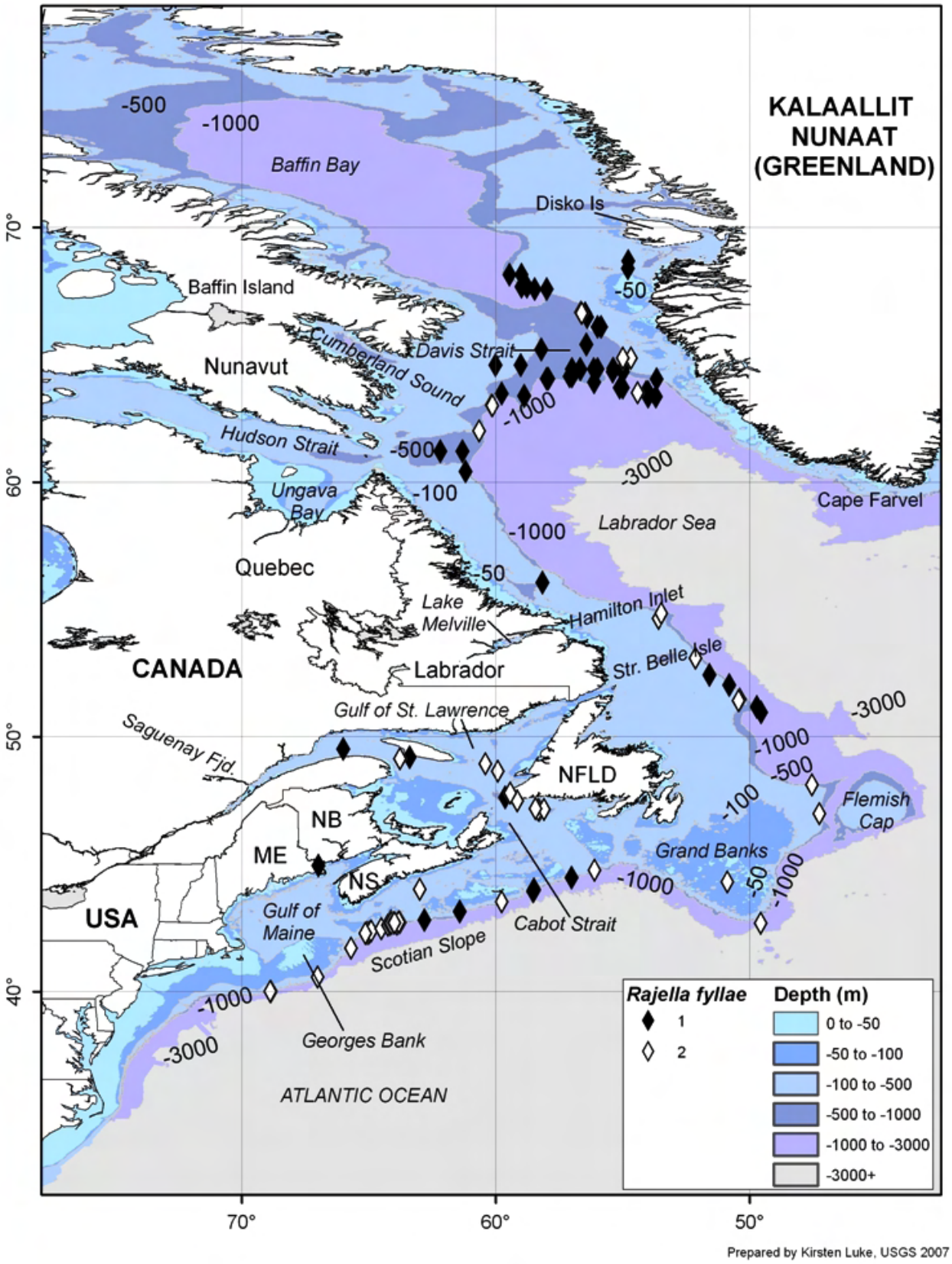
Amblyraja jenseni **shorttail skate, raie à queue courte**
Amblyraja hyperborea **Arctic skate, raie arctique**



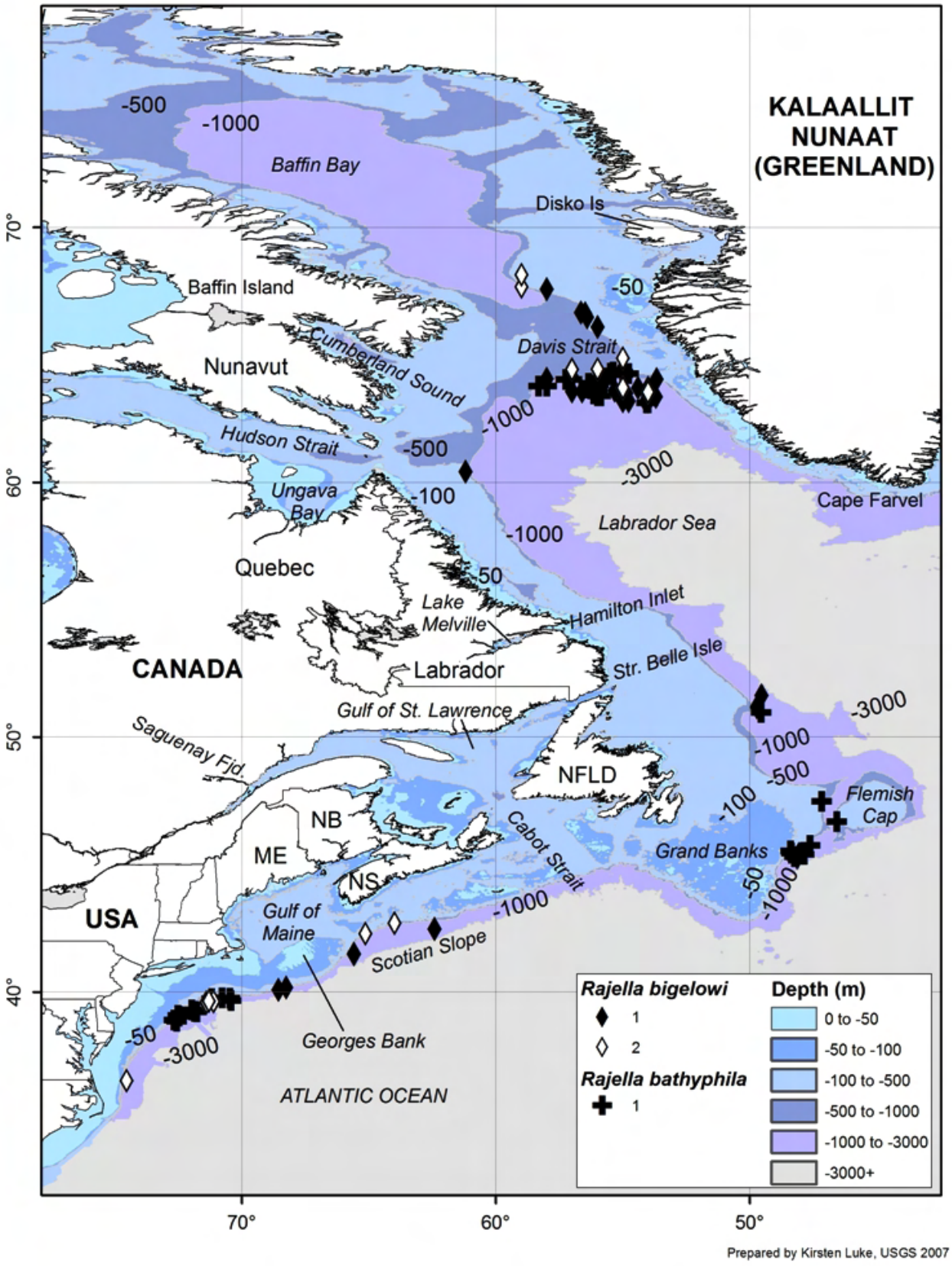
Amblyraja radiata thorny skate, raie épineuse



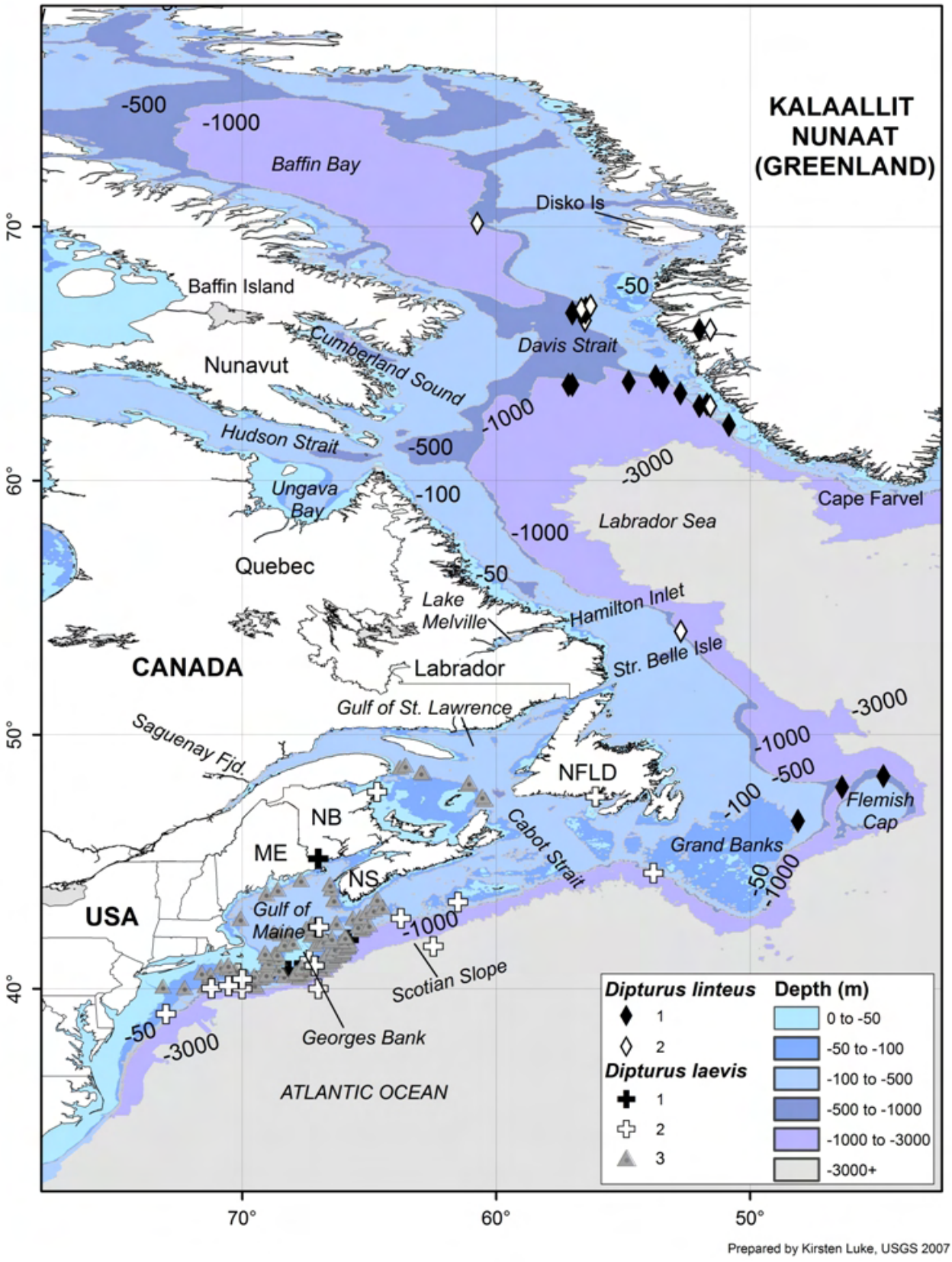
Rajella fyllae round ray, raie ronde



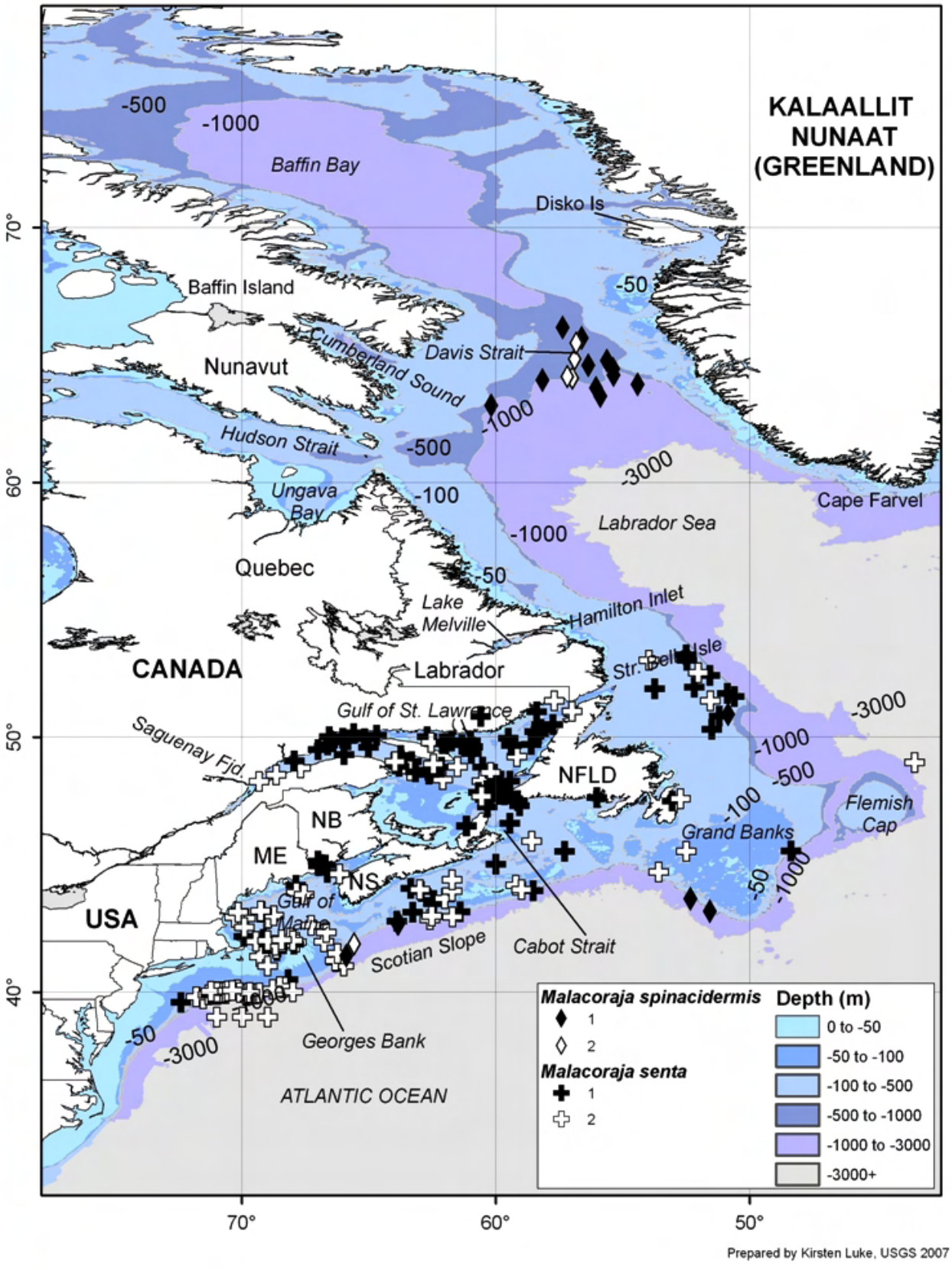
Rajella bigelowi **Bigelow's ray, raie de Bigelow**
Rajella bathyphila **deepwater ray, raie bathyale**



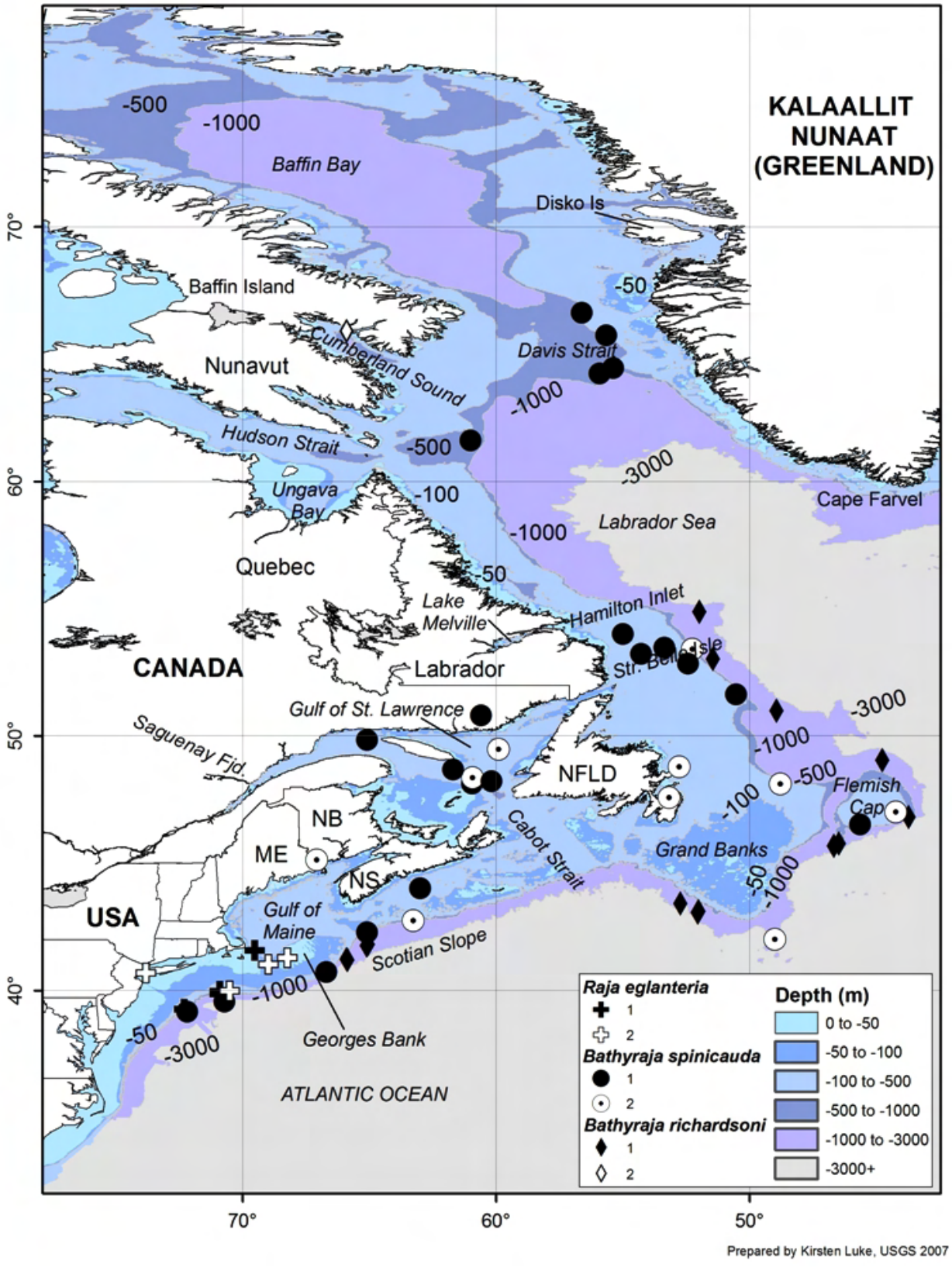
Dipturus linteus **pale ray, raie linon**
Dipturus laevis **barndoor skate, grand raie**



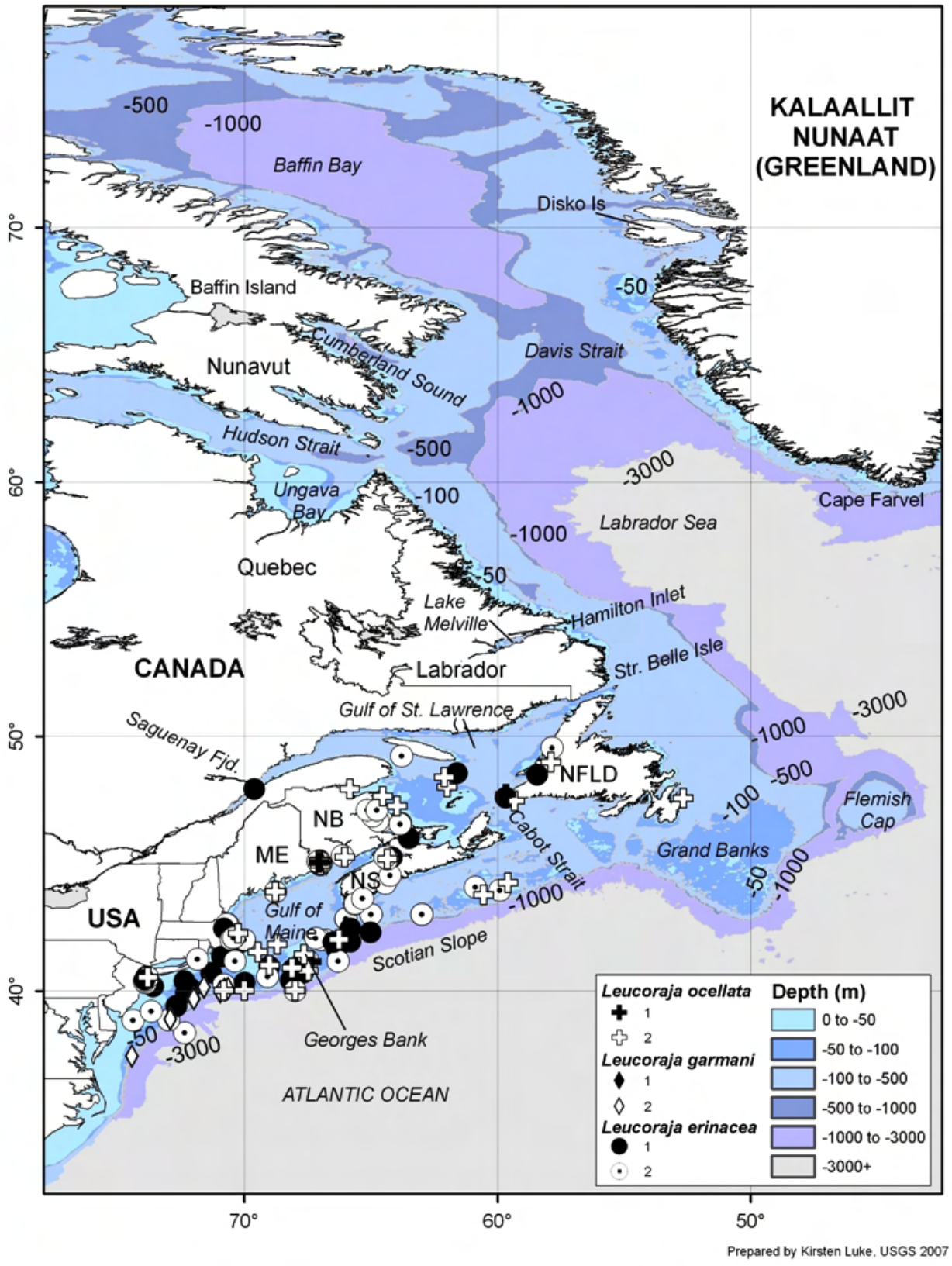
Malacoraja spinacidermis **soft skate, raie molle**
Malacoraja senta **smooth skate, raie à queue de velours**



Raja eglanteria **clearnose skate, raie blanc nez**
Bathyraja spinicauda **spinytail skate, raie à queue épineuse**
Bathyraja richardsoni **Richardson's ray, raie de Richardson**



Leucoraja ocellata **winter skate, raie tachetée**
Leucoraja garmani **rosette skate, raie rosette**
Leucoraja erinacea **little skate, rie hérisson**



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List of zoological museums contributing data:

- *American Museum of Natural History, New York, NY, USA*
- *Atlantic Reference Centre, Huntsman Marine Science Centre, St. Andrews, NB*
- *Canadian Museum of Nature - Musée canadien de la nature, Ottawa, ON*
- *Florida Museum of Natural History, University of Florida, Gainesville, FL, USA*
- *Institut für Seefischerei, Hamburg, Germany*
- *Institut de Ciécies del Mar (Instituto de Investigaciones Pesqueras), Barcelona, Spain*
- *Institut Maurice Lemontagne, DFO, Mont Joli, QE*
- *Museum National d'Histoire Naturelle, Paris, France*
- *Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA*
- *Royal Museum of Natural History, Göteborg, Sweden*
- *Royal Ontario Museum, Toronto, ON*
- *Texas A&M University Ichthyological Collection, College Station, TX, USA*
- *The Museum of Nature, London, UK*
- *University of British Columbia, Fish Museum, Vancouver, BC*
- *University of Kansas, Natural History Museum, Lawrence, KS, USA*
- *University of Michigan Zoological Collection, Ann Arbor, MI, USA*
- *Virginia Institute of Marine Science, Fish Museum, Gloucester Point, VA, USA*
- *National Museum of Natural History, Smithsonian Institution, Washington, DC, USA*
- *Zoological Museum, University of Copenhagen, Denmark*

Additional sources of skate records from research cruises, surveys, and publications:

- *FishBase (Online Fish Data Resource)*
- *Canadian Department of Fisheries and Oceans, St. Johns, Newfoundland*
- *U.S. National Marine Fisheries Service, NE Fisheries Center, Woods Hole, MS, USA*
- *Virginia Institute of Marine Science, Gloucester Point, VA, USA. Deep-Sea Database*
- *LITERATURE SOURCES: Bigelow & Schroeder (1953b), Drainville (1970), Scott & Scott (1988), Templeman (1965), Templeman (1973).*

Institutions granting permissions to use previously published skate images:

- *Yale Peabody Museum of Natural History, Yale University, New Haven, CT, USA (re. B. bigelowi, M. spinacidermis, L. garmani, R. eglanteria, L. ocellata).*
- *Canadian Museum of Nature, Ottawa (re: B. richardsoni, and back cover base image).*

Bathymetric mapping data sources:

- *Divins, D.L., and D. Metzger, NGDC Coastal Relief Model, Retrieved September 2006, http://www.ngdc.noaa.gov/mgg/coastal/coastal.html*
- *Sloss, P.W., and D. Metzger, NGDC ETOPO2v2, Retrieved September 2006, http://www.ngdc.noaa.gov/mgg/fliers/01mgg04.html*

Supporting database deposition: The Excel® database (**Can-Atl-Rajidae-2007.xls**) assembled to support the species distribution maps appearing in this guide is permanently archived at the Atlantic Reference Centre, Huntsman Marine Science Centre, St. Andrews, NB (G. Pohle, Curator of Invertebrates; Lou Van Guelpen, Curator of Fishes and Collection Manager), Email: ARC@mar.dfo.mpo.gc.ca.

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