Petition to List the Northwest Atlantic Distinct Population Segment (DPS) of the Thorny Skate (*Amblyraja radiata*) as Endangered or Threatened or, alternatively, to List the United States DPS of the Thorny Skate as Endangered or Threatened under the U.S. Endangered Species Act

Photograph by Bernd Ueberschaer

Submitted to the United States Secretary of Commerce, Administrator of the National Oceanic and Atmospheric Administration, and the National Marine Fisheries Service

Petitioners:

Animal Welfare Institute
900 Pennsylvania Ave. SE
Washington, DC 20003

Defenders of Wildlife
130 17th St NW
Washington, DC 20036

May 28, 2015

Animal Welfare Institute
www.awionline.org

DEFENDERS OF WILDLIFE

Executive Summary

The Animal Welfare Institute and Defenders of Wildlife (Petitioners) hereby petition the Secretary of Commerce, the Administrator of the National Oceanic and Atmospheric Administration, and the Assistant Administrator for Fisheries of the National Oceanic and Atmospheric Administration, to list the Northwest Atlantic population of thorny skate (*Amblyraja radiata*) as an endangered or threatened Distinct Population Segment (DPS), pursuant to the Endangered Species Act (ESA) (16 U.S.C. § 1531–44). In the alternative, Petitioners request NMFS to list a U.S. DPS of the thorny skate as a threatened or endangered species. In addition, Petitioners seek the designation of critical habitat concurrently with any listing of the thorny skate, as authorized by statute.

The thorny skate is a "K-selected" species, meaning it is relatively long-lived, reaches sexual maturity later in life, and has a low fecundity rate. These life history characteristics limit the species' ability to recover in response to abrupt population declines, and render it particularly vulnerable to overexploitation.

Thorny skate populations throughout the Northwest Atlantic have declined precipitously over the past four decades. In Canada, where the species is still fished in a directed fishery, thorny skates have suffered a dramatic population decline since the 1980s that is conspicuously parallel to the species' decline in the U.S. on the Scotian Shelf, located Southwest of Nova Scotia, Canada, summer survey biomass has decreased by 80% since 1970 (IUCN 2009). Though currently the species is ostensibly maintaining historically low, relatively stable population numbers in Canadian waters, there is evidence of hyper-aggregation within the species' center of biomass in the Northwest Atlantic, with 80% of the biomass now concentrated in 20% of the area along the southwest slope of the Grand Banks (76 Fed. Reg. 7889 (Dec. 20, 2011)).[1] The International Union for the Conservation of Nature (IUCN), in 2009, assessed the thorny skate population in Canada as "vulnerable." However, the North Atlantic Fisheries Organization's (NAFO) Scientific Council advised that Canada's 2013 Total Allowable Catch (TAC) limit for all skates be set at 7,000 tons (2013 and 2014), despite the fact that this amount significantly surpasses the average annual commercial catch from 2009-2011, where minimal to no rebuilding of the thorny skate stock has occurred. Notably, there are no indications that Canada's stock has experienced any recovery since NAFO brought it under management (NAFO Scientific Council Sept. 2012). This means that the species will likely continue to hyper-aggregate, minimizing its chances of long term survival, and that it will continue to exist at only 20% of its historical biomass on the Scotian Shelf.

Additionally, it is worth noting that IUCN's classification of "vulnerable" equates to a "threatened" designation under the ESA.[2] Included in the IUCN's "vulnerable" category are species "believed likely to move into the 'Endangered' category in the near future . . ." and

[1] Kulka *et al.* (2006). Note that for other marine fish species (e.g., the northern cod), hyper-aggregation has been demonstrated to be a precursor to collapse (citing Rose and Kulka 1999).
[2] *See* Threatened Fish and Wildlife; Guadalupe Fur Seal, 50 Fed. Reg. 51252, 51254 (Dec. 16, 1985). In this listing decision the Guadalupe fur seal, which was listed by the IUCN as vulnerable, was determined by NMFS to be threatened.

species whose populations "have been seriously depleted and whose ultimate security has not yet been assured."

While persisting at historically low levels in Canada, and with little hope that the population will recover, the thorny skate is even more imperiled in the U.S. where biomass indices have steadily declined since the mid-1970s resulting in population numbers currently at all-time lows. Despite the species' designation as "prohibited"[3] since 2003 under the New England Fishery Management Council's (NEFMC) Skate Fishery Management Plan (FMP), unsustainable bycatch mortality and illegal landings continue to drive down population numbers and threaten the species' survival in U.S. waters. Accordingly, the species is currently listed as a "Species of Concern" by NMFS and was assessed as "Critically Endangered" in U.S. waters by the IUCN (IUCN 2009). In 2014, NMFS determined that the thorny skate is subject to overfishing and continues to be overfished based on a survey biomass index (79 Fed. Reg. 28,686 (May 19, 2014).

Regulatory mechanisms in Canada and the U.S. have proven insufficient to promote significant stock rebuilding and to improve the species' precarious status throughout the Northwest Atlantic. Specifically, NMFS' regulatory scheme has failed to rebuild the thorny skate's seriously depleted population in U.S. waters despite the agency's recognition that thorny skate is a species of concern. Therefore, NMFS should list the Northwest Atlantic population as an endangered or threatened DPS or, alternatively, designate a U.S. DPS and list it as an endangered or threatened species, pursuant to the ESA. In connection with the listing of either potential DPS, NMFS should also designate critical habitat.

Notice of Petition

Penny Pritzker
Secretary of Commerce
U.S. Department of Commerce
1401 Constitution Ave., NW
Washington, DC 20230

Dr. Kathryn Sullivan
Acting undersecretary of Commerce for Oceans and Atmosphere
Office of Administrator
National Oceanographic and Atmospheric Administration
1401 Constitution Ave. NW
Washington, D.C. 20230

Eileen Sobeck
Assistant Administrator for Fisheries
National Oceanographic and Atmospheric Administration
1315 East West Highway
Silver Spring, MD 20910

[3] Possession in closed areas could be prohibited when the closure is in effect, and/or a bag limit could be imposed on vessels.

Table of Contents

I. Petitioners:

The Animal Welfare Institute (AWI) is a national, non-profit charitable organization, with more than 30,000 constituents, dedicated to alleviating the suffering inflicted on animals by humans. AWI is committed to safeguarding marine species and their habitats. The organization's efforts focus on curbing humankind's harmful impact by urging governments and other policy makers to halt or prevent damaging actions, as well as educating the public and others about the deleterious effects their actions can wreak on the oceans' inhabitants. AWI engages policymakers, scientists, industry professionals, non-governmental organizations, farmers, veterinarians, teachers, and the public in its broad animal protection mission. AWI works to minimize the impacts of all human actions detrimental to endangered species, engages Congress to strengthen the ESA, and representatives of AWI regularly attend meetings of the Convention on International Trade in Endangered Species of Wild Fauna and Flora to advocate for the international protection of threatened and endangered species. More information about AWI is available at www.awionline.org. If any correspondence related to this petition is to be sent by electronic mail, please direct it to D.J. Schubert at dj@awionline.org.

Defenders of Wildlife (Defenders) is a national, non-profit, conservation organization dedicated to the protection of all native animals and plants in their natural communities. With more than 1.2 million members, supporters, and activists, Defenders is a leading advocate for the protection of threatened and endangered species. Defenders' 2013-2023 Strategic Plan identifies elasmobranchs, including rays and skates, as one of several key species families whose conservation is a priority for the organization's work. More information on Defenders is available at www.defenders.org. Defenders' 2013-2023 Strategic Plan is available at https://www.defenders.org/publications/defenders-strategic-plan-2013-2023.pdf. If any correspondence related to this petition is to be sent by electronic mail, please direct it to Jane Davenport at jdavenport@defenders.org or Jay Tutchton at jtutchton@defenders.org.

II. Specific Requested Actions

Petitioners hereby formally petition the Secretary of Commerce, the Administrator of the National Oceanic and Atmospheric Administration, and the National Marine Fisheries Service pursuant to 16 U.S.C. § 1533(b)(3), 5 U.S.C. §553(e), and 50 C.F.R. § 424.14(a), to list the Northwest Atlantic population of the thorny skate (*Amblyraja radiata*) as an endangered or threatened Distinct Population Segment (DPS) under the ESA.

Alternatively, if NMFS determines that the Northwest Atlantic population of the thorny skate does not qualify for listing, Petitioners requests that NMFS designate a DPS in U.S. waters and list it as threatened or endangered.

If NMFS finds the species to be threatened, in either the Northwest Atlantic or U.S., Petitioners request NMFS act under the power granted to it through Section 4(d) of the ESA, 16 U.S.C § 1533(d), and adopt and enforce strict prohibitions on all take of thorny skates in the Northwest Atlantic or U.S, respectively.[4]

In addition, in connection with any listing action, Petitioners seek the designation of critical habitat for the thorny skate in U.S. waters, as authorized by statute (16 U.S.C. § 1533(a)(3)(A); 50 CFR § 424.12(h)).

III. NMFS Must Issue an Initial Finding within 90 Days that the Petitioned Action May Be Warranted

Upon receipt of this petition, the ESA requires NMFS to initiate a specific response process. First, within 90 days, NMFS must "make a finding as to whether the petition presents substantial scientific or commercial information indicating that the petitioned action *may* be warranted" (16 U.S.C. § 1533(b)(3)(A) [emphasis added]). To obtain a positive 90-day finding, Petitioners need not demonstrate that the proposed listing action is warranted; rather, Petitioners must only present substantial information demonstrating that such action *may be* warranted (16. U.S.C. § 1533(b)(3)(A)). Substantial information is defined as "the amount of information that would lead a reasonable person to believe the measure proposed in the petition may be warranted." 40 C.F.R. § 424.14(b)(1). It is only after a positive 90-day finding is issued that NMFS must complete a "status review" to determine if the listing is warranted or not warranted. 50 C.F.R. § 424.14(b)(1).

In making a finding as to whether a petition presents "substantial information" warranting a positive 90-day finding, the wildlife agency considers whether the petition:

i. Clearly indicates the administrative measure recommended and gives the scientific and any common name of the species involved;

[4] 16 U.S.C. §1533 4(d) authorizes NOAA fisheries to enact a special rule that modifies the protections of species listed as threatened with special measures that are "necessary and advisable to provide for the conservation of the species."

ii. Contains detailed narrative justification for the recommended measure; describing, based on available information, past and present numbers and distribution of the species involved and any threats faced by the species;

iii. Provides information regarding the status of the species over all or significant portion of its range; and

iv. Is accompanied by appropriate supporting documentation in the form of bibliographic references, reprints of pertinent publications, copies of reports or letters from authorities, and maps.

50 C.F.R. §§ 424.14(b)(2)(i)–(iv). NMFS's own guidance on "substantial information" states that the information presented should merely be "adequate and reliable,"[5] not conclusive.

Both the language of the regulation itself (by setting the "reasonable person" standard for substantial information) and the relevant case law underscore the point that the ESA does *not* require "conclusive evidence of a high probability of species extinction" in order to support a positive 90-day finding. *Ctr. for Biological Diversity v. Morgenweck*, 351 F. Supp. 2d 1137, 1140 (D. Colo. 2004). In reviewing negative 90-day standards, the courts have consistently held that the evidentiary threshold under a 90-day review is much lower than the one required under a 12-month review. *See*, *e.g., Ctr. for Biological Diversity v. Kempthorne*, No. CV 07-0038-PHX-MHM, 2008 WL 659822, at *8 (D. Ariz. Mar. 6, 2008) ("[T]he 90–day review of a listing petition is a cursory review to determine whether a petition contains information that warrants a more in-depth review."). *See also Moden v. U.S. Fish & Wildlife Serv.*, 281 F. Supp. 2d 1193, 1203 (D. Or. 2003) (holding that the substantial information standard is defined in "non-stringent terms" and that "the standard in reviewing a petition...does not require conclusive evidence.").

Rather, the courts have held that the ESA contemplates a "lesser standard by which a petitioner must simply show that the substantial information in the Petition demonstrates that listing of the species *may* be warranted" (emphasis added). *Morgenweck*, 351 F. Supp. 2d at 1141 (quoting 16 U.S.C. § 1533(b)(3)(A)). *See also Ctr. for Biological Diversity v. Kempthorne*, No. C 06-04186 WHA, 2007 WL 163244, at *3 (N.D. Cal. Jan. 19, 2007)(holding that in issuing negative 90-day findings for two species of salamander, FWS "once again" erroneously applied "a more stringent standard" than that of the reasonable person). Thus, a petition does not need to establish that there is a high likelihood that the species is either threatened or endangered at the 90-day finding stage. Although a reviewing court is highly deferential to the Service's listing determinations:[6]

> The 'may be warranted' standard, however, seems to require that in cases of such contradictory evidence, the Service must defer to information that supports petition's position. It would be wrong to discount the information submitted in a petition solely because other data might contradict it. At this stage, unless the

[5] U.S. FISH AND WILDLIFE SERVICE & THE NATIONAL MARINE FISHERIES SERVICE, PETITION MANAGEMENT GUIDANCE 13 (1996), *available at* http://www.nmfs.noaa.gov/op/pds/documents/02/110/02-110-06.pdf.
[6] *Colo. River Cutthroat Trout v. Kempthorne*, 448 F. Supp. 2d 170,175 (D.D.C. 2006) ("Although the Court may not substitute its judgment for that of the agency, the Court's review must nevertheless be 'searching and careful.'") (Citing *Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 378 (1989)).

> Service has demonstrated the *unreliability* of information that supports the petition, that information cannot be dismissed out of hand.

Kempthorne, 2007 WL 163244 at *4.

In 2011, AWI submitted a petition to list the Northwest Atlantic DPS of the thorny skate as an endangered or threatened species or, alternatively, to list the U.S. DPS of the thorny skate as an endangered species. WildEarth Guardians (Guardians) submitted a similar petition at approximately the same time. Due to the close proximity in time in which the two petitions were submitted, NMFS reviewed them both in one 90-day finding. NMFS ultimately published a negative 90-day finding stating the petition did not present, "substantial scientific and commercial information" that the petitioned actions may be warranted (76 Fed. Reg. 78,891 (Dec. 20, 2011)). However, in direct opposition to this conclusion, its *draft* positive 90-day finding (obtained through the Freedom of Information Act or FOIA) stated, "we find that the petitions and information readily available in our files do present substantial scientific or commercial information does exist indicating that the petitioned actions concerning thorny skates may be warranted" (FOIA Responsive Document, [Draft Positive 90-day Finding for AWI's 2011 Petition to List the Northwest Atlantic DPS of the Thorny Skate as Endangered or Threatened]).

Best Available Scientific and Commercial Data Standard

ESA listing decisions, such as 90-day findings, must be based on the "best scientific and commercial data available." 16 U.S.C. § 1533(b)(1)(A). Similar to the "substantial information" standard under the 90-day review, case law has established that the scientific evidence need not be conclusive.[7] If the evidence presented is the most recent, available biological information on a species, NMFS cannot simply disregard it because it is inconclusive. This is particularly important under a 90-day review since as noted above, the wildlife agency must make a positive finding and commence a status review when a reasonable person would conclude based on the available evidence that listing may be warranted.

The fact that a positive 90-day finding was drafted prior to the agency's previous negative 90-day finding indicates there was some degree of uncertainty within NMFS regarding the strength of the scientific or commercial information available on the status of the thorny skate. Similarly, in regards to a 2010 petition to list the porbeagle shark under the ESA, NMFS stated that "conflicting evidence" existed regarding a DPS for the species and that a "more thorough

---

[7] *See City of Las Vegas v. Lujan*, 891 F.2d 927, 933 (D.C. Cir. 1989) ("[Section 4] merely prohibits the Secretary from disregarding available scientific evidence that is in some way better than the evidence he relies on. Even if the available scientific and commercial data were inconclusive, he may – indeed must – still rely on it at this stage…"); *Trout Unlimited v. Lohn*, 645 F. Supp. 2d 929, 950 (D. Or. 2007) ("[T]he agency 'cannot ignore available biological information'") (citing *Kern Co. Farm Bureau v. Allen*, 450 F.3d 1072, 1080–81 (9th Cir. 2006)); *In re Polar Bear Endangered Species Act Listing and 4(d) Rule Litigation*, 794 F. Supp. 2d 65, 106 (D.D.C. 2011) ("As this Court has observed, 'some degree of speculation and uncertainty is inherent in agency decision-making' and 'though the ESA should not be implemented 'haphazardly'…an agency need not stop in its tracks when it lacks sufficient information.'") (Citing *Oceana v. Evans*, 384 F. Supp. 2d 203, 219 (D.D.C. 2005)).

analysis" was needed. Despite this determination, the agency found there was no "substantial information" to warrant a positive 90-day finding on a petition to list a Northwest Atlantic DPS of the porbeagle shark (*Humane Society of the U.S. v. Pritzker*, No. 11-01414 (BJR), 2014 WL 6946022 (D.D.C. Nov. 14, 2014).[8] However, in a challenge to this determination, the district court held that "NMFS' own conclusion regarding the need for more thorough analysis suggests that a reasonable person might conclude that 'a review of the status of the species concerned' was warranted" *Id.* at *5. Comparably, the internal agency conflict within NMFS regarding its response to AWI's 2011 petition, could lead a reasonable person to believe that the petitioned action may be warranted. Furthermore, NMFS, in the negative 90-day finding, determined that it is possible that the water temperatures in the Gulf of Maine and the declining thorny skate biomass could be linked but more research (a more thorough analysis) is needed providing additional support for a positive 90-day finding and the initiation of a status review.

The IUCN Red List

The IUCN was founded in 1984 and is the largest professional global conservation network. The IUCN is a highly respected scientific authority. The organization is perceived as a neutral forum gathering and distributing scientific information on the conservation status of species. Its 11,000 experts establish and use definitive standards to evaluate the extinction risk faced by particular species and maintain this information in an on-line database known as the IUCN Red List of Threatened Species ("Red List"). The Red List is well respected and is considered an authoritative source on species' conservation status.[9] The United States supports the work of the IUCN and scientific agencies of the United States, including FWS and NMFS, use the Red List as a reference and a source of best available scientific and commercial information when evaluating the extinction risk faced by species.

The Red List provides taxonomic, conservation status and distribution information on plants and animals throughout the world. It is "widely recognized as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species."[10] It categorizes species into nine different categories. Based on the best available evidence, a species can be (1) Extinct; (2) Extinct in the Wild; (3) Critically Endangered; (4) Endangered; (5)

[8] The full version of this is attached and can be viewed in the appendix to this petition.
[9] *See generally* Ana S.L. Rodrigues, *et al.*, *The Value of the IUCN Red List for Conservation*, *in* 21 TRENDS IN ECOLOGY AND EVOLUTION 71 (2006), *available at* http://intranet.iucn.org/webfiles/doc/SSC/Gen_docs/e_bulletin_/May_2008/Rodrigues_etal_2006.pdf; *See also*, S.H.M. Butchart, *et al.*, *Using Red List Indices to Measure Progress Towards the 2010 Target and Beyond, in* 360 PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY 255, 256 (2005) ("The IUCN Red List is now widely recognized as the most objective and authoritative system for classifying species in terms of their risk of extinction."), *available at* http://rstb.royalsocietypublishing.org/content/360/1454/255.full.pdf+html; Joshua Ginsburg, *The Application of IUCN Red List Criteria at Regional Levels, in* 15 CONSERVATION BIOLOGY 1206, 1206 (2001) ("Red Lists and Red Data Books of the World Conservation Union (IUCN) are among the most widely used tools available to conservationists world-wide for focusing attention on species of conservation concern."), *available at* http://onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.2001.00112.x/pdf.
[10] *About*, IUCN RED LIST, http://www.iucnredlist.org/about (last visited April 15, 2015).

Vulnerable; (6) Near Threatened; (7) Least Concern; (8) Data Deficient; and (9) Not Evaluated.[11] The Red List places species into categories denoting their extinction risk based on certain criteria. The general aim of the system is to provide an explicit, objective framework for the classification of species according to their extinction risk. The IUCN Red List categories are widely recognized internationally, are relied on in a variety of scientific publications, and are used by numerous governmental and non-governmental organizations.

The scientific data utilized to support the Red List determinations "are regularly published in scientific literature," and should be peer reviewed.[12] Additionally, the science supporting a listing is considered the best scientific information available.[13] Any listing determinations can be petitioned, though any challenge must also be backed by scientifically published sources.[14] Finally, all species are reviewed either every ten or five years by Red List Authorities ("RLAs"). An RLA is the Species Survival Commission ("SSC," one of IUCN's six scientific commissions) Specialist Group "responsible for the species, group of species, or specific geographic area."[15] The reassessment of the species and the supporting information ensures that the "IUCN Red List is credible and scientifically accurate."[16]

In evaluating the extinction risk faced by a species, the IUCN first decides whether adequate data exists to make an assessment. For those species without sufficient data, the IUCN lists the species as Data Deficient. If there is adequate data, the IUCN places the species into one of seven categories based on application of its criteria. The seven categories are: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, and Least Concern. The IUCN considers species in the Critically Endangered, Endangered, or Vulnerable categories to be threatened with extinction.

The IUCN defines a Critically Endangered species as one where the best available evidence indicates that it meets the criteria for this category and the species is considered to be facing an extremely high risk of extinction in the wild. An Endangered species is one considered to be facing a very high risk of extinction in the wild and a Vulnerable species is considered to be facing a high risk of extinction in the wild. Accordingly, these categories are analogous to the ESA's endangered and threatened species definition.

The IUCN's criteria for listing a species as Critically Endangered are quantitative, extensive, and rigorously applied. The IUCN's species assessment criteria, like those found in the ESA, require the use of the best available scientific information, but are more objective and quantitative than the ESA's definitions of threatened and endangered species. Under the IUCN's Red List

---

[11] SPECIES SURVIVAL NETWORK, IUCN RED LIST CATEGORIES AND CRITERIA 14-15 (2001), *available at* http://jr.iucnredlist.org/documents/redlist_cats_crit_en.pdf.
[12] *Red List Overview: Introduction*, IUCN RED LIST http://www.iucnredlist.org/about/overview (last visited April 15, 2015).
[13] *Id*.
[14] *Procedure for Handling of Petitions against Current Listings on the IUCN Red List of Threatened Species*, IUCN RED LIST, http://www.iucnredlist.org/documents/petitions_process.pdf (last visited April 15, 2015).
[15] *Red List Overview: Establishment of Red List Authorities*, IUCN RED LIST, http://www.iucnredlist.org/technical-documents/assessment-process (last visited April 15, 2015).
[16] *Id*.

methodology, a species is listed as Critically Endangered if the best available evidence indicates its meets any of the following criteria (A to E):

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
   - (a) Direct observation
   - (b) An index of abundance appropriate to the taxon
   - (c) A decline in area of occupancy, extent of occurrence and/or quality of habitat
   - (d) Actual or potential levels of exploitation
   - (e) The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km2 and estimates indicating at least two of a-c:
   - a. Severely fragmented or known to exist at only a single location.
   - b. Continuing decline, observed, inferred or projected, in any of the following:
     - (i) Extent of occurrence
     - (ii) Area of occupancy
     - (iii) Area, extent and/or quality of habitat
     - (iv) Number of locations or subpopulations
     - (v) Number of mature individuals.
   - c. Extreme fluctuations in any of the following:

(i) Extent of occurrence
(ii) Area of occupancy
(iii) Number of locations or subpopulations
(iv) Number of mature individuals.

2. Area of occupancy estimated to be less than 10 km2, and estimate indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.
b. Continuing decline, observed, inferred or projected, in any of the following:
(i) Extent of occurrence
(ii) Area of occupancy
(iii) Number of locations or subpopulations
(iv) Number of mature individuals.
c. Extreme fluctuations in any of the following:
(i) Extent of occurrence
(ii) Area of occupancy
(iii) Number of locations or subpopulations
(iv) Number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

a. Population structure in the form of one of the following:
(i) No subpopulation estimated to contain more than 50 mature individuals, OR
(ii) At least 90% of mature individuals in one subpopulation.
b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years)

IUCN's Critically Endangered Listing Criteria, available at pp. 16–18 of https://portals.iucn.org/library/efiles/documents/RL-2001-001-2nd.pdf

The IUCN Red List Designation of Critically Endangered for Thorny Skates Supports a Positive 90-Day Finding

Although the IUCN Red List criteria differ from the requirements for listing a species as endangered or threatened under the ESA,[17] both NMFS and FWS have utilized IUCN data and criteria on species in listing decisions. This is because the IUCN is considered a credible source of scientific data that meets the "best available science" requirement of the ESA.[18] Reliance on IUCN data easily meets the "substantial information" standard required to initiate a status review under the ESA.[19] Given the rigorous set of listing criteria that must be evaluated and applied, the IUCN Red List is arguably a more objective and science-based listing evaluation than an ESA listing. Indeed, a 2012 study by Harris *et al.* underscores that U.S. wildlife agencies are "failing to keep pace with global listing assessments of imperiled species."[20] This study contrasts the IUCN Red List, based on "unambiguous criteria, objective categories that measure probability of extinction, and a dynamic system that quantifies uncertainty in assessments" with the vague and much more subjective ESA categories of "threatened" and "endangered."[21] With respect to marine fish species, Davies and Baum (2012) found that IUCN Red Listings were not biased towards exaggerating threat status, and that IUCN threat listings can serve as an accurate flag for relatively data-poor fisheries.[22]

NMFS has previously relied on IUCN data and species categorizations a number of times in both proposed and final listing decisions. In its decision to list the Guadalupe fur seal as threatened, NMFS specifically noted in its response to the IUCN comment supporting the seal be listed as endangered:

> The Guadalupe fur seal is listed by IUCN as "vulnerable." Included in this category are species "believed likely to move into the 'Endangered' category in the near future . . ." and species whose populations "have been seriously depleted and whose ultimate security has not yet been assured." This classification corresponds more closely with the ESA definition of "threatened" than "endangered" and therefore, it appears that the "threatened" status is consistent with the IUCN category of vulnerable.[23]

Here, NMFS noted the IUCN categorization of the species and applied the comparable ESA categorization. NMFS thus validated the IUCN Red List as a legitimate source of the best available scientific information.

---

[17] 16 U.S.C. § 1533(a)(1).
[18] *Id*. § 1533(b)(1)(A).
[19] 16 U.S.C. § 1533(b)(3)(A).
[20] Harris, J. B. C., *et al*. "Conserving imperiled species: a comparison of the IUCN Red List and the U. S. Endangered Species Act. Conservation Letters 5 (2012): 64-72.
[21] *Id*. at 70.
[22] Davies, T. D., and J. K. Baum. "Extinction Risk and Overfishing: Reconciling Conservation and Fisheries Perspectives on the Status of Marine Fishes." Scientific Reports 2.51 (2012): 1-9.
[23] Threatened Fish and Wildlife; Guadalupe Fur Seal, 50 Fed. Reg. 51,252, 51,254 (Dec. 16, 1985).

In a more recent listing decision, NMFS discussed the IUCN categorization of three species of seals. Specifically, the decision stated that "the bearded seal is currently classified as a species of 'Least Concern'' on the IUCN Red List. *These listings highlight the conservation status of listed species and can inform conservation planning and prioritization*."[24] Again, NMFS clearly gave credence to the IUCN Red List as a valid source of the best available scientific data.

NMFS has previously relied on and adapted the IUCN's criteria for estimating risk extinction. For example, in its proposed endangered listing of a distinct population of Hawaiian insular false killer whale, NMFS' biological research team "defined the level of risk based on thresholds that have been used to assess other marine mammal species, and consistent with the criteria used by the IUCN (IUCN, 2001)."[25] This reliance on the IUCN risk criteria also appeared in a joint decision by NMFS and the FWS to determine nine distinct population segments of loggerhead turtle.[26] Furthermore, almost the entire joint decision was supported by IUCN Marine Turtle Specialist reports or IUCN scientists' papers on loggerheads.[27] A number of other listing decisions by NMFS have also cited to IUCN reports and species categorizations.[28]

Relatedly, the FWS has also relied on IUCN science numerous times. There have been some recent notable examples, including the listing of polar bears as threatened, justification for delisting the gray wolf, and the proposed delisting of three captive antelope species.[29] Additionally, the FWS has a grant program called "Wildlife Without Borders." It funds projects

[24] Threatened Status for the Arctic, Okhotsk, and Baltic Subspecies of the Ringed Seal and Endangered Status for the Ladoga Subspecies of the Ringed Seal, 77 Fed. Reg. 76,740, 76,748 (Dec. 28, 2012) (emphasis added).
[25] Proposed Endangered Status for the Hawaiian Insular False Killer Whale Distinct Population Segment, 75 Fed. Reg. 70,169, 70,170 (Nov. 17, 2010).
[26] Determination of Nine Distinct Population Segments of Loggerhead Sea Turtles as Endangered or Threatened, 76 Fed. Reg. 58,868, 58,899 (Sept. 22, 2011).
[27] *See id*.; *see also* 12-Month Finding and Proposed Endangered Listing of Five Species of Sawfish under the Endangered Species Act, 78 Fed. Reg. 33,300 (June 4, 2013) (Relying on IUCN data throughout proposed listing).
[28] *See* 90-Day Finding on a Petition To List the Dwarf Seahorse as Threatened or Endangered, 77 Fed. Reg. 26,478, 26,481 (May 4, 2012); 90-Day Finding on a Petition To List Nassau Grouper as Threatened or Endangered, 77 Fed. Reg. 61,556, 61,561 (Oct. 10, 2012); *See also* Proposed Listing Determinations for 82 Reef-Building Coral Species, 77 Fed. Reg. 73,220, 73,253 (Dec. 7, 2012), *available at* https://www.federalregister.gov/articles/2012/12/07/2012-29350/endangered-and-threatened-wildlife-and-plants-proposed-listing-determinations-for-82-reef-building ("All the proposed corals are listed in the IUCN Red List of Threatened Species as vulnerable, endangered, or critically endangered. Thus, the proposed listing is consistent with these classifications."); Listing Determinations for Six Distinct Population Segments of Scalloped Hammerhead Sharks, 78 Fed. Reg. 20,718, 20,721 (Apr. 5, 2013) ("[T]he IUCN classification for the scalloped hammerhead shark alone does not provide the rationale for a listing recommendation under the ESA, but the sources of information that the classification is based upon are evaluated in light of the standards on extinction risk and impacts or threats to the species."); 12-Month Finding on Petitions To List the Northeastern Pacific Ocean Distinct Population Segment of White Shark as Threatened or Endangered, 78 Fed. Reg. 40,104, 40,123 (July 3, 2013), *available at* https://www.federalregister.gov/articles/2013/07/03/2013-16039/endangered-and-threatened-wildlife-12-month-finding-on-petitions-to-list-the-northeastern-pacific ("Listing a species on the IUCN Red List does not provide any regulatory protections for the species, but serves as an evaluation of the species' status.").
[29] Determination of Threatened Status for the Polar Bear (*Ursus maritimus*) Throughout Its Range, 73 Fed. Reg. 28,212, 28,216 (May 15, 2008); Removing the Gray Wolf (*Canis lupus*) From the List of Endangered and Threatened Wildlife, 78 Fed. Reg. 35,664, 35,678 (Jun. 13, 2013); 12-Month Findings on Petitions to Delist U.S. Captive Populations of the Scimitar-horned Oryx, Dama Gazelle, and Addax, 78 Fed. Reg. 33,790, 33,791 (Jun. 5, 2013).

to conserve species with a very high risk of extinction that are located outside the United States, Canada, and wealthier European nations.[30] Species eligible for the grant "should meet the criteria to be listed as 'Critically Endangered' or 'Endangered' on the IUCN's Red List."[31] The FWS utilizes the IUCN's categorization of imperiled species, recognizing its legitimacy as a species-listing system. Moreover, in the past, the FWS has used IUCN categorization of species in its Candidate Notice of Review. The FWS explained:

> Those species with the highest IUCN rank (critically endangered) . . . originally comprised a group of approximately 40 candidate species (''Top 40''). These 40 candidate species have had the highest priority to receive funding to work on a proposed listing determination. As we work on proposed and final listing rules for those 40 candidates, we apply the ranking criteria to the next group of candidates with an LPN of 2 and 3 to determine the next set of highest priority candidate species.[32]

Again, this highlights the FWS's reliance on IUCN's categorization of species and the IUCN's credibility as a source of the best available scientific data.

Although NMFS and the FWS are separate agencies, they have been given the same task of determining whether a species is endangered or threatened. In 1994, the agencies promulgated a "Notice of Interagency Cooperative Policy on Information Standards under the ESA," a joint statement by the agencies agreeing to both utilize "the best scientific and commercial data available" when determining whether any species is endangered or threatened. The information can include "…status surveys, biological assessments, and other unpublished material…from State natural resource agencies and natural heritage programs, Tribal governments, other Federal agencies, consulting firms, contractors, and individuals associated with professional organizations and higher educational institutions."[33] This type of policy agreement indicates that there is uniformity in what the agencies can and should rely on. Thus if the FWS finds it acceptable to rely on IUCN categorizations and data, NMFS should as well.

Given the objective, data-driven process used by the IUCN Red List to categorize species, the IUCN categorization of a species as imperiled, including Critically Endangered, proves that reasonable people— experts in their field— have determined that the best available scientific evidence shows that the species is likely to be endangered or threatened as those terms are defined in the ESA.

---

[30] U.S. FISH AND WILDLIFE SERVICE, WILDLIFE WITHOUT BORDERS: CRITICALLY ENDANGERED ANIMALS CONSERVATION FUND 2 (2013), *available at* http://www.fws.gov/International//pdf/factsheet-wildlife-without-borders.pdf (last visited April 15, 2015)
[31] *Id*.
[32] Review of Native Species That Are Candidates for Listing as Endangered or Threatened, 76 Fed. Reg. 66,370, 66,380 (Oct. 26, 2011) (In 2012, the FWS did not mention IUCN and instead pointed to the recent settlement decisions).
[33] Notice of Interagency Cooperative Policy on Information Standards under the Endangered Species Act, NOAA FISHERIES: ENDANGERED SPECIES ACT POLICIES, GUIDANCE AND REGULATIONS, http://www.nmfs.noaa.gov/pr/pdfs/fr/fr59-24271.pdf (last updated Aug. 12, 2013).

In sum, applying the Red List criteria to the thorny skate, the IUCN determined the thorny skate was Critically Endangered. This assessment signifies the highest level of threat short of a species being extinct in the wild. In other words, according to the IUCN, the thorny skate is as close to extinction in the wild as possible.

I. Species Account

A. Biology and Status

1. Taxonomy

Amblyraja radiata is most commonly referenced as the "thorny skate" or "starry skate" (IUCN 2011), though, for the purposes of this petition, "thorny skate" will be used exclusively. The thorny skate was formerly in the genus *Raja* but was moved to the genus *Amblyraja* in 1998. The genus name is derived from the Greek "*amblys*" meaning blunt or dull and the Latin "*raja*" meaning stingray (IUCN 2011). (The full taxonomic description of the species is provided in Table 1 below.)

Table 1: Taxonomic Hierarchy[34]

Kingdom	*Animalia* – Animal
Phylum	*Chordata* – Chordate
Subphylum	*Vertebrata* – Vertebrate
Class	*Chondrichthye* – Cartilaginous Fish
Subclass	*Elasmorbranchii* – Cartilaginous Fish, Ray, Shark, Skate, and
Order	*Rajiformes* – Ray, Sawfish, Skate
Family	*Rajidae* – Ray, Skate
Genus	*Amblyraja* – Stout Skate
Species	*Amblyraja radiata* – Thorny (or Starry) Skate

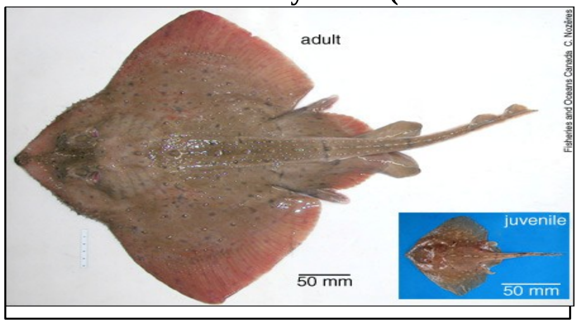
2. Physical Description[35]

Thorny skates are distinguishable from other skate species by a combination of the following characteristics: the rostrum is stout and extends distinctly anterior to the anterior-most pectoral rays; thorns with radiate bases are present in a single row along the midline of the disc and tail; and the number of mid-row thorns from the nuchal region to the origin of the first dorsal fin (i.e., the middle of the back and tail) range from 11-19. 76 Fed. Reg. 78892 (Dec. 20, 2011). The species is generally brown dorsally with a white ventral surface. 76 Fed Reg. 78892 (Dec. 20, 2011).

---

[34] *See* Integrated Taxonomic Information System (ITIS) Report, [Accessed Nov. 2014]. ITIS is a coalition of federal agencies formed to create scientifically credible taxonomic information for use by the scientific community and the general public.
[35] *See* 90-Day Finding on Petitions to List the Thorny Skate (*Amblyraja radiata*) Under the Endangered Species Act, 76 Fed. Reg. 78891 (December 20, 2011).

Figure 1: Photos of the Thorny Skate (Adult and Juvenile)



Source: Marine Species Guide for the St. Lawrence

Thorny skates may reach lengths of over 1 meter (approximately 39 inches) in total length (TL), but the maximum size varies over its range and evidence suggests that size varies by locale. 76 Fed. Reg. 78892 (Dec. 20, 2011). European thorny skates (e.g., from the North Sea) are smaller than those from Iceland and North America. Maximum sizes reported include 102 centimeters (cm) TL from Nova Scotia, 89.5 cm TL from Georges Bank, 80.0 cm TL from Massachusetts Bay, and 93.5 cm TL off the coast of New Jersey (NEFSC 2003). Thorny skate specimens captured off the Labrador coast have not been measured at lengths greater than 72 cm (Templeman 1987).

3. Geographic Range

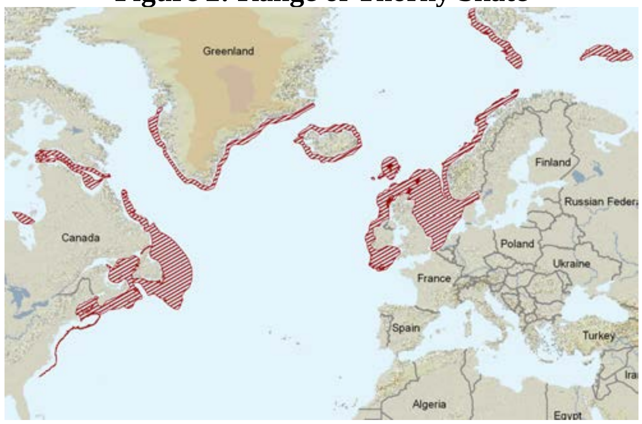
The thorny skate is one of seven skate species endemic to the waters of the Northwest Atlantic Ocean.[36]

It is a boreal and arctic species found on both sides of the Atlantic Ocean from Greenland and Iceland to the English Channel in the eastern North Atlantic ((76 Fed. Reg. 78892 (Dec. 20, 2011)) and from the Hudson Bay, Canada, to South Carolina in the western North Atlantic (Robins and Ray 1986; Collette and Klein 2002). Thirty to forty percent of the species global range is in Canadian waters (COSEWIC). The center of the thorny skate's abundance in the Northwest Atlantic extends northward from the Gulf of Maine as far north as the Gulf of St. Lawrence. The thorny skate is the most densely populated on the southern range of the Grand Banks and the eastern section of the Scotian Shelf (McEachran and Musick 1975; Kulka and Miri 2003). Northeast Fisheries Science Center (NEFSC) bottom trawl surveys indicate that in U.S. waters thorny skates are most abundant in the Gulf of Maine and on Georges Bank, with very few thorny skates caught inshore (<27 meters depth), around Southern New England, or in the Mid-Atlantic regions (NEFMC 2009).

---

[36] In U.S. waters, the thorny skate is managed in a complex of seven native skate species with which it shares this portion of its range: the winter skate (*Leucoraja ocellata*), little skate (*Leucoraja erinacea*), barndoor skate (*Dipturus laevis*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate(*Leucoraja garmani*) (NOAA 2009).

Figure 2: Range of Thorny Skate



Source: IUCN Red List of Threatened Species, Thorny Skate (*Amblyraja radiata*) [37]

The greatest density of thorny skates in Canadian waters is in the Grand Banks region off Newfoundland, where it is managed as a single stock. The continuous distribution, lack of physical barriers on the Grand Banks, and a synchronous migration indicate that the stock found predominately in the Grand Banks region represents a single reproductive population (Kulka *et al.* 2006). Since the mid-1980s, however, the thorny skate's range on the Grand Banks has been contracting (Kulka and Miri 2003).

Several reports indicate that thorny skates can make short-distance seasonal migrations but that they generally remain sedentary. Limited seasonal migrations have been noted on the Scotian Shelf, which lies between the Grand Banks in Canada and U. S. waters (Simon and Frank 1996). Recent distribution studies show that thorny skates on the Grand Banks undergo a seasonal migration, shifting to deeper waters during the spring. It appears this aggregation in deeper waters is correlated to warmer ocean temperatures. 76 Fed. Reg. 78893 (Dec. 20, 2011). Notwithstanding these limited migrations, the species is generally considered non-migratory. A 20-year study in the Newfoundland area notes that most of the tagged skates were recaptured less than 97 km from their tagging location, indicating a relatively sedentary population. 76 Fed/ Reg. 78893 (Dec. 20, 2011).

4. Life History and Reproduction

The thorny skate, like other elasmobranchs, is a "K-selected species," and as such is relatively long-lived, reaches sexual maturity at a late age, and has low fecundity (Sulikowski *et al.* 2005a). Researchers aged thorny skates in the Gulf of Maine and found the oldest estimated age to be 16 years for both females and males (corresponding TLs were 105 cm for female and 103 cm for male). 76 Fed. Reg. 78893 (Dec. 20, 2011); Sulikowski *et al.* 2005a). The maximum lifespan of the thorny skate in the wild is unknown. In a separate study, Sulikowski *et al.* (2006) estimates that female thorny skates reach sexual maturity at approximately 11 years (corresponding length

[37] *See* http://www.iucnredlist.org/apps/redlist/details/161542/0 [Accessed Nov. 2014].

– 875 mm TL (87.5 cm)) and males at approximately 10.90 years (corresponding length – 865 mm TL (86.5 cm)). 76 Fed. Reg.78893 (Dec. 20, 2011).

Thorny skates are oviparous (i.e., egg layers) ((76 Fed. Reg. 78892 (Dec. 20, 2011)) and reproduce throughout the year in the Gulf of Maine and in autumn months on the Grand Banks (Sulikowski *et al.* 2005b; Del Rio 2001, 2002). While few studies have examined the fecundity and reproductive success for this species, the NEFMC extrapolated data from a 2008 study by Parent *et al.* using captive skates and estimated the thorny skate's mean annual fecundity at 40.5 eggs per year, with a hatching success of 37.5% (i.e., roughly 15 hatchlings per year). Separate studies by Templeman (1987) and Walker (1998) estimate litter sizes of 10 to 45 eggs. Berestovskii (1994) estimates the thorny skate's embryonic development period to take 2.5 to 3 years, while separate laboratory studies estimate the development period of the embryos, in temperatures of 32°F to 49°F (-0.3°C to 9.5°C), at 2 to 2.5 years (FMNH 2011). Size at birth ranges from 8 to 12 cm TL (Berestovskii 1994; Kulka and Miri 2003; Walker 1998). Based on extrapolated data from a 2008 Parent et al. study involving captive skates, the NEFMC estimated the mean fecundity of the thorny skate at 40.5 eggs per year, with a hatching success of 38% (approximately 15 surviving hatchlings annually) (COSEWIC 2012).

5. Habitat

Thorny skates are found over a wide variety of ocean floor substrates from sand, gravel, and pebbles to broken shell and soft mud. ((76 Fed. Reg. 78893 (Dec. 20, 2011); NEFSC 2003)). In the northern Atlantic, they inhabit cooler waters with temperature ranges from -1.3°C to 14°C, while on the Grand Banks they are concentrated in bottom temperatures between 2.5°C and 5°C (McEachran 2002). Thorny skates can be found at a depth range of 18 to 1,200 meters ((76 Fed. Reg. 78893 (Dec. 20, 2011)), but surveys from Nova Scotia to Cape Hatteras found that they generally occur at depths between 27 and 439 meters and are most abundant between 111 and 336 meters (NEFSC 2003). The species has been found in Gulf of Maine waters at depths greater than 26 meters and as deep as 669 meters along the upper part of the continental slope off southern New England (NEFSC 2003).

6. Prey and Predation

Thorny skates are both benthivorous and piscivorous, feeding opportunistically on the most abundant and available benthic invertebrates and forage fish throughout their range (NEFSC 2003). However, the thorny skate's diet is size-dependent. Larger thorny skates over 60 cm TL feed primarily on squid and fish such as herring, redfish, sculpins, wolfish, mackerel, sand lance, and flatfish, while smaller skates 20 to 60 cm TL feed mostly on polychaetes, euphausids, and decapods (Collette and Klein-MacPhee 2002).

Possible competition for prey resources exists between thorny and smooth skates. Although smooth and thorny skates are sympatric species (i.e., overlapping in distribution), the possible competition for prey items likely poses a limited threat to the thorny skate because it has a more diverse diet than the smooth skate (NEFSC 2003).

Predators of juvenile and adult thorny skates include seals, sharks, and halibut. Predators of thorny skate eggs include halibut, goosefish, and Greenland sharks. Predatory gastropods can eat thorny skate embryos within egg capsules (NEFSC 2003).

7. Population Trends

The 2008 Skate Stock Assessment and Fishery Evaluation (SAFE) Report prepared by the NEFMC documents a precipitous decline in the thorny skate's abundance and biomass in U.S. waters since the late 1970s. Notably, since thorny skate fishing had been ongoing for decades by the 1970s, the reported abundance and biomass had likely already declined from their pre-exploitation levels. In 1987, the biomass index for thorny skates initially fell below the established biomass threshold value (2.2 kg/tow) and biomass indices for the species have demonstrated a persistent decline since that year. When the skate Fishery Management Plan (FMP) was implemented in 2003 the thorny skate was listed as "overfished" because the biomass index that year (.74kg/tow) was below the established biomass threshold (2.2 kg/tow) and well below the biomass target (4.41 kg/tow) (NEFSC 2007).[38] The current biomass threshold and biomass target were lowered to 2.06 and 4.13, respectively (NEFSC 2013).

In addition to the thorny skate's "overfished" status, NMFS also ascribes a status designation that "overfishing is occurring" when there is a decrease of more than 20% between two consecutive moving averages from the biomass index (NEFMC 2009). In 2009, NMFS determined that "overfishing is occurring" on thorny skates because the 2005-2007 (.42kg/tow) three-year moving average was 24% lower than the 2004-2006 (.55kg/tow) three-year average (NEFMC 2009). The most recent three-year average mean biomass index from 2011-2013 (0.12kg/tow), is only 3% of the species' biomass target indicating that the population of thorny skates in U.S. waters is currently at its nadir (NEFMC 2014). Moreover, it indicates the species is now, once again, subject to overfishing because the 2011-2013 index results represent a 33% decrease from the 2010-2012 three-year moving average (0.18kg/tow), which is greater than the 20% decline required to establish overfishing (NEFSC 2013; NEFMC 2014). Indeed, as reflected in Table 2, thorny skate index data and three years moving averages have largely declined at least since 2003. Furthermore, as noted previously and as reflective of the severity of the declining population trend is the IUCN's classification of the United States' population as "Critically Endangered." The IUCN classifies the Canadian thorny skate population as "vulnerable" (IUCN).[39]

---

[38] The biomass *target* is estimated as the 75th percentile of the appropriate survey series for that species (i.e., 4.13kg/tow for thorny skates), and the stocks are declared to be "overfished" (i.e., below biomass threshold) when the three-year moving average of the NMFS trawl survey index (mean weight per ton) is less than one half of the 75th percentile of mean weight per tow of the reference survey series for that species (i.e., less than 2.06 kg/tow for thorny skates) (NEFMC 2006, NEFSC 2013).

[39] IUCN Red List of Threatened Species, *Amblyraja radiata*, available at http://www.iucnredlist.org/details/161542/0 (last accessed February 22, 2015).

Table 2: Thorny skate survey/index data, three year moving averages, and percent change since 2003:

Year	Index/survey (kg/tow)	3-year average	Percent change	Percent change years
2003	0.74	0.42 (2006-2008	-2.4	2009-2011 compared to 2008-2010
2004	0.72	0.26 (2007-2009)	-24.1	2010-2012 compared to 2009-2011
2005	0.20	0.24 (2008-2010)	- 33	2011-2013 compared to 2010-2012
2006	0.74	0.24 (2009-2011)		
2007	0.32	0.18 (2010-2012)		
2008	0.20	0.12 (2011-2013)		
2009	0.25			
2010	0.28			
2011	0.18			
2012	0.08			
2013	0.10			

Sources: NEFSC 2013 (see Table 1); NEFMC 2014; the 2013 kg/tow index was calculated from the 2011-2013 three-year moving average.

Although NMFS implemented the skate FMP in 2003 with the goal of rebuilding the thorny skate population over 25 years, the species has continued to decline over the past ten years. As required under 50 C.F.R. § 648.320(a)(3), when an overfished species experiences a decrease in biomass, "[t]he Council shall take management action to ensure that stock rebuilding will achieve target levels." Given that the thorny skate has been recognized as overfished under the Skate FMP and that its biomass has continued to decline so sharply that it is now only at 3% of its target biomass, action is mandated. In its 2014 Skate Complex Annual Monitoring Report, NEFMC's Skate Plan Development Team cautioned the Council to "consider management measures, beyond the continuing possession prohibition, that will halt the declining biomass of thorny skate and lead to rebuilding," and suggests it "prioritize research into the population dynamics of the species" (NEFMC 2014). None of these actions have been taken to date.

Parallel to these downward trends in U.S. waters, Canadian indices of thorny skates also demonstrate a precipitous decline over the past four decades. The thorny skate dominates Canadian catches of skate species, composing approximately 90% of rajids caught in survey trawls (COSEWIC 2012) with the center of concentration of thorny skates in Canadian waters, as well as the Northwest Atlantic generally, on the Grand Banks. Since the mid-1980s, the range of the thorny skate on the Grand Banks has been contracting (Kulka and Miri 2003). Canadian assessments indicate that the thorny skate population in this area remains low, despite reduced fishing mortality, and there is evidence of hyper-aggregation with 80% of the biomass now concentrated in 20% of the area along the southwest slope of the Grand Banks (Kulka *et al.* 2007). Kulka *et al.* (2006) notes that for other marine fish species (e.g., the northern cod), hyper-aggregation has been demonstrated to be a precursor to collapse (citing Rose and Kulka 1999).[40] Canada is only 30 or 40% of the NW Atlantic DPS range, thus, regardless of its status in Canada, the species is still declining in a significant portion of its range (i.e. the U.S.).

8. Factors for Decline

United States

The most pressing threat to the thorny skate in U.S. waters is commercial fishing because skates are taken primarily as bycatch during groundfish fishing operations. Since 2000, approximately 65-86% of total skate discards have been derived from otter trawl fisheries. Scallop dredge gear produces the second largest amount of skate discards followed by sink gillnet gear (NEFMC 2009 citing NEFSC 2006).

A recent study examined the discard mortality rates of four skate species after being landed and subsequently confined in an ocean pen for 72 hours (Mandelman *et al.* 2012). When only accounting for moderate and extended tow durations, which most accurately represent normal commercial fishing practices, thorny skates experienced a 22% mortality rate – second only to smooth skates. The species also experienced one of the highest injury rates at the time of capture (52%), despite moderate deck times and similar handling protocols, which, in reality, may vary substantially from vessel to vessel. Consequently, the state of many of the specimens that survived the 72 hours pen trials was compromised, leaving them susceptible to numerous sub lethal impacts after their release/discard. When the mortality rate of thorny skates was tested during seven day extended laboratory pen trials it was significantly higher (66%), meaning that only one third of the specimens survived. *Id.*

The researchers conducting this study noted thorny skates appeared "listless and lacked discernible vigor at the culmination of pen trials." *Id*. As a result, they concluded that the true mortality of the individuals in the 72-hour pen trials may be closer to those in the extended trial. Moreover, the study suggests that "caution be recommended before utilizing the low 72 hour thorny skate mortality figures at face value for management purposes" *Id*. Therefore, a retention ban is an ineffective protection mechanism because thorny skates caught as bycatch may die a high percentage of the time.[41] In addition, the immediate return of bycaught skate to the waters where they are captured would likely result in an even higher mortality rate due to their compromised condition, injuries, and existence of predators in the ocean compared to the sea pens used in the 72-hour study.

---

[40] The Northern cod (*Gadus Atlantica*) became hyper-aggregated on the Labrador Shelf shortly before its collapse. (COSEWIC 2012).

[41] Since the NEFMC's implementation of the 2003 FMP, in most circumstances has been unlawful to retain, land, or possess thorny skates.

Although reported skate discard rates have been declining since the 1990s, the decline likely corresponds to the increasing demand for skate wings likely associated with increasing restrictions on other, more profitable, groundfish species (NEFMC 2009) versus a reduction in bycatch (NEFMC 2009 citing NEFSC 2006), as well as the fact that skate populations are declining overall. The current market for skate wings is primarily an export market, with France, Korea, and Greece as leading importers. Seafood dealers prefer large-sized wings, and thorny, barndoor, and winter skates are all considered sufficiently large enough species to warrant processing. Despite a prohibition since 2003 on the possession and landing of thorny and barndoor skates in U.S. waters, NEFMC confirms that illegal thorny and barndoor skate wings still occur in landings (NEFMC 2009). Specifically, figures provided in the 2008 Stock Assessment and Fisheries Evaluation (SAFE) Report from NMFS Fisheries Statistics Office indicate that from 2006-2007 thorny skate wings composed 3%, 6.7%, and 0.2% of sampled landings for Maine, Massachusetts, and Rhode Island, respectively (NEFMC 2009).

While NMFS states that between 2007 and 2010 only 0.7% of landed wings were identified as thorny skate wings (which it believes signifies the prohibition on thorny, barndoor, and smooth skates is 98% effective), it also recognizes illegal landings were higher in past years.[42] (76 Fed. Reg. 78896-78898; Dec. 20, 2011). To assume that a decreased percentage of reported thorny skate wings signify the 2003 prohibition is effective in deterring skate landings, however, fails to examine the whole picture. Because thorny skate management under the FMP did not change from 2006, when the percentage of thorny skates found in wing samples was 9.22%, to 2010 when the three-year average of thorny skates found in wing samples was 0.61% (76 FR 78896; Dec. 20, 2011), there is no reason to think that the prohibition became significantly more effective. Instead, it is equally, if not more likely, that the decrease in landed thorny skate wings is a result of the steady decline of the species' biomass and abundance since the 1970s.

Traditionally, another issue plaguing thorny skates was the lack of species specific reporting requirements. According to the 2008 SAFE Report "[a]lthough reporting of skate landings by species has been encouraged, species identification by vessels and dealers remains problematic, and most landings continue to be unclassified or misrepresented" (NEFMC 2009). In 2007, for example, the vast majority of all landed skates were reported as "unclassified" (NMFS landing species code 3651) (NEFMC 2009). Thus, incidental thorny skate catches and landings were likely under-reported. This is yet another reason that current regulations are ineffective at conserving the species.

However, in August 2014, the newly implemented Framework Adjustment 2 to the Northeast skate FMP changed the reporting standard. It now requires all landings be reported by one of the seven specific skate species or by "little/winter skate" if an unknown mix of the two species exists. 79 Fed. Reg. 51504; Aug. 29, 2014). The owner/operator of any vessel holding a federal skate permit must maintain on board the vessel, and submit to NMFS, a federal fishing Vessel Trip Report (VTR) for all fishing trips (regardless of species retained). On these VTRs, fishermen must now identify all landed skates by specific species and must report all discarded

[42] NMFS cited the 98% from NMFS NE Region unpublished data in its negative 90-day finding on the 2011 thorny skate petition. Consequently, no public date exists to determine how this statistic was derived.

skates according to two (non-species-specific) class sizes: "large skates" (greater or equal to 58.42 centimeters (23 inches) TL) and "small skates" (less than 58.42 centimeters (23 inches) TL) (79 RF 51504; Aug. 29, 2014). Although this is an improvement, it is still clearly not enough to conserve the species.

In general, skates have little to no recreational value and are not intentionally pursued in any recreational fisheries in the U.S. (NEMFC 2009). Between 2000-2007, recreational skate landings, where skates are retained and/or killed by the angler, composed only 0.4-3.0% of the total estimated catch during this time period; the vast majority of skates caught by recreational anglers were released alive (NEFSC 2009). In 2003, threats to thorny skates from foreign and recreational landings were insignificant and, together, accounted for less than 1% of the total fishery landings (NEFSC 2003).

Canada

The main human induced threats to the thorny skate in Canada are both directed and undirected fishing mortality. Nearly all bycatch occurs on the southern Grand Banks (Div. 3 LNOPs)[43] where the directed fishery operates. In Division 3 LNO/Subdivision 3Ps (around the Grand Banks) thorny skate abundance indices from spring surveys peaked at 213, 697 in 1985 and appear to have stabilized in recent years. (NAFO Scientific Council 2014).[44] In 2009, estimated total directed fishery catches on the Grand Banks (including landings plus discards) reached 7,868 tons. The high levels of bycatch were attributed to directed fisheries for unrelated species in the area. Commercial fishery take of thorny skates has dropped from 17,000 tons per year in the 1980's to 6,000 tons per year presently. Despite the reduction in removals, fishing mortality (catch/relative biomass) has not improved and continues to hover at approximately 10 percent (COSEWIC 2012).

Despite historically low population levels of thorny skates in Division 3 LNO waters and the evidence of hyper-aggregation on the Grand Banks, until 2013 NAFO's Total Allowable Catch (TAC) for skates was always designated higher than advised by NAFO's Scientific Council. Indeed, in 2012, the TAC was over double the advised amount even though minimal to no rebuilding of this stock occurred since it was brought under management in YEAR. In 2011, NAFO failed to adopt the Council's recommendation and instead pledged to adopt the Council's 2012 advice. However, despite this commitment, the years of decreased fishing mortality, and the species' Division 3LNO stock remaining imperiled, NAFO set its 2013 and 2014 TAC limits at 7,000 tons; over 1,500 tons more than TAC from 2009-2011 (NAFO 2012).

In Canada, thorny skates are also taken as bycatch in areas from the Scotian Shelf and north to the Davis Strait, but in much smaller amounts than associated with the directed fishery on the Grand Banks (IUCN 2011). While the thorny skate population on the Scotian Shelf has historically been smaller than that on the Grand Banks, the population on the Scotian Shelf has

[43] The reference to Division 3 LNO/P refers to the fishery management areas on/adjacent to the Grand Banks.
[44] The 2011 and 2013 spring survey results for Division 3LNOPs showed modest improvement at 75,324 and 101,846 respectively (NAFO Scientific Council Meeting May 2014).

declined consistent with the population decline on the Grand Banks (IUCN 2009). The Scotian Shelf population showed an 80% decline in biomass from the mid-1970s through the mid-2000s with no obvious environmental cause (IUCN 2009).

Like the biomass index on the Grand Banks, biomass surveys conducted on the Scotian Shelf reveal that thorny skate population levels have remained relatively stable but at low levels since the late 1990s (IUCN 2009). It is likely these results are correlated with greatly reduced groundfish fishing efforts (McPhie 2007).

B. The Northwest Atlantic or, alternatively, the U.S. Thorny Skate Populations are Distinct Population Segments

1. ESA Definition of Distinct Population Segment

The ESA grants NMFS authority to list any "species" as endangered or threatened. A "species" is defined to include "any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." (16 U.S.C. §§ 1533; 1532(16)). The U.S. Fish and Wildlife Service (USFWS) and NMFS' Joint Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act (61 Fed. Reg. 4722; February 7, 1996) identifies "two criteria for making DPS determinations: (1) The population must be *discrete* in relation to the remainder of the taxon (species or subspecies) to which it belongs; and (2) the population must be *significant* to the remainder of the taxon to which it belongs" (75 Fed. Reg. 39657; July 12, 2010).

"A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions: (1) it is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation; or (2) it is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the ESA" (75 Fed. Reg. 39657; July 12, 2010). Courts have interpreted "markedly" to mean "appreciably" separate from other populations (*National Assoc. of Home Builders v. Norton*, 340 F.3d 835, 851 (9th Cir. 2003)).

If a population segment is found to be discrete under one or both of the enumerated conditions, its biological and ecological significance to the taxon to which it belongs is to be evaluated. This consideration may include, but is not limited to: (1) persistence of the discrete population segment in an ecological setting unusual or unique to the taxon; (2) evidence that the loss of the discrete population segment would result in a significant gap in the range of a taxon; (3) evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range; and (4) evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics (75 Fed. Reg. 39657; July 12, 2010). These significance factors are "nonexclusive" – if any one factor is satisfied, a discrete population is considered significant (*see Maine v. Norton*, 257 F.Supp. 2d 357, 388 (D. Me. 2003)). If a population segment is both discrete and significant, then it is a DPS and may be evaluated for endangered or threatened status including whether it is threatened or endangered throughout all or a significant portion of its range.

2. The Northwest Atlantic Population of Thorny Skates is a DPS

The Northwest Atlantic thorny skate population, encompassing Canadian and U.S. waters, undoubtedly satisfies both the "discrete" and "significant" requirements for DPS designation under the ESA. The Northwest Atlantic population is "discrete" because it is "markedly separated from other populations" due to "physical [and] behavioral factors," and is "significant" because the loss of the [DPS] would result in a significant gap in the range of the taxon" (75 Fed. Reg. 39657; July 12, 2010).

3. The Northwest Atlantic Population of Thorny Skates is Discrete

Scientific literature on thorny skates consistently demarcates the Northwest and Northeast Atlantic populations (e.g., NEFSC 2003 citing McEachran 2002). While research indicates that small groups of this species may make limited seasonal migrations, the thorny skate is generally considered a sedentary species. A twenty-year study of the Northwest Atlantic stock in the Newfoundland area by Templeman (1984) found that most thorny skates were recaptured within 97 km of their tagging location; and in Passamaquoddy Bay off the northeastern shore of Maine, the species is a year-round resident (NEFSC 2003 citing Tyler 1971). Studies of the Northeast Atlantic stock also indicate a relatively sedentary population. In the North Sea, for example, 85% of tagged thorny skates were recaptured within 93 km of their release point (Walker *et al.* 1997). The furthest distance skates were recorded to have travelled by Templeman was 386 km – significantly less than a trans-Atlantic migration (1984). Indeed, there are no scientific studies that indicate trans-Atlantic migration or significant genetic interface between the Northwest and Northeast Atlantic stocks.

In NMFS' denial of AWI's 2011 petition, the agency emphasizes that Templeman (1984) determined that a small percentage of thorny skates (13%) were found 161 km to 386 km from where they were tagged. Additionally, the agency cites a 2007 study (Chevolot *et al.*) in which mitochondrial DNA samples from thorny skates were examined across Newfoundland, Iceland, Norway and the North Sea, demonstrating that genetic diversity was "relatively homogenous." NMFS uses these facts, in conjunction with a study suggesting little genetic structure among thorny skates in the Gulf of Maine or Canada, to imply that the U.S. or Northwest DPS constitute portions of "a large scale panmictic stock, connected by large scale dispersal of individual skates" (76 Fed. Reg. 78893; Dec. 20, 2011).

However, in stark contrast to that conclusion, due to the significant variance in sexual maturity and lengths between the Grand Banks and areas to the north (particularly the Labrador Shelf), Templeman (1987) concluded that large-scale migrations did not occur. Genetic variances are likely due to varying local conditions and minimal mixing of populations (COSEWIC 2012). Notably, a more recent 2011 genetic study of thorny skates in the Northwest Atlantic discovered the mitochondrial CO1 gene sequences were fairly variable when measured against other skate species in the same region (Coulson *et al.* 2011). These findings suggest that genetic diversity may in fact exist in the species and physical factors, such as long distances, may hinder thorny skates from embarking on longer migrations.

Even Chevolot et.al (2007), acknowledges that the conclusion regarding thorny skates' migratory range "is much greater than previously acknowledged," and this is problematic. First, the sample size involved is small and only contains one molecular marker and is thus, not representative of the genetic diversity within the thorny skate populations. In addition, the lack of genetic diversity in the North Atlantic does not match "predictions based on life characteristics." The study attempts to justify its results by highlighting a parallel study (Chevolot 2006) involving a separate skate species (*Raja clavata*, also known as the thornback skate) in which the same molecular marker was used and significant genetic structure was identified. However, this comparison is not credible because Chevolot's 2006 study deals with a different skate species with different phylogeographic and population genetic structure patterns (*id*.) and because it does not minimize the problems associated with a small sample size. Further, although Templeman (1984) determined that 13% of skates were found up to 386km from their tagging location, the majority were found less than 100km from where they were tagged. Examined in the aggregate, these studies indicate that although a small portion of the skate population may be capable of greater migration than previously thought, there is no indication that a significant portion of the population travels the great distance between the Northeast Atlantic and the Northwest Atlantic and, consequently, genetic mixing of populations may not occur. Such a migration would expose the thorny skates to unsuitable conditions during the migration, such as greater depths and potentially new predators, which could increase mortality rates and reduce productivity.

4. The Northwest Atlantic Population of Thorny Skates is Significant

The IUCN evaluated the conservation status of several populations of thorny skates throughout the Atlantic and assessed the Northeastern Atlantic stock as a "Species of Least Concern." In striking contrast, the IUCN assessed the species as "Vulnerable" in Canadian waters and "Critically Endangered" in U.S. waters. These two separate assessments and classifications indicate the IUCN, whose expertise has been recognized by NMFS (50 Fed. Reg. 51252, 51254 (Dec. 16, 1985)), considers the two populations both discrete and significant. Considering the distribution of the species both in the Northeast and Northwest Atlantic, there can be little doubt that if the U.S. and Canadian populations were extirpated, this would result in a significant reduction in the species' range with no significant evidence that populations outside of this range could recolonize these waters. Accordingly, the best available scientific evidence clearly establishes that the Northwest Atlantic population of thorny skates is a markedly discrete and significant population and, thus, constitutes a DPS pursuant to the ESA (75 Fed. Reg. 39657; July 12, 2010).

5. The Population of Thorny Skates in United States Waters is also, alternatively, a DPS

As an alternative to DPS designation of the Northwest Atlantic population, the thorny skate population in U.S. waters also satisfies the "discrete" and "significant" requirements for DPS designation under the ESA. The U.S. population is "discrete" because "it is delimited by international governmental boundaries [delineating the U.S. and Canada] within which differences in control of exploitation, [. . .] conservation status, [and] regulatory mechanisms exist that are significant in light of § 4(a)(1)(D) of the ESA" (75 Fed. Reg. 39657; July 12, 2010). Evidence also suggests that the U.S. DPS may also be "discrete" because it is "markedly separated" from the Canadian population "as a consequence of physical [and/or] ecological factors" (75 Fed. Reg. 39657; July 12, 2010). Further, the U.S. population meets the "significant" criterion of DPS designation because the loss of the DPS would result in a significant reduction in the range of the taxon.

6. The U.S. Population of Thorny Skates is Discrete

Marked disparities between Canada and the U.S. regarding control of exploitation, conservation status, and regulatory mechanisms substantiate the "discreteness" of the U.S. DPS of the thorny skate. In Canada, the thorny skate is managed as a single stock under Canadian fishery regulations, and thorny skates dominate Canadian commercial catches representing approximately 95% of total skates caught. The skate fishery on the Grand Banks is considered a directed fishery for thorny skates (Kulka *et al.* 2010).

As a direct result of overfishing and bycatch mortality, since the 1970s, the Canadian thorny skate population has continued to suffer a precipitous decline in its mature population, ranging from 63% to 97% in southern regions. In contrast, the population has experienced recent improvement in the middle and northern sections of its range (COSEWIC 2012). Despite the conspicuously low population numbers, the traditional TACs for skates in Canadian waters "exceed[ ] the average catch during a period when minimal or no rebuilding of this stock occurred" (Kulka *et al.* 2010). NEFMC, in consultation with NMFS, concurred that these TACs exceed the recommended level of exploitation to rebuild the stock (NEFMC 2009). Moreover, although the 2013 and 2014 skate TAC for NAFO Division 3LNO (7,000 metric tons) has been decreased, if reached, it would still exceed the NAFO Scientific Council's recommendation that skate catches not exceed recent average annual catches (5495 t) (NAFO 2012). Despite these conclusions, the thorny skate lacks substantive protective regulatory measures in Canada.

Indeed, despite being recognized as a species of "special concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2012), the thorny skate has not yet been afforded any level of protective status in Canada.[45] The decline in thorny skate biomass in Canada as a result of the species exploitation is concurrent with biomass declines in the U.S. Consequently, thorny skate exploitation and the lack of any protections afforded the species in Canada may be negatively impacting the U.S. population in the northern most part of its range. As a result, the U.S. DPS has a need for protected status is even greater. Moreover, taking steps to conserve the U.S. DPS is consistent with Congress' intent that a species in the U.S. should not be allowed to go extinct simply because it is more abundant in another country (*See Maine v. Norton*, 257 F.Supp. 2d 357, 388 (D. Me. 2003).

[45] The Laurentian Channel, an area of concentration for thorny skates, was announced as an Area of Interest for designation as a Marine Protected Area under the Oceans Act in 2010, but to date, no further action has been taken.

Over the past four decades in the U.S., the thorny skate has undergone a dramatic population decline. Unlike thorny skate exploitation in Canada, however, the U.S. has never had a directed fishery for thorny skates. The population decline in the U.S. is primarily attributed to retained incidental catches, bycatch, and discard mortality (NEFMC 2009).Further, in contrast with the relatively stabilized Canadian population, the U.S. population of thorny skate is currently being "overfished," is "subject to overfishing," and continues to decline despite its listing as a "prohibited species" under the 2003 FMP prohibiting commercial and recreational fisheries for the species. *Id*.

In addition to these differences in conservation actions and fishery regulations between Canada and the U.S., evidence supports the contention that population segregation and sub-division into subpopulations is occurring in the Northwest Atlantic stock (IUCN 2011). [The center of concentration of thorny skates in the entire northwest Atlantic region is on the Grand Banks, off the coast of Newfoundland, where the species' range has been contracting since the 1980s (Kulka and Miri 2003). The population on the Grand Banks underwent a 68% decline between the 1970s and early 1990s (Kulka *et al.* 2007). Recent studies indicate that the decline coincided with a period of cold ambient temperatures. Consequently, 80% of the biomass is now "hyper-aggregated" in 20% of the area along southwest slope of the Grand Banks (Kulka *et al.* 2007).] In U.S. waters, thorny skates are most abundant in the Gulf of Maine and Georges Bank offshore strata (NEFMC 2009). Juxtaposing these relatively concentrated populations in U.S. waters to the "hyper-aggregated" Canadian population, the U.S. DPS may be "discrete" under the DPS requirements of the ESA because it is "markedly separated from [the Canadian] populations […] as a consequence of physical [and] ecological factors" (75 Fed. Reg. 39657; July 12, 2010).

7. The U.S. Population of Thorny Skates is Significant

The U.S. thorny skate population spans nearly 1,300 miles from Maine to South Carolina. Consequently, loss of thorny skates in U.S. waters would result in an appreciable loss of the species' range in the Northwest Atlantic. Further, the best available scientific evidence indicates that the Northwest Atlantic population of thorny skates is "discrete," at least because of international regulatory differences and because of separation resulting from physical and ecological factors. These differences are significant in light of section 4(a)(1)(D) of the ESA because the inadequacy of Canada's existing regulatory mechanisms have the potential to heavily impact the U.S. thorny skate population and create a permanent gap in the taxon. This impact could become even more significant as thorny skate range moves further north in response to the ecological consequences of ocean warming attributable to climate change. Thus, the thorny skate population within United States waters constitutes a DPS pursuant to the ESA.

II. The Thorny Skate Satisfies the Statutory Criteria for Listing as an Endangered Species Distinct Population Segment (DPS)

The ESA defines an endangered species as "any species which is in danger of extinction throughout all or a portion of its range" (16 U.S.C. § 1532(6)). A species is threatened if "it is likely to become an endangered species within the foreseeable future" (16 U.S.C. § 1532(20)). In determining whether or not a species is endangered, NMFS must base its decision on five factors prescribed by the statute:

> (a) The present or threatened destruction, modification, or curtailment of habitat or range;
> (b) Overutilization for commercial, recreational, scientific, or educational purposes;
> (c) Disease or predation;
> (d) The inadequacy of existing regulatory mechanisms; or
> (e) Other natural or manmade factors affecting its continued existence.

16 U.S.C. § 1533(a)(1). The presence of "any one or a combination" of the listing factors requires listing (50 C.F.R. § 424.11(c)). "Each factor is equally important and a finding by the Secretary that a species is negatively affected by just one of the factors warrants a nondiscretionary listing as either endangered or threatened" (*See National Wildlife Federation v. Norton*, 386 F. Supp. 2d. 553, 558 (D. Vt. 2005)). Further, the listing decision must be made "*solely* on the basis of the best scientific and commercial data available" (16 U.S.C. § 1533(b)(1)(A)). "Economic considerations have no relevance to determinations regarding the status of species" H.R. No. 97-835 (1982).

Though evidence is provided in this petition in respect to all five listing factors, the continued survival of the thorny skate, including in the proposed Northwest Atlantic DPS and the U.S. DPS, is endangered by three of the five factors enumerated in the ESA: (B) overutilization for commercial, recreational, scientific, or educational purposes; (D) inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors.

Listing Factors Present in the NW Atlantic DPS and the U.S. DPS

A. Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Bottom trawl fisheries are responsible for up to 86% of thorny skates caught as bycatch in U.S. waters and are the primary component of Canada's directed thorny skate fishery (NEFMC 2009). Otter trawling is shown to have enduring negative impacts on benthic ecosystems (Collie 2000; NEFSC 2004). However there is currently a dearth of scientific data specifically quantifying the impacts of trawling on thorny skate habitat in the northwest Atlantic.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

1. Historical Overutilization

Petitioners acknowledge that NMFS has generally downplayed the "overutilization for commercial purposes in the form of historical overfishing" as a significant factor for ESA listing.

For example, in 2002, NMFS issued a negative 12-month finding for listing the barndoor skate and stated that although "available data suggest that overfishing (directed catch and bycatch) was the major threat," biomass indices at the time of petitioning had steadily increased, due in part to the elimination of foreign fishing (67 Fed. Reg. 61058; Sept. 27, 2002).

However, this circumstance is not applicable to thorny skates because population estimates for the thorny skate in Canadian waters indicate stable, but not increasing numbers. And, in U.S. waters biomass indices have been declining for decades without reprieve, despite the federal ban on the landing and possession of thorny skates since 2003. Indeed, thorny skate populations have been historically exploited at such unsustainable rates in U.S. waters that any continued mortality today, through either illegal landings or discard mortality from incidental bycatch, could have devastating and irrevocable impacts on the survival of the species.

In another case, where NMFS issued a negative 90-day finding on an ESA listing petition for the Northwest Atlantic DPS of the porbeagle shark, NMFS acknowledged the petitioner's claim that "historical and continued overfishing requires that the species be listed under the ESA," but dismissed this contention because, at the time of the petition, porbeagle population numbers were stable at low levels and possibly increasing (75 Fed. Reg. 39661; July 12, 2010). However, notably, in its ruling on a challenge to the agency's 90-day finding, the court held that the agency acted arbitrarily and capriciously. Specifically, in regard to the agency's claim that "stocks are depleted… [but] stocks are stable or increasing in size," the court found NMFS considered only the most optimistic view. The court noted that although this view was acceptable, the plaintiff only had to show "the amount of information that would lead a reasonable person to believe the measure proposed in the petition may be warranted" (*Humane Society of the U.S. v. Pritzker*, 2014).

Similarly, in this case, the best available data on the status of the thorny skate is sufficient to lead a reasonable person to believe an endangered or threatened listing for the species may be warranted. This is supported by the fact that the IUCN, composed of expert scientists, has classified thorny skates a as "vulnerable" globally and "Critically Endangered" in U.S. waters (IUCN 2009). Further evidence to support this is the fact that participation in the commercial skate wing fishery in the Northwest Atlantic has grown dramatically over the past 30 years in response to the burgeoning international demand for skate wings and fishermen's interest in developing new markets. In Canada, skates were historically caught only as incidental bycatch in other Canadian fisheries (e.g., groundfish fisheries), but a directed skate fishery was initiated in 1994 as a response to closures in the traditional Canadian groundfish fishery and an increasing international market for skate wings (NEFMC 2009). In the U.S., commercial skate wing fisheries (primarily directed at winter skates) have also increased in number over the past few decades to satiate the growing international appetite for skate wings. The total landings of skates caught in United States waters have increased steadily since the early 1980s, from less than 1,000 metric tons of skates (wings and/or carcasses) landed in 1982 to approximately 19,000 metric tons landed in 2007 (NEFMC 2009).

As previously indicated, while thorny skate populations throughout the Northwest Atlantic suffered dramatic declines over the past few decades, biomass indices in Canadian waters indicate that the species is maintaining relatively stable population numbers at very low levels. In U.S. waters, however, the thorny skate population continues to decline at an alarming rate, despite the alleged protections provided by the FMP which prohibit thorny skate landings and possession. In the time lapse between the genesis of the escalating demand for skate wings in the 1980s and the FMP's implementation in 2003, the thorny skate lacked federal regulatory protections in the U.S., and consequently, suffered the quintessential ravages of the "tragedy of the commons" from which the species has yet to recover. Historical, as well as current, overfishing of thorny skates continues to have deleterious effects on the species' population in U.S. waters and is a significant factor in the species' continued decline. Indeed, the most recently published biomass average (0.12 kg/tow) is approximately 6% of the biomass threshold (2.06 kg/tow), and roughly 3 % of the biomass target (4.13kg/tow) for the species (NEFSC 2013).

2. Continued Overutilization: Illegal Landings and Discard Mortality

Although the historical decline of thorny skates in U.S. waters is ascribed to over-exploitation by commercial fisheries, some claim that overutilization is generally not considered a significant cause of the species' continued decline. Proponents of this argument contend that overutilization of thorny skates in United States waters (for commercial purposes) technically ceased following the prohibition on thorny skate landings and possession in 2003 (NEFMC 2009). Additionally, that the thorny skate is not considered a "preferred species" in the skate wing fishery (NOAA 2009).[46] These assertions are misguided, however. Thorny skate wings may not be as desired for the skate wing market as winter skate wings but, nevertheless, dockside samples of skate landings indicate that thorny skates are illegally landed, most likely for the skate wing market (NEFMC 2009). Moreover, even if thorny skates are caught as bycatch, the likelihood of mortality at the time of discard, or shortly thereafter, is strong (Mandelman *et al.* 2012).

a. Illegal Landings

Thorny, barndoor, and winter skates are all considered sufficient in size for the skate wing market (NEFMC 2009), and despite the ban on landing thorny skates, reports of illegal thorny skate landings suggest that this species is, in fact, currently commercially exploited in the wing market (NEFMC 2009). In the U.S., skate landings were not required to be reported by species until August 2014.[47] Consequently, nearly 100% of the landings were reported as "unclassified" or misrepresented skates (NEFMC 2009). Port samplers and enforcement officers are not present to inspect every commercial landing, but instead conduct random portside searches. Consequently, without inspection of every skate landing, there is ample leeway for fishermen to misreport their landings, particularly regarding the number of illegal thorny skate landings.

---

[46] The tough skin of the thorny skate makes the species less ideal to catch than other skate species because it is difficult for them to be skinned with skinning machines. Instead, fishing vessels from Southern New England Ports typically target little skates and juvenile winter skates (NOAA 2009).

[47] In August 2014. 50 C.F.R. § 648 b (1)(iii) was amended to read, "the owner or operator of any vessel issued a skate permit shall report the species of skates landed as specified in this paragraph. Species of skates landed for bait shall be identified according to the following categories: Winter skate, little skate, little/winter skate, barndoor skate, smooth skate, thorny skate, clearnose skate, and rosette skate. Species of skates landed as wings (or other product forms not used for bait) shall be identified according to the following categories: Winter skate, barndoor skate, thorny skate, and clearnose skate (79 FR 51506, Aug. 29, 2014)."

NMFS Fisheries Statistics Office provided evidence supporting this concern in its issuance of skate wing species composition data from 2006-2007 where it found that thorny skate wings composed 6.7% and 3% of the sampled dockside landings in Massachusetts and Maine, respectively (NEFMC 2009). Given the thorny skate's historically low population numbers and life history parameters as a "K- selected" species, every illegal take exacerbates its precipitous population decline and critically threatens stock rebuilding efforts.

b. Bycatch and Discard Mortality[48]

In contrast to Canada's directed thorny skate fishery, in the U.S. thorny skates are primarily taken as bycatch in groundfish trawl fisheries. As a prohibited species, fishermen are banned from possessing or landing thorny skates or their parts, and federal regulations mandate the fishermen must discard any thorny skates that are incidentally caught in the trawl gear while fishing for other species (50 C.F.R. § 648.322(e)(1)). Although data on acute (i.e., immediate) and delayed (i.e., post-release) mortality rates of discarded skates is limited, it could be close to 66% (Mandelman *et al. 2012*).

According to the Standardized Bycatch Reporting Methodology 3-year Review Report, in 2009 and 2010, roughly 70% of all skates caught in various fisheries (including otter trawls, longline, sink gillnets, and scallop trawls) were discarded (Wigely 2011). However, as a result of the potentially high thorny skate discard mortality rate, a 70% discard rate could still have a devastating effect on the species biomass.

Discard rates are based on reports of independent observers. Of the four otter trawling vessels selected for observation, less than 10% of the selected vessels' total trips/sea days/landings were observed under the auspices of the Northeast Fisheries Observer Program (NEFSC 2011). NEFSC's study highlights the possibility of egregious mis- and under-reporting of skate discard ratios. Bearing in mind the assumed under-reporting of skate discards, from 2003-2010, 3,594 t thorny skates were estimated to have been discarded from otter trawl fisheries in United States waters (SPDT 2011).

Applying both the 72-hour mortality rate (22%) from ocean pen studies and the extended trial mortality rate (66%) at least 790 t and 2,372 t of thorny skates are estimated to have died as incidental bycatch in otter trawling fisheries. The fact that, at a minimum, 790 t of thorny skate have died as incidental bycatch is extremely significant given that the thorny skate is a species of concern and any landing or possession of it is prohibited. Reiterative of the potentially grievous damage illegal landings inflict on thorny skate populations, every discard mortality – acute or delayed – exacerbates the thorny skate's population decline and critically threatens stock rebuilding efforts. Moreover, of those thorny skates caught and released alive, their long-term survival rate has not yet been accurately quantified.

C. Disease and Predation

[48] In the final rule listing the largetooth sawfish as an endangered species, NMFS stated "entanglement and other bycatch are commonly considered in the overutilization factor for ESA listing" (76 FR 133, July 12, 2011).

Predators of juvenile and adult thorny skates include seals, sharks, and halibut. Predators of thorny skate eggs include halibut, goosefish, and Greenland sharks while predatory gastropods can eat thorny skate embryos within egg capsules (NEFSC 2003). The thorny skate is also plagued by a variety of parasites that are found on the skin, in the intestinal tract, and in body cavities (FMNH 2011).[49]

Disease and predation, however, are not currently considered significant threats to the species' survival.

D. Inadequacy of Existing Regulatory Mechanisms

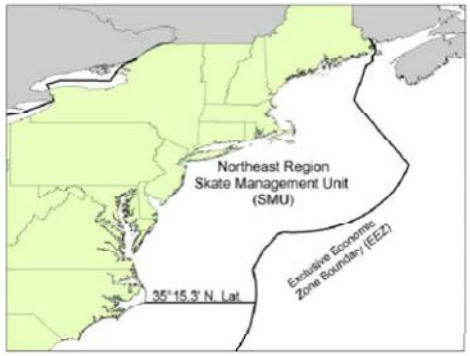
1. Federal Management

Congress enacted the Magnuson-Stevens Fishery Conservation and Management Act (MSA) in 1976 (amended in 1996) to govern marine fisheries management. Generally, the MSA regulates fishing in federal waters, and each state has jurisdiction over fisheries within three miles of its shoreline (16 U.S.C. § 1801; 1856(a)(1)). The MSA created eight regional fishery management councils that are charged with preparing FMPs for each fishery under the respective council's authority (16 U.S.C. § 1852(h)). The FMPs, which are codified and implemented by NMFS, must generally prevent overfishing while providing for optimal yield (16 U.S.C. § 1851(a)(1)).

In U.S. waters, the thorny skate is within the jurisdiction of the NEFMC, and management regulations regarding this species are stipulated by the FMP for the Northeast Skate Complex that governs management of the seven endemic skate species collectively as a single complex.[50] The Skate Management Unit (SMU) for the Northeast skate fishery encompasses the area of the Atlantic Ocean from 35°15.3' North latitude, the approximate latitude of Cape Hatteras, North Carolina, northward to the United States-Canada border, and extending eastward from the shore to the outer boundary of the Exclusive Economic Zone (EEZ) and northward to the United States-Canada border (NOAA 2011a). (See Figure 3.)

Figure 3. Skate Management Unit (SMU)

[49] Thorny skates are parasitized by generalized species of *Monogenea* as well as many other parasites including protozoan parasites like *Haemogregarina delagei*, *Trichodina oviducti*, and *Trypanosoma rajae* (FMNH 2011).
[50] The seven species which comprise the Northeast skate complex include: winter, barndoor, thorny, smooth, little, clearnose, and rosette skates. For information on these species, see http://www.nero.noaa.gov/sfd/sfdskate.html.



Source: NOAA[51]

The current FMP for the Northeast skate complex requires federal permits and sets Total Allowable Landings (TAL) for commercial skate fishing (NEFMC 2009; 50 C.F.R. §§ 648.320-648.323). In 2014, the framework was adjusted to implement a 30% reduction in the Skate Acceptable Biological Catch (ABC). However, the catch reduction was largely the result of a decrease in trawl survey biomass for the more populous winter and little skate species. While this measure is expected to improve the condition of winter skates (a species that is subject to overfishing, but is not overfished), it does not adequately address the overfishing and overfished status of the substantially smaller population of thorny skates. This deficiency in the ABC limit reflects NMFS' intent to address overfishing and rebuild overfished thorny skate populations by developing a new skate action plan in 2014. However, as of the date of this petition, no such action has been announced.

Since 2003, the FMP has prohibited the possession or landing of thorny skates (NOAA 2011a). Specifically 50 C.F.R. §648.320(e)(1) stipulates that a vessel fishing in the EEZ portion of the SMU may not retain, possess, or land thorny skates taken in or from the EEZ portion of the SMU. However, despite NMFS' management efforts and the prohibition on thorny skate possession/landing, the species has continued to suffer an unabated decline. This is likely due to a combination of the bycatch issues and their potentially high long-term discard mortality rate, as identified by the Mandelman *et al.* (2012) study. Thus, although regulations exist to protect the thorny skate, they are ineffective.

A general lack of species-specific identification, both on-boat and at landing, poses a significant threat to the thorny skate's survival in U.S. waters. Ideally, fishermen would positively identify any prohibited species (i.e., thorny, smooth or barndoor skates) that were bycaught and immediately discard them. However, because thorny skates are a prohibited species, the likelihood that the landings of this species are underreported is strong (in spite of the requirement). In 2009, NMFS acknowledged that the species identification by fishermen, both at sea and at landing, was "problematic" even with agency-sponsored programs for fisher education, on-boat observers, and port samplers ("dockside monitors") (NEFMC 2009). Yet, the only enforcement or support of the species-specific reporting requirement identified by the agency is "outreach, education, and continued monitoring of landings by NMFS [which] will aid fishing vessels and dealers with this transition (79 Fed. Reg. 51505, Aug. 29, 2014)."

[51] http://www.nero.noaa.gov/nero/regs/infodocs/NESkateInfoSheet.pdf. [Accessed Nov. 2014].

Positive species identification at landing is hindered because one of the identification options under the current regulations permit vessels to "possess and/or land skates as wings *only* (wings removed from the body of the skate and the remaining carcasses discarded)" (50 C.F.R. § 648.322(b)(4), emphasis added). The thorny skate's most distinctive and identifiable physical characteristics are large thorns on the ridgeline of its back. A vessel could foreseeably "wing" a thorny skate at sea (intentionally or mistakenly), discard the carcass, and, because the brown-grayish wings are much less distinguishable than the thorny body, decide that the thorny skate wings as "unclassified" without alerting the port samplers or enforcement officers to the specimen's true identity as a prohibited species. Indeed, the vast majority of landed skates are landed as "unclassified" (undifferentiated by species) (NEFMC 2009).

"Problematic" misidentification pervades the dealer market as well. Permitted dealers report that the vast majority of skate wings they purchase are listed under two general (non-species-specific) market categories: "unclassified wings" (code 3651) and "big skate" (code 3671) (NEFMC 2009). Further, skates are often mislabeled at market, as evidenced by the photo below of a placard reading "Skate: *Raja Radiata*" accompanying a whole skate for sale by *Eastern Fisheries, Inc.* at the 2010 Brussels Seafood Show (Brussels, Belgium).The pictured skate is likely a winter skate (*Leucoraja ocellata*), but was mislabeled as *Raja radiata*, the taxonomic name of the thorny skate until 1998 (*See* Figure 4.) While it is unknown whether the skate was intentionally or mistakenly mislabeled, the image nevertheless highlights a lack of oversight and enforcement of the thorny skate prohibition, despite the training enforcement agents receive to ensure this does not occur.

Mislabeling, regardless of whether it is intentionally designed to deceive consumers or merely the result of misinformation, can increase consumer demand for the perceived product. Given the inextricable dynamic between demand and supply, fishermen may be encouraged to land thorny skates in greater abundance in an effort to satiate the growing appetite, perceived or real, for thorny skate wings. This contention is not unfounded in light of the current regulatory scheme that, as admitted by NMFS, is failing to curtail illegal thorny skate landings and may inadvertently be fostering a market for the species' parts (NEFMC 2009).

Figure 4: Skate "*Raja Radiata*" at 2010 Brussels Seafood Show

(Source of photograph unknown.)

Further, as previously indicated, the thorny skate has been classified as both an "overfished" and "prohibited" species since 2003 and has been designated as subject to "overfishing" since 2013. Unfortunately, the take or "harvest" of species so designated carries disparate penalties. Appendix 3 of NOAA's Policy for Assessment of Penalties and Permit Sanctions stipulates that fishing for, taking or retaining "particularly vulnerable, depleted or *overfished* species" is a Level IV violation, whereas possession of *prohibited* species is a Level I violation (NOAA 2011b). (See Table 3 below).According to the "Penalty Matrix for the MSA," Level IV violations warrant penalties ranging from $10,000 for "unintentional" violations up to $60,000, with permit sanctions for "intentional" violations. Level I violations, however, incur significantly lower penalties ranging from written warnings for "unintentional" violations up to $8,000 for "intentional" violations (NOAA 2014). (See Table 4 below).

Table 3: Offense Level Guidance, Magnuson-Stevens Act Schedule
(NOAA 2014)

Violation	Gravity Offense Level
VIOLATIONS REGARDING PERMITS, REPORTING, DOCUMENTATION, AND PERMIT	
• Fishing for, taking, or retaining particularly vulnerable, depleted, or ***overfished*** species without a required permit	Level IV
VIOLATIONS REGARDING SIZE/CONDITION/QUANTITIY OF FISH OR	
• Possession of prohibited species	Level I

Table 4: Penalty Matrix for Magnuson-Stevens Act (NOAA 2011b)

	Level of Culpability			
Gravity Offense Level	**A Unintentional**[52]	**B Negligent**	**C Reckless**	**D Intentional**
Level I	Written warning- $2,000	Written warning- $4,000	$2,000-$6,000	$6,000-$8,000
Level IV	$10,000-$15,000	$15,000-$25,000	$20,000-$40,000; permit sanction of 10-	$40,000-$60,000; permit sanction of

[52] The "unintentional" culpability level "reflects the strict liability nature of regulatory violations, and the fact that the statutes NOAA enforces are designed to protect marine resources even where a violation is unintentional" (NOAA 2014).

NMFS' designation of thorny skates as both "prohibited," "overfished," and subject to "overfishing" inherently allows room for inconsistent enforcement of the law. A written warning for illegally taking a "prohibited" thorny skate is certainly not as deterring as a $10,000 penalty for illegally taking an "overfished" thorny skate. Since thorny skates continue to be an "overfished" species, have been subject to "overfishing" since 2013, and are still being illegally landed (NEFMC 2009), records should exist of fishermen cited for Level IV violations. Such records are conspicuously absent, however, raising concerns about whether violators are being penalized.

Finally, in the Final Amendment 3 to the FMP for the NE Skate Complex adopted in 2009, NMFS rejected skate time/area closures in the SMU. These closures were proposed as a conservation measure to promote biomass rebuilding, particularly for the thorny skate. The proposed alternatives (Alternatives 1A and 1B) that included time/area closures would have only applied to vessels on declared skate trips. Nonetheless, the time/area closure management scheme was rejected in exchange for alternatives that defined annual catch limits, TALs, and accountability measures for the skate complex as a whole.

In reference to the alternatives to Amendment 3 that were ultimately adopted, NMFS asserted that "the landings and catch limits proposed by [Alternatives 3B and 4] have an acceptable probability of promoting biomass growth and achieving the rebuilding (biomass) targets for smooth and thorny skates" (NEFMC 2009). Despite this optimistic prediction, as previously referenced, the most recent three-year average biomass index for thorny skate (2011-2013) of 0.12kg/tow was 33% lower than its previous three-year average (.18kg/tow in 2010-2012). Additionally, in the three-years since thorny skates were last petitioned for listing under the ESA, the species was determined to be subject to overfishing and remains "overfished" (NEFSC 2013). In short, the existing regulatory mechanisms set forth in the FMP under the purview of the MSA are inadequate to promote the recovery of the thorny skate in U.S. waters and may actually be *promoting* the species' continued decline. NMFS acknowledged this as early as 2013 in a letter to the NEFMC, stating "In accordance with the National Standard 1 of the Magnuson-Steven Fishery and Conservation Act, the Council must address the new overfishing status of thorny and winter skate, and also continue to address the overfished status of the thorny skate"(NOAA 2014).

In August 2014, NMFS implemented reduced skate catch limits, claiming that they will address the overfishing status of the winter skate, which is not designated as overfished. However, NMFS acknowledges that these reductions will not help improve the overfished or overfishing status of thorny skates (79 Fed. Reg. 51504; Aug. 29, 2014). NMFS' reasoning for not implementing measures designed to improve the stock status of thorny skates was that such measures could not be "analyzed in time to be considered with Framework 2." *Id.*

This reasoning is curious given that NMFS drafted a positive 90-day finding in response to AWI's 2011 petition, prior to changing course and publishing a negative 90-day finding. Moreover, in July 2012, a year after the agency initially recognized that a listing action may be warranted, Tobey Curtis (a fishery policy analyst with NMFS) submitted a proposal for a project which would have assessed the species' discard mortality, habitat preferences, and life history.

Although this study could be completed for as little as $35,000, the proposal was denied because "it just wasn't a high enough priority…" (FOIA Responsive Document, [Internal Email – Thorny Skate Proposal], (July 26, 2012). In sum, despite recognizing in 2011 that it required more data about thorny skates, submission of a 180-day research project to obtain the data more than two years prior to the implementation of Framework 2, and NMFS' internal recognition (in September 2013) that the species was subject to overfishing, the Curtis' proposal was denied due to its low priority classification. As a result, contrary to NMFS' statement that there was not enough time to analyze measures to address the rebuilding of thorny skates, both the need and the solution had been previously identified. Had NMFS funded the study, it would have had ample time to identify measures to improve the species' stock status.

Moreover, precedent has already been established for providing a species with ESA protections when "prohibited" status under a FMP fails to rebuild the stock. In the case of the Atlantic salmon (*Salmo salar*), despite NEFMC's implementation of a FMP for the species in 1988 and a subsequent prohibition on possession/landing, the species continued to decline (NOAA 2011b). In 2000, NMFS and USFWS published a final rule listing the Gulf of Maine DPS of Atlantic salmon as an endangered species under the ESA (NOAA 2011b). Since then, NMFS and USFWS have completed a recovery plan (2005), expanded the Gulf of Maine DPS (2009), and determined critical habitat (2009) for the endangered Atlantic salmon (NOAA 2011b). In aggregate, these ESA-sponsored federal actions effectively stymied the species' extirpation and have successfully encouraged modest stock recovery (USASAC 2011). Analogous to the Atlantic salmon, the thorny skate's unremitting population decline, notwithstanding its current "prohibited" status, also warrants ESA listing to prevent the species' extirpation and promote its recovery.

2. Canadian Management

Canada's regulatory mechanisms regarding its directed fishery for thorny skates have allegedly staved off extirpation of the species within the nation's waters. Yet, by adopting NAFO's suggested TAC limits for skates, the country has implemented regulations that have not successfully promoted stock rebuilding. Thorny skate abundance indices have reportedly stabilized in recent years while biomass indices have gradually increased (DFO 2013). Nonetheless, both indices remain at historically low levels (NAFO 2011). The current TAC for skates in NAFO Divisions 3LNO is 7,000 t, down from 12,000 t in 2011, but this limit still exceeds the average catch from 2009 to 2011, when minimal or no rebuilding of this stock occurred *(*NAFO 2012).

As previously highlighted, despite the fact that the average reported annual catch from Div. 3LNO from 2009-2011 (5,495 t) is over 1500 t less than half the current TAC, the most recent biomass surveys do not indicate a change in the status of the stock (NAFO 2012). In fact, there have been no indications the stock is recovering since it was brought under management. Consequently, both the current TAC and the reported average skate catches over time are too high to promote any stock recovery. Moreover, the thorny skate still lacks substantive protective regulatory measures in Canada and has not been afforded a conservation status by COSEWIC (COSEWIC 2012).

E. Other Natural or Manmade Factors

1. Global Climate Change and Hypoxia

Global warming poses a long-term threat to Northwest Atlantic thorny skates and their recovery from depletion. Climate change is correlated with rising concentrations of atmospheric carbon, and the global warming trend is likely to accelerate as greenhouse gas emissions increase worldwide. In a 2011 press release, the World Meteorological Organization reported that the atmospheric concentration of carbon dioxide has increased by 39% since 1750.[53] This represents the largest increase in the past 650,000 years and perhaps higher than any level in the past 20 million years (Denman *et al.* 2007). Correspondingly, over the past century, the global temperature average has risen roughly 0.74°C (Trenbeth *et al.* 2007) and is forecasted to increase by 1.8 to 4°C by the end of the 21st Century (CSIC 2011 citing Meehl *et al.* 2007). In the Northeast Shelf Ecosystem, the sea surface temperature (SST) reached its all-time high of 14 degrees Celsius (57.2 degrees Fahrenheit) in 2012.[54]

Ocean temperatures are rising in tandem with global ambient temperatures, a trend that is likely causing adverse effects on thorny skates. After concluding a four-decade study on ocean temperatures from 1948 to 1998, Levitus *et al.* (2000) asserts that global ocean temperatures increased 0.31°C on average in the upper 300 m.[55] In addition, the study by Rose (2005) asserts that if climate change results in a warming of northern ocean waters, it is expected that more species will invade northern waters.

This trend could, in turn, adversely affect the thorny skate's predator-prey dynamics or introduce new pathogens that could harm thorny skates. Global warming trends may also be indicative of a contraction of the range of cold-water species (e.g., the thorny skate) (Rose 2005), an occurrence that would imperil the species even further. Such a contraction could be a potential factor in the steady biomass decrease of the species in the Gulf of Maine which represents the southern-most portion for the majority of species range and consequently, skates living in this particular region could be "more sensitive to environmental changes than other skates in the region." (FOIA Responsive Document, [NOAA Memo – Comments on AWI's Petition to List Thorny Skates as Threatened or Endangered under the ESA] (Sep. 19, 2011)].

According to NMFS, a change in ocean temperature is more likely to result in a large northern shift of the stock status over time than direct mortality of the species (although it acknowledges that "more research" is needed to determine if a correlation exists between increasing water temperatures and the steadily decreasing thorny skate biomass). However, the agency also states

[53] World Meteorological Organization. Greenhouse Gas Concentrations Continue Climbing. Press Release No. 934. November 11, 2011 (available at https://www.wmo.int/pages/mediacentre/press_releases/pr_934_en.html)
[54] The Northeast Shelf Ecosystem represents the southernmost portion of the thorny skates' range and extends from the Gulf of Maine to Cape Hatteras. Over the last four decades the average SST in the region has been lower than 12.4 degrees Celsius (54.3 degrees Fahrenheit). *See*: www.nefsc.noaa.gov/press_release/2013/SciSpot/SS1304.
[55] Thorny skates in the Northwest Atlantic are most abundant from 111 to 336 m, and on the Scotian Shelf the species demonstrates a preferred temperature range of 2 to 5 °C (NEFSC 2003).

"available information on thorny skate temperature preferences suggests that this could be a possibility" (FOIA Responsive Document, [NOAA Memo – Comments on AWI's Petition to List Thorny Skates as Threatened or Endangered under the ESA] (Sep. 19, 2011)). This acknowledgement is significant because it recognizes that a more thorough analysis would need to be completed to provide a conclusive finding on the connection between global warming and the declining thorny skate biomass. Notably, in the porbeagle decision, the court found NMFS' need for a more thorough analysis sufficient to suggest a reasonable person "might conclude 'a review of the status of the species concerned' was warranted." While, in regard to the thorny skate, although NMFS did not concede this in its negative 90 day finding, it was well aware that the species had experienced a significant loss of occupied habitat primarily attributable to the direct and indirect effects of climate change, as documented by its own scientists (see below).

If the proposed U.S. DPS of thorny skates attempted a northern migration due to rising ocean temperatures, there would likely be a large negative impact to the species' biomass. As research has indicated, the majority of thorny skates are not capable of journeys of more than 96 km (Templeman 1984).The Gulf of Maine ranges from New Brunswick southward to Massachusetts, spanning more than 12,000 km in distance. Since the farthest thorny skates have been documented travelling is 386km, a large-scale northern migration appears unlikely.

According to the scientific literature, climate change is already affecting ecosystem structure, composition, and integrity in the North Atlantic including the Northwest Atlantic. Sea and surface temperature warming has initiated a cascade of related impacts including changes to: a) oceanic currents; b) water circulation patterns; c) freshwater discharge patterns and amounts; d) precipitation patterns; e) sea level rise; f) salinity levels; g) extent and thickness of sea ice; h) biogeographic range expansions of planktonic species; i) water stratification and mixing patterns; j) alterations to species abundance, distribution, and composition. See e.g., Greene et al. (2008). More specifically, Greene and Pershing (2007) report that "changes in climate beginning in the later 1980s resulted in an enhanced outflow of low-salinity waters from the Arctic and a general freshening of shelf waters from the Labrador Sea to the Mid-Atlantic Bight." They add that "this freshening altered circulation and stratification patterns on the shelf and has been linked to changes in the abundance and seasonal cycles of phytoplankton, zooplankton, and fish populations."

In the Gulf of Maine, where thorny skates are found, the hydrography is strongly influenced by the Labrador Current with the Gulf's ecology broadly dependent on the interrelationship between the Labrador Current and the northern wall of the Gulf Stream (Nye 2010). Sea surface temperatures in the Gulf of Maine have risen by approximately 0.7ºC over the past century (Trenberth et al. 2007; Shearman 2010) with the rate of increase accelerated in recent years with a rise of 0.23ºC from 1982 to 2006 (Belkin 2009). Such increases have altered various ecosystem processes including through the ingress of larger quantities of freshwater thereby influencing the Gulf's salinity levels. In turn, according to a NOAA report examining the impact of climate change on the Gulf of Maine, this makes "vertical mixing of the water column more difficult, hindering bottom water to be mixed into the surface layers of the Gulf of Maine" (Nye 2010). The corresponding stratification "prevents nutrients from being brought into the surface layer that phytoplankoton need to grow…(and that) reductions in available nutrients will affect phytoplankton productivity, the base of the food web and these effects will cascade up to larger organisms like fish and marine mammals" Id.

As phytoplankton forms the backbone of the Gulf of Maine food web, any impacts of climate change will have effects throughout the food web. In the Gulf of Maine, based on a limited analysis of available data, there has been an increase in primary productivity from 1958 to 2002 but with a shift in phytoplankton species from large diatoms to small dinoflagellates (Leterme et al. 2005). More recently, as deep water in the Gulf has become fresher and cooler, nitrate concentrations have declined while silicate concentrations have increase (Townsend et al. 2010). While there is some uncertainty in our knowledge of how such nutrient changes will alter phytoplankton communities, the increase in silicate concentrations may favor diatom production which could increase overall ecosystem productivity due the relatively large size of diatoms compared to small dinoflagellates (Nye 2010).

Just as freshwater can affect phytoplankton productivity and composition, changes in salinity altered phytoplankton and zooplankton assemblages in the Gulf of Maine region since the 1990s. As phytoplankton production increased there was a corresponding increase in the number of small zooplankton. For example, the biomass of *Calanus finmarchicus*, a large zooplankton species that is a major food item for many fish species and a primary source of nourishment for the endangered right whale, has increased in the Gulf of Maine in recent years but the biomass of larger *C. finmarchicus* has not (Nye 2010). As reported in the NOAA report, "in general, the zooplankton assemblage has changed from large zooplankton to smaller zooplankton" (Kane and Prezioso 2008; Ecosystem Assessment Program 2009) which such a shift potentially having "important consequences to animals at higher trophic levels" as they may need to consumer larger amounts of zooplankton and feed for extended periods of time to meet their energetic demands (Nye 2010).

Beyond the effects of such ecological impacts to species, including the thorny skate, changes in the thermal habitat also impacts species assemblages, composition, and abundance. It is well understood that temperature, in this case ocean temperature, is a critical factor controlling species growth, development, and survival and is key to determining what habitat species inhabit, if or when they engage in migration, and the population's growth rate (Nye 2010). As indicated in the NOAA report, most species in the Gulf of Maine prefer temperatures in the 5-15ºC range. Due to climate change impacts, however, the amount of thermal habitat between 5-15ºC along the Northeast shelf of the United States, including the Gulf of Maine, has decreased over the past two decades but with the amount of coldest and warmest habitat increasing. This has led to "a habitat 'squeeze' for most of the species in the Northwest Atlantic" (Nye 2010).

In response, mobile organisms generally shift their spatial distribution in order to find more favorable habitat. This is precisely what has been documented in the Northwest Atlantic. Indeed, over the past forty years, in over half of the fish stocks which were subject to study, their center of biomass has shifted northward and/or found more suitable habitat at deeper depths in the ocean (Nye et al. 2009). Since the temperature of the thermal habitat occupied by these species has not changed over the same time frame, this indicates that the fish species are remaining within their preferred habitat by relocating to higher latitudes and depths where water temperature is cooler (Nye 2010).

Of the 36 species that experience a northward shift in the center of their biomass, twelve experience range contraction with the largest contraction documented for the thorny skate (Nye et al. 2009). Indeed, as over the past 40 years, the area occupied by the thorny skate has contracted by approximately 517.5 square kilometers/year corresponding to a loss of habitat of nearly 21,000 square kilometers over the past 40 years. Id.

Paralleled with global warming trends, hypoxia (oxygen deficiency) has increased in frequency, duration, and severity in the world's coastal areas during the last few decades (CSIS 2011 citing Diaz and Rosenberg 2008). These oxygen deficiencies decrease the abundance and diversity of benthic macrofauna, most notably echinoderms, fish, and crustaceans (CSIC 2011). Continued ocean warming is predicted to increase the extent and severity of marine macrofauna mortality under hypoxia by the combined effect of reducing dissolved oxygen concentration in the ocean and increasing the oxygen requirements of organisms and their sensitivity to reduced oxygen concentrations (CSIC 2011 citing Najjar *et al.* 2010). Additionally, this combined effect is predicted to further reduce the quality and size of suitable habitat for aerobic organisms whose suitable habitat is restricted by water temperature (CSIC 2011) (i.e., the thorny skates).[56] Concurrent with rising ocean temperatures, increased nutrient flux into coastal zones (e.g., industrial and agricultural runoff) is also contributing to the expansion of hypoxia across coastal waters worldwide (CSIC 2011 citing Diaz and Rosenberg 2008). These compounding factors suggest that the threats to marine biodiversity from hypoxia will be greater than anticipated (CSIC 2011). More specifically, in the U.S. there has been a significant increase in hypoxic zones in coastal waters and estuaries in the North Atlantic (CENR 2010). Although the direct impacts of these expanding hypoxic zones on thorny skates is speculative, any adverse impact on the species or on the abundance/distribution of its predators or prey will severely hinder the already imperiled species' potential to recover.

2. Natural Stochastic Events

The viability of a relatively small population, like that of thorny skates in the Northwest Atlantic, is a function of chance events:

> "These chance events are products of demographic and environmental stochasticity, that is, of unpredictable environmental factors that affect the survival or fecundity of some (in demographic stochasticity) and sometimes all (in environmental stochasticity) individuals in a population"

(Hutchins and Reynolds 2004 citing Lande 1993). Small populations may be far more likely to become extirpated or extinct as a result of demographic or environmental stochasticity than as a result of reduced genetic variability associated with small populations (Hutchins and Reynolds 2004 citing Lande 1993 and Caughley 1994).

[56] On the Scotian Shelf the species demonstrates a preferred temperature range of 2 to 5 °C (NEFSC 2003).

As a "K-selected" species, the thorny skate has a low intrinsic rate of increase and relatively late age of maturity. Similar to the barndoor skate, these life history characteristics make the species prone to excessive mortalities and rapid stock collapse (67 Fed. Reg. 61057; Sept. 27, 2002).

Accordingly, the thorny skate's alarmingly low population estimates coupled with its K-selected life history parameters (i.e., low intrinsic rate of increase, relatively late age of maturity) place the species at risk of adverse effects resulting from natural stochastic events. Further, these same K-selected life history parameters make the species highly vulnerable to even limited fishing pressure.

III. Conclusion

A. Requested Designation

Petitioners request that the Secretary of Commerce, through NMFS, list the Northwest Atlantic population of the thorny skates (*Amblyraja radiata*) as an endangered or threatened DPS under the ESA. Alternatively, if NMFS determines that the Northwest Atlantic population of the thorny skates does not qualify for listing, Petitioners requests that NMFS list, as a threatened or endangered DPS, the U.S. population of the thorny skate. If NMFS finds the species to be threatened, in either the Northwest Atlantic or U.S., Petitioners request that NMFS act under the power granted to it through §4(d) of the ESA and adopt and enforce a strict prohibition all take of thorny skates in the Northwest Atlantic or the U.S., respectively.[57]

This listing action is warranted given the numerous threats that this species faces, as well as its historically low population levels. As described above, the number of thorny skates in both the proposed Northwest Atlantic DPS and the U.S. DPS declined precipitously over the past 40 years. The Northwest Atlantic population in Canada continues to persist at historically low population levels. Coupled with the population's hyper-aggregation on the southwest slope of the Grand Banks, these factors make the population highly susceptible to a stochastic event and rising water temperatures, as well as exploitation by Canada's directed skate fishery, further imperiling the species. In U.S. waters, the decline in thorny skate numbers is ongoing in spite of a prohibition on possession and landing of the species and the species' designation as both "overfished" and "subject to overfishing." Consequently, and based on the best available scientific evidence, it is abundantly clear that the thorny skate's continued existence is threatened by overutilization for commercial, recreational, scientific, or educational purposes; inadequacy of existing regulatory mechanisms; and other natural or manmade factors.

[57] 16 U.S.C. §1533 4(d) authorizes NOAA fisheries to enact a special rule that modifies the protections of species listed as threatened with special measures that are "necessary and advisable to provide for the conservation of the species."

B. Critical Habitat

Given that the population of thorny skates in U.S. waters continues to decline (despite a regulatory scheme ostensibly designed to promote the rebuilding of its stock), Petitioners request that critical habitat in U.S. waters be designated for the thorny skate, concurrent with a final ESA listing for the Northwest Atlantic DPS or, alternatively, the U.S. DPS. Congress defines critical habitat for any threatened or endangered species in 16 U.S.C. §1532(5)(A) as:

(i) the specific areas within which the geographical area occupied by the species, at the time it is listed in accordance with the provisions of § 1533 of this title, on which are found those physical or biological features

(I) essential to the conservation of the species and

(II) which may require special management considerations or protection; and

(ii) Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of §1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species. (*See also* 50 C.F.R. § 424.12).

In determining whether critical habitat is both "prudent" and "determinable," NMFS must analyze the physical and biological requirements of the thorny skate listed in 50 C.F.R. § 424.12(b), including:

(1) Space for individual and population growth, and for normal behavior;
(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;
(3) Cover and shelter;
(4) Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally,
(5) Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

Critical habitat designation would be "prudent" because it would benefit the species generally, and is "determinable" because sufficient scientific information exists about the thorny skate's range and habitat in U.S. waters to determine the required habitat of the species and to permit identification of the area.

Based on the statutory definition and agency criteria for critical habitat, Petitioners request that the Secretary of Commerce, acting through NMFS, designate critical habitat within U.S. waters sufficient to protect those areas where the species is known to exist, as well as additional potential recovery habitat that may support the species.

IV. Literature Referenced

Belkin, I.M. 2009. Rapid warming of large marine ecosystems. Progress in Oceanography. 81:207-213.

Berestovskii, E.G. 1994. Reproductive biology of skates of the family Rajidae in the seas of the far north. J. Ichthyol. 34: 26-37.

Chevolot M., Hoarau G., Rijnsdorp A.D., Stam W.T., Olsen J.L. 2006. Phyogeography and population structure of thornback rays (*Raja clavata* L., Rajidaw). Mol Ecol 15:3693-3705.

Chevolot M., Wolfs P.H.J, Palsson J., Rijnsdorp A.D., Stam W.T., Olsen J.L. 2007. Population structure and historical demography of the thorny sake (*Amblyraja radiate*, Rajidae) in the North Atlantic. Mar Biol 151:1275-1286.

Collette, B.B. and G. Klein-MacPhee. 2002. Fishes of the Gulf of Maine. Smithsonian Institution press. Washington. 748 p.

Collie, J.S., G.A. Escanero, and P.C. Valentine. 2000. Photographic evaluation of the impacts of bottom fishing on benthic epifauna. International Council for the Exploration of the Sea (ICES) Journal of Marine Science, 57: 987-1001.

Committee on Environment and Natural Resources. 2010. Scientific Assessment of Hypoxia in U.S. Coastal Waters. Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC.

Committee on the Status of Endangered Wildlife in Canada. 2012. COSEWIC assessment and status report on the Thorny Skate *Amblyraja radiata* in Canada. Committee on the Status of Endangered Wildlife in Canada. 14, 69-70, p.

Consejo Superior de Investigaciones Cientificas. 2011. Temperature effects on hypoxia and benthic fauna. Collaborative Project, Theme 6: Environment (including Climate Change). Duration: March 1, 2009 – February 31, 2012. Submission date: Month 24.

Coulson, M.W., D. Denti, L Van Guelphen, C. Miri, E.K. Kenchington and P. Bentzen. 2011. DNA barcoding of Canada's skates. Mol. Ecol. Resources 11: 968-978.

Davies, T. D., and J. K. Baum. "Extinction Risk and Overfishing: Reconciling Conservation and Fisheries Perspectives on the Status of Marine Fishes." Scientific Reports 2.51 (2012): 1-9.

del Río J.L. 2002. Some aspects of the thorny skate, *Amblyraja radiata*, reproductive biology in NAFO Division 3N.

del Río, J.L. and S. Junquera 2001. Some aspects of the thorny skate (*Raja radiata* Donovan, 1808) reproductive biology in NAFO Division 3N Regulatory Area.

Denman, K. et al. 2007. Couplings between Changes in the Climate System and Biochemistry. Climate Change 2007: The Physical Climate Bias. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press.

Department of Fisheries and Oceans. 2013. Stock Assessment of NAFO Subdivision 3Ps Thorny Skate. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/077.

Ecosystem Assessment Program. 2009. Ecosystem Assessment Report for the Northeast US Continental Shelf Large Marine Ecosystem. Report No. 09-11, US Department of Commerce, Northeast Fisheries Science Center Reference Document, Woods Hole, MA.

Florida Museum of Natural History (FMNH). 2011. Ichthyology at the Florida Museum of Natural History, Thorny Skate (prepared by Kimberly Kittle). Available at www.flmnh.ufl.edu/fish. [Accessed Jan. 2015.]

Greene, C.H., and Pershing, A.J. 2007. Climate drives sea change. Science. 315:1084-1085.

Greene, C.H., Pershing, A.J., Cronin, T.M., and Ceci, N. 2008. Arctic climate change and its impacts on the ecology of the North Atlantic. Ecology. 89 (11):824-838.

Humane Society of the U.S. v. Pritzker, No 11-01414 (BJR), (D.D.C. Nov. 14, 2014).

Intergovernmental Panel on Climate Change (IPCC). Climate Change 2007: The Physical Climate Bias. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press. Available at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-3.html

International Union for Conservation of Nature and Natural Resources (IUCN). 2009. IUCN Red List of Threatened Species, *Amblyraja radiata*. Available at www.iucnredlist.org. [Accessed Nov. 2014.]

Center for Biological Diversity v. Kempthorne, 2008 WL 659822, at 9.

Kulka, D.W. and C.M Miri. 2003. The status of Thorny skate (*Amblyraja radiata* Donovan, 1808) in NAFO Divisions 3L, 3N, 3O, and Subdivision 3Ps.

Kulka, D.W., and C.M. Miri. 2007. Update on the status of thorny skate (*Amblyraja radiata*, Donovan 1808) in NAFO Divisions 3L, 3N, 3O, and Subdivision 3Ps. NAFO SCR Doc. 07/33. Serial No. N5385.

Kulka, D.W. and F.K. Mowbray. 1998. The status of thorny skate (*Raja radiata*), a non-traditional species in NAFO Divisions 3L, 3N, 3O and Subdivision 3Ps. Can. Stock Assess. Secret. Res. Doc. 98/131. 70 p.

Kulka, D.W., M.R. Simpson, and C.M. Miri. 2006. An Assessment of Thorny Skate (*Amblyraja radiata*) on the Grand Banks of Newfoundland. Scientific Council Meeting – June 2006. Northwest Atlantic Fisheries Organization. NAFO SCR Doc. 06/44. Serial No. N5269.

Leterme, S.C., Edwards, M., Seurant, L., Attrill, M.J., Reid, P.C, and John, A.W.G. 2005. Decadal basin-scale changes in diatoms, dinoflagellates, and phytoplankton color across the North Atlantic. Limnology and Oceanography. 50:1244-1253.

Maine v. Norton, 257 F. Supp. 2d 357, 388 (D. Me. 2003).

McEachran, J.D. 2002. Skates. Family Rajidae. *In* B.B. Collette and G. Klein-MacPhee eds. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd Edition. p. 60-75. Smithsonian Institution Press, Washington, DC. 748 p.

Mandelman, J.W., et al. 2012. Short-term post-release mortality of skates (family Rajidae) discarded in a western North Atlantic commercial otter trawl fishery. Fish. Res. (2012), http://dx.doi.org/10.1016/j.fishres.2012.09.020

McEachran, J.D. and J.A. Musick. 1975. Distribution and relative abundance of seven species of skates (Pisces: Rajidae) which occur between Nova Scotia and Cape Hatteras. Fish. Bull. (U.S.) 73: 110-136.

McPhie, R.P. 2007. Biological parameters in Northwest Atlantic skates (Family Rajidae) on the eastern Scotian Shelf: A comparative life history study with implications for species conservation. M.Sc. Thesis, Dalhousie University.

Nat'l Ass'n of Home Builders v. Norton, 340 F.3d 835, 851(9th Cir. 2003).

North Atlantic Fisheries Organization. Scientific Council Meeting – 2011. Serial No. N5930, NAFO SCS Doc. 11/16. 236 p.

North Atlantic Fisheries Organization. 34th Annual Meeting - September 2012. Skates in Division 3LNO. Serial No. N6081. NAFO/FC Doc. 12/7.

National Oceanic and Atmospheric Administration. 2014. [NOAA Office of the General Counsel – Enforcement Section. Issued July 12, 2014. Policy for the Assessment of Civil Administrative Penalties and Permit Sanctions. 9, 24 pp.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS). May 15, 2009. Species of Concern- Thorny Skate, *Amblyraja radiata.* Available at www.nmfs.noaa.gov/pr/pdfs/species/thornyskate_detailed.pdf. [Accessed March 2015.]

National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS). [NOAA 2011a.] Updated May 24, 2011. Northeast Skate Fishery Information Sheet. Available at http://www.nero.noaa.gov/nero/regs/infodocs/NESkateInfoSheet.pdf. [Accessed May 25, 2015.]

National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS). [NOAA 2011b.] Fish Watch – U.S. Seafood Facts, Atlantic salmon (Wild) (*Salmo salar*). Available at http://www.nmfs.noaa.gov/fishwatch/species/atl_salmon.htm. [Accessed May 25, 2015].

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Sep. 19, 2013. Letter from John K Bullard, NOAA Regional Administrator, to Thomas Nies, Executive Director of the New England Fishery Management Council.

New England Fishery Management Council. November 7, 2014. Northeast Skate Complex 2014 Annual Monitoring Report, available at s3.amazonaws.com/nefmc.org/1_2014-Skate-Annual-Monitoring-Report-Final-2.pdf [Accessed Nov. 29, 2014].

New England Fishery Management Council, July 2, 2013. Update of Skate Stock Status Based on NEFSC Bottom Trawl Survey Data through autumn 2012 and spring 2013, available at http://www.nefsc.noaa.gov/program_review/background2014/TOR3TercerioSkate%20StocksStatusUpdate%202013.pdf [Accessed March 21, 2015].

New England Fishery Management Council. November 30, 2009. Final Amendment 3 to the Fishery Management Plan (FMP) for the Northeast Skate Complex and Final Environmental Impact Statement (FEIS) with an Initial Regulatory Flexibility Act Analysis. 459 p.

Northeast Fisheries Science Center. 2003. Essential Fish Habitat Source Document: Thorny Skate, *Amblyraja radiata,* Life History and Habitat Characteristics. NOAA Technical Memo NMFS-NE-178.

Northeast Fisheries Science Center. 2004. Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast U.S. Shelf, and an Evaluation of the Potential Effects of Fishing on Essential Fish Habitat. NOAA Technical Memorandum NMFS-NE-181.

Northeast Fisheries Science Center. 2007. 44th Northeast Regional Stock Assessment Workshop (44th SAW): 44th SAW assessment report. US Dept. Commerce, Northeast Fish Sci. Cent. Ref. Doc. 07-10; 661p.

Northeast Fisheries Science Center. 2011. Standardized Bycatch Reporting Methodology 3-year Review Report – 2011 Part 1. NEFSC Reference Document 11-09; 296 p.

Northeast Fisheries Science Center. July 2, 2013. Memorandum for John K. Bullard – Update of Skate Stock Status Based on NEFSC Bottom Trawl Survey Data Through Autumn 2013 and spring 2013.

Northwest Atlantic Fishery Organization. 2012. 34th Annual Meeting; - September 2012. Skates in division 3LNO.

Nye, J.A. 2010. Climate change and its effects on ecosystems, habitat and biota; State of the Gulf of Maine Report. Gulf of Maine Council on the Marine Environment and the National Oceanic and Atmospheric Administration. 18 pgs.

Nye, J.A., Link, J.S., Hare, J.A., and Overholtz, W.J. 2009. Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. Marine Ecology Progress Series. 292:111-129.

Parent, S., S. Pepin, J.P. Genet, L. Misserey, and S. Rojas. 2008. Captive Breeding of the Barndoor Skate (*Dipturus laevis*) at the Montreal Biodome, With Comparison Notes on Two Other Captive-Bred Skate Species. Zoo Biology 27:145–153.

Rose, G. A. 2005. On distributional responses of North Atlantic fish to climate change. ICES Journal of Marine Science, 62: 1360-1374.

Rose, G.A., and D.W. Kulka. 1999. Hyper-aggregation of fish and fisheries: how CPUE increased as the northern cod declined. Can. J. Fish. Aquat. Sci. 56: 1-10.

Scott, W.B. and M.G. Scott. 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219. 731 p.

Shearman, R.K. and Lentz, S.J. 2010. Long-term sea surface temperature variability along the US East Coast. Journal of Physical Oceanography. 40:1004-1017.

Simon, J.E. and K.T. Frank 1996. Assessment of the Division 4VsW skate fishery. DFO Atl. Fish. Res. Doc. 96/105. 51 p.

Simpson, M.R. and C.M. Miri. 2010. Assessment of Thorny Skate (*Amblyraja radiata* Donovan, 1808) in NAFO Divisions 3LNO and Subdivision 3Ps. Scientific Council Meeting – June 2010. Northwest Atlantic Fisheries Organization. NAFO SCR Doc. 10/24. Serial No. N5782.

Skate Plan Development Team Report. May, 2011. 2012-2013 Skate Complex Acceptable Catch Limit Recommendations. 49 p.

Sulikowski, J. A., J. Kneebone, S. Elzey, J. Jurek, W. H. Howell, & P. C. W. Tsang. 2006. Using the composite variables of reproductive morphology, histology and steroid hormones to determine age and size at sexual maturity for the thorny skate *Amblyraja radiata* in the western Gulf of Maine. Journal of Fish Biology. 69: 1449 - 1465.

Sulikowski, J. A., J. Kneebone, S. Elzey, J. Jurek, P.D. Danley, W.H. Howell, and P.C.W. Tsang. 2005a. Age and growth estimates of the thorny skate (*Amblyraja radiata*) in the western gulf of Maine. Fishery Bulletin. 103: 161 - 168.

Sulikowski, J. A., J. Kneebone, S. Elzey, J. Jurek, P.D. Danley, W.H. Howell, and P.C.W. Tsang. 2005b. The reproductive cycle of the thorny skate (*Amblyraja radiata*) in the western gulf of Maine. Fishery Bulletin. 103: 536-543.

Templeman, W. 1984. Migrations of thorny skate, *Raja radiata*, tagged in the Newfoundland area. J. Northwest Atl. Fish. Sci. 5: 55-63.

Templeman, W. 1987. Differences in sexual maturity and related characteristics between populations of thorny skate *Rajaradiata* in the Northwest Atlantic. J. Northw. Atl. Fish. Sci. 44 (1):155−168.

Townsend, D.W., Rebuck, N.D., Thomas, M.S., Karp-Bass, I., and Gettings, R.M. 2010. A changing nutrient regime in the Gulf of Maine. Continental Shelf Research. 30:820-832.

Trenberth, K.E., Jones, P.D., Ambenje, P., Bojariu, R., Easterling, D., Tank, A.K., Parker, D. Rahimzadeh, F., Renwick, J.A., Rusticucci, M., Soden, B. and Zhai, P. 2007. Observations: Surface and Atmospheric Climate Change. In: Solomon, S., Oin, D., Manning, M., Chen, Z., Marquis, M., Averyl, K.B., Tignor, M., Miller, H.E. [eds] Climate Change 2007: The Physical Climate Bias. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. UK.

U.S. Atlantic Salmon Assessment Committee Annual Report. March, 2011. 2012-2013 Report No. 23 – 2010 Activities. 181 p.

Walker. P.A. 1998. Fleeting Images, Dynamics of North Sea Ray Populations. Ph.D. Thesis, University of
Amsterdam.

Walker, P.A, G. Howlett, and R. Millner. 1997. Distribution, movement and stock structure of three ray species in the North Sea and eastern English Channel. ICES J. Mar. Sci. 54: 797-808.

Wigley S.E., Blaylock J., Rago P.J., Murray K.T., Nies T.A., Seagraves R.J., Potts D., Drew K. 2012. Standardized Bycatch Reporting Methodology 3-year Review Report 2011 - Part 2. US Dept Commerce, Northeast Fish Sci Cent Ref Doc. 12-27; 226 p.