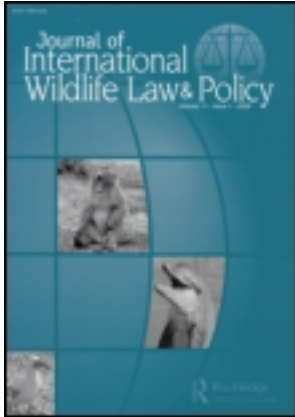


This article was downloaded by: [Dalhousie University]

On: 11 September 2013, At: 07:00

Publisher: Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Journal of International Wildlife Law & Policy

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/uwlp20>

Sustaining American Eels: A Slippery Species for Science and Governance

Cecilia Engler-Palma ^a, David L. VanderZwaag ^a, Richard Apostle ^b, Martin Castonguay ^c, Julian J. Dodson ^d, Emma Feltes ^e, Charles Norchi ^f & Rachel White ^g

^a Marine & Environmental Law Institute, Schulich School of Law, Dalhousie University, Halifax, Canada

^b Department of Sociology and Social Anthropology, Dalhousie University, Halifax, Canada

^c Institut Maurice-Lamontagne, Fisheries and Oceans Canada, Mont-Joli, Canada

^d Département de Biologie, Université Laval, Laval, Québec, Canada

^e Toronto, Canada

^f Center for Oceans and Coastal Law, University of Maine School of Law, Portland, Maine, USA

^g University of Maine School of Law, Portland, Maine, USA

Published online: 16 Aug 2013.

To cite this article: Cecilia Engler-Palma, David L. VanderZwaag, Richard Apostle, Martin Castonguay, Julian J. Dodson, Emma Feltes, Charles Norchi & Rachel White (2013) Sustaining American Eels: A Slippery Species for Science and Governance, *Journal of International Wildlife Law & Policy*, 16:2-3, 128-169, DOI: [10.1080/13880292.2013.805060](https://doi.org/10.1080/13880292.2013.805060)

To link to this article: <http://dx.doi.org/10.1080/13880292.2013.805060>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims,

proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

Sustaining American Eels: A Slippery Species for Science and Governance

CECILIA ENGLER-PALMA*
DAVID L. VANDERZWAAG**
RICHARD APOSTLE***
MARTIN CASTONGUAY†
JULIAN J. DODSON††
EMMA FELTES†††
CHARLES NORCHI#
RACHEL WHITE###

1. INTRODUCTION

For centuries, the American eel has been an important food source and a significant social and cultural icon for Indigenous peoples throughout eastern North America. Eel was also a staple for early settlers and the working class until the mid-20th century. It is still one of the most important commercial freshwater fisheries in Canada. However, despite its economic, social, and cultural significance, the American eel seems to have slipped through the cracks of science and management. Not only are many aspects of the eels' life cycle still a scientific mystery, management regimes at the global, regional, and domestic level have failed to grasp the complexities of the elusive species.

This research was supported by the Ocean Tracking Network (OTN), through a network project grant (NETGP #375118-08) from the Natural Sciences and Engineering Research Council of Canada (NSERC) with additional support from the Canadian Foundation for Innovation (CFI, Project #13011), and the Social Sciences and Humanities Research Council (SSHRC #871-2009-0001). The authors thank Brian Jessop and Anthony Davis for their insightful comments on an earlier version of this article. Any errors remain the authors' responsibility.

*JSD Student, Marine & Environmental Law Institute, Schulich School of Law, Dalhousie University, Halifax, Canada.

**Professor and Canada Research Chair in Ocean Law and Governance, Marine & Environmental Law Institute, Schulich School of Law, Dalhousie University, Halifax, Canada.

***Professor, Department of Sociology and Social Anthropology, Dalhousie University, Halifax, Canada.

†Research Scientist, Institut Maurice-Lamontagne, Fisheries and Oceans Canada, Mont-Joli, Canada.

††Professor, Département de Biologie, Université Laval, Laval, Québec, Canada.

†††Researcher, writer, and rights advocate based in Toronto, Canada.

#Director, Center for Oceans and Coastal Law, University of Maine School of Law, Portland, Maine, USA.

##JD Candidate 2014, University of Maine School of Law, Portland, Maine, USA.

The American eel, *Anguilla rostrata* (LeSueur, 1817), belongs to the family Anguillidae, collectively referred to as freshwater eels. The 18 species in the family occur widely throughout the world.¹ The American eel is the only anguillid occurring in North American waters.²

The native range of the species encompasses more than 10,000 km of coastline from Greenland and Iceland to Venezuela, including many offshore islands.³ The Canadian distribution of American eel extends to five National Freshwater Biogeographic Zones⁴ (NFBZ) and estuaries in the provinces of Ontario, Québec, New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland and Labrador.⁵ In the United States, the species distribution range comprises the inland waters and territorial sea of all Atlantic coastal states from Maine to Florida and the Gulf of Mexico coast to the Mexican border.⁶

Eel are generally catadromous, which means they migrate to various freshwater locations as they move from their early stages of growth (as eggs, larvae [leptocephali], and glass eels) to elvers, and yellow and silver eels, respectively, as they start maturation in fresh or brackish water, before returning to the Atlantic ocean for reproduction.⁷ The American eel, as well as the European eel (*Anguilla anguilla* Linnaeus, 1758) both return to the Sargasso Sea⁸ for reproduction, frequently after juvenile growth periods as long as

¹ Jun Aoyama, *Life History and Evolution of Migration in Catadromous Eels (Genus Anguilla)*, 2 AQUA-BIOSCIENCE MONOGR. 1 (2009).

² Alternative common names include Atlantic eel, common eel, freshwater eel, silver eel, yellow-bellied eel, green eel, black eel, bronze eel, elver, whip, and eelgann (W.B. Scott & E.J. Crossman, *Freshwater Fishes of Canada*, CAN. BULL. FISH. AQUAT. SCI. 184 (1973); W.B. Scott & M.G. Scott, *Atlantic Fishes of Canada*, CAN. BULL. FISH. AQUAT. SCI. 219 (1988)). In French, the species is called *Anguille d'Amérique* (common name), *anguille argentée*, *anguille jaune*, *anguillette*, and *civelle*. The Mi'kmaq use *ka't* or *g'at*, the Algonquins *pimzi* or *pimizi*, the Ojibwe *bimizi*, the Seneca *goda:noh*, and the Cree *Kinebikoinkosew* (COMMITTEE ON THE STATUS OF ENDANGERED WILDLIFE IN CANADA (COSEWIC), COSEWIC ASSESSMENT AND UPDATE STATUS REPORT ON THE AMERICAN EEL (*ANGUILLA ROSTRATA*) IN CANADA (2012)).

³ G.S. Helfman et al., *Reproductive Ecology of the American Eel*, in COMMON STRATEGIES OF ANADROMOUS AND CATADROMOUS FISHES 42 (M.J. Dadswell et al., eds., 1984).

⁴ NFBZ 1 (Maritimes), NFBZ 2 (Eastern Arctic), NFBZ 3 (Southern Hudson Bay-James Bay), NFBZ 8 (Atlantic Islands), NFBZ 9 (Lower St. Lawrence), and NFBZ 10 (Great Lakes, Upper St. Lawrence). See Government of Canada, *Report on the Eel Stock and Fishery in Canada 2010/11*, in REPORT OF THE 2011 SESSION OF THE JOINT EIFAAC/ICES WORKING GROUP ON EELS, LISBON, PORTUGAL, 5–9 SEPTEMBER 2011, ANNEX 11, 265 (ICES/FAO, 2011); and COSEWIC, NATIONAL FRESHWATER BIOGEOGRAPHIC ZONES, at http://www.cosewic.gc.ca/images/fig2-FreshwaterBiogeographicZones_Eng.jpg (visited 17 April 2013).

⁵ COSEWIC, *supra* note 2, at 13–14.

⁶ ATLANTIC STATES MARINE FISHERIES COMMISSION (ASMFC), AMERICAN EEL BENCHMARK STOCK ASSESSMENT, STOCK ASSESSMENT REPORT No. 12:01 (2012), at 5 [hereinafter ASMFC, STOCK ASSESSMENT REPORT 2012].

⁷ The catadromous lifestyle, however, is facultative as many individuals spend part of or the entire continental phase of their life cycle in brackish waters. See Section 3.1 and Françoise Daverat et al., *Phenotypic Plasticity of Habitat Use by Three Temperate Eel Species, Anguilla anguilla, A. japonica, and A. rostrata*, 308 MAR. ECOL. PROG. SER. 231 (2006).

20 years or more.⁹ When silver eels return to the ocean to reproduce, they stop eating, develop expanded blue pupils designed to provide vision at lower depths, and their bodies change to deal with enormous increases in water pressure as they descend in the water column. Following reproduction, eels die.¹⁰ Recent studies have confirmed that the reproductive strategy of American eel results in panmixia; the entire species is composed of one common gene pool with no evidence of population structuring within the species.¹¹

Many gaps remain in the scientific knowledge of eels' life cycle both in their continental and oceanic phase. Adult eels have never been seen in the Sargasso Sea, have never been observed mating, and have never been captured in the open ocean.¹² Habitat requirements for the oceanic migration and for incubation of embryos are largely unknown, and there is also very little knowledge about specific factors that influence the production of eels in fresh water, estuarine/coastal areas, or in the oceans.

Unraveling the eels' mysteries is not only a matter of scientific curiosity; it is a matter of pressing urgency. American eel has already been extirpated, or are close to extirpation, from part of its historical freshwater habitat;¹³ it has been assessed as depleted throughout its distribution in the United States;¹⁴ and it has been assessed as threatened in Canada.¹⁵ Management both in Canada and the United States is characterized by its fragmentation throughout the species' distribution range. Efforts at coordination at the bilateral level (Canada - United States) have been unsuccessful to date, while broader regional cooperation has not been pursued.

This article addresses the slippery nature of eel science and management through four sections. Section 2 describes the socio-economic significance of American eel for First Nations¹⁶ and for commercial fishers, with particular emphasis on Canada. Section 3 summarizes the current

⁸ The Sargasso Sea is an area of open ocean situated within the North Atlantic Subtropical Gyre, and bounded on all sides by the clockwise flow of major ocean currents. As these currents vary, the precise boundaries of the Sargasso Sea also vary. The delineation of the Sargasso Sea study area by the Sargasso Sea Alliance covers 4,163,499 km² in an area extending between 22°–38°N, 76° – 43°W and centred on 30°N and 60°W. (D. D' A. LAFFOLEY ET AL., THE PROTECTION AND MANAGEMENT OF THE SARGASSO SEA: THE GOLDEN FLOATING RAINFOREST OF THE ATLANTIC OCEAN. SUMMARY SCIENCE AND SUPPORTING EVIDENCE CASE 7 (2011)).

⁹ The only clear difference between the two genetically different species is the vertebrae count. *Anguilla rostrata* has on average 107, while *Anguilla anguilla* has on average 114.

¹⁰ F.W. TESCH, THE EEL (2003).

¹¹ Caroline L. Côté et al., *Population Genetics of the American Eel (Anguilla rostrata): FST = 0 and North Atlantic Oscillation Effects on Demographic Fluctuations of a Panmictic Species*, 22 MOL. ECOL. 1763 (2013).

¹² RICHARD SCHWEID, CONSIDER THE EEL 75 (2002).

¹³ ASMFC, STOCK ASSESSMENT REPORT 2012, *supra* note 6, at 5; COSEWIC, *supra* note 2, at 33, 35.

¹⁴ ASMFC, STOCK ASSESSMENT REPORT 2012, *supra* note 6, at 4.

¹⁵ COSEWIC, *supra* note 2.

¹⁶ The complex subject matters of the Indigenous peoples' relationship with natural resources and the Aboriginal and treaty right to fish exceed the scope of this article. We attempt, however, to highlight the

scientific knowledge and identifies policy-relevant knowledge gaps currently addressed by the Ocean Tracking Network (OTN) research project on American eels. Section 4 addresses the complex global and regional governance framework applicable to American eel management, as well as the fragmented Canadian and U.S. domestic management frameworks. The last section draws on this multidisciplinary groundwork to chart new directions for eel science and governance.

2. SOCIAL AND ECONOMIC IMPORTANCE OF AMERICAN EEL: UNDERSTANDINGS AND CHALLENGES

Across North America, eels have been an important source of protein for First Nations, and an important element of their traditional way of life since time immemorial. Eels have also provided important sustenance and formed the basis of a commercial fishery for the first North American settlers. However, the nature of eels' socio-economic contribution has changed over time both for aboriginal communities and non-indigenous fishers.

2.1 Eel and First Nations: Ga'tewe'g'tieg, ga'tewe'g'tieg (We Go Hunting for Eels)¹⁷

Ga'tewe'g'tieg, ga'tewe'g'tieg. This phrase resonates back through more than 3,000 years of Mi'kmaq peoples' continuous eel fishing.¹⁸ Indeed, the Mi'kmaq's relationship to the American eel captured public attention during the Supreme Court of Canada's historic Marshall decision in 1999 which upheld Mi'kmaq peoples' 18th century treaty right to fish and sell their catch for profit.¹⁹ While the Marshall case drew public attention to Mi'kmaq fishing specifically, eels have had significance for Indigenous peoples throughout eastern North America. A recount of the historical use of eel by First Nations illustrates how eel has provided both sustenance and community to First Nations, assembling around it spiritual, political, and cultural relations.

practical and cultural connection between Indigenous peoples and eels as a significant subject matter with specific governance implications, and to raise awareness of the need for further research.

¹⁷ This section summarizes a detailed account of the practical, spiritual, and political significance of eel for North America First Nations contained in a longer paper contributed by Emma Feltes, on file with authors. The map included in this section was designed with the assistance of Jonathan Rotsztein, graphic designer at ALL CAPS Design.

¹⁸ Harlan I. Smith & William J. Wintemberg, *Some Shell-Heaps in Nova Scotia*, 47 NATIONAL MUSEUM OF CANADA BULLETIN (1929); PATRICIA ALLEN, *THE OXBOW SITE: CHRONOLOGY AND PREHISTORY IN NORTHEASTERN NEW BRUNSWICK* (1980).

¹⁹ R. v. Marshall, [1999] 3 S.C.R. 456, 177 D.L.R. (4th) 513 and R. v. Marshall, [1999] 3 S.C.R. 533, 179 D.L.R. (4th) 193 [hereinafter Marshall decision].

FIGURE 1. The significance of eel for Indigenous peoples can be seen throughout North America's East Coast.



For the Innu, eels were a consistent staple when available.²⁰ Large camps would be set up along the St. Lawrence in the summer and fall due to the abundance of eels and moose (Figure 1, Point 2). By the early part of the 17th century, many southern Innu were accustomed to situate these camps around French settlements on the lower St. Lawrence. The Innu would use the tides to trap eels in weirs—low stone walls that extended from the shore.²¹ Where they could not depend on the tide, eels were speared using three-pronged harpoons.²²

For the Maliseet, Abanaki, and Mi'kmaq, eel had similar importance. Eels were caught by either spear or weir along the St. Lawrence River, the Restigouche River,²³ and waterways throughout the Gaspé Peninsula, New

²⁰ Kenneth S. Lane, *The Montagnais Indians, 1600–1640*, 7 KROEBER ANTHROPOL. SOC. PAP. (1952). The only exception existed in the interior Labrador Peninsula (Figure 1, Point 1), where it was taboo to eat saltwater species, including salmon, cod, eel, seal, and porpoise (FRANK GOULDSMITH SPECK, NASKAPI: THE SAVAGE HUNTERS OF THE LABRADOR PENINSULA 79 (1935)).

²¹ Lane, *id.*, at 8.

²² Gerald F. Reid, Culture Summary: Innu 9. Human Relations Area Files (2009), at [http://ehra.fworldcultures-beta.its.yale.edu/ehrafe/fullContext.do?method=fullContext&forward=searchFullContext&col=collection\('/eHRAF/ethnography/NorthAmer/NH06'\)&docId=nh06-018&page=nh06-018-00233&offsetId=nh06-018-00244&tocOffsetId=toch0601800196&resultSelect=2](http://ehra.fworldcultures-beta.its.yale.edu/ehrafe/fullContext.do?method=fullContext&forward=searchFullContext&col=collection('/eHRAF/ethnography/NorthAmer/NH06')&docId=nh06-018&page=nh06-018-00233&offsetId=nh06-018-00244&tocOffsetId=toch0601800196&resultSelect=2) (visited 17 April 2013).

²³ Phillip K. Bock, *Micmac*, in 15 HANDBOOK OF NORTH AMERICAN INDIANS; NORTHEAST at 109 (Bruce G. Trigger ed., 1978).

Brunswick, Nova Scotia, and Newfoundland.²⁴ For the Mi'kmaq in particular, eel and other fish were a crucial food source, making up 90 percent of their diet.²⁵ This is reflected in Mi'kmaq place names, including the contemporary Eel River and Eel Ground reserves, as well as Xudjo'yan, in Sandy Point, Newfoundland (Figure 1, Point 3) which translates as "eel-spearing place."²⁶ Eel skin was also used as rope,²⁷ and to wrap sprains and other injuries.²⁸ Eel oil was rubbed over the body and hair for protection against the heat, cold, and mosquitoes,²⁹ and for relief from chest colds and congestion.³⁰ Furthermore, there are numerous accounts of the spiritual, political, and social importance of eels for the Mi'kmaq peoples.³¹

Eel also had a central role in the history and traditions of the Haudenosaunee First Nation. It is said that Deganawida, "The Great Peacemaker," named the fifth Haudenosaunee longhouse clan after the eel.³² The Onondaga and Cayuga of the Haudenosaunee Confederacy fished eels from the streams and lakes between Lake Ontario and the Susquehanna (Figure 1, Point 6).³³ Eels were smoked, dried, fried, roasted, or used as an ingredient in traditional corn soup,³⁴ or used for tanning.³⁵

²⁴ CHRESTIEN LE CLERCQ & WILLIAM FRANCIS GANONG, *NEW RELATION OF GASPEZIA: WITH THE CUSTOMS AND RELIGION OF THE GASPESIAN INDIANS* 452 (1910).

²⁵ HARALD E.L. PRINS, *THE MI'KMAQ: RESISTANCE, ACCOMMODATION, AND CULTURAL SURVIVAL* 29 (1996).

²⁶ Frank Gouldsmith Speck, *Micmac Hunting Territories in Nova Scotia and Newfoundland*, in *BEOTHUK AND MICMAC* 80 (1922), at 138.

²⁷ WILSON D. WALLIS & RUTH SAWTELL WALLIS, *THE MICMAC INDIANS OF EASTERN CANADA* 48 (1955); SHELLEY DENNY & TYSON PAUL, *CULTURAL AWARENESS, ECOLOGY AND CONSERVATION OF THE AMERICAN EEL FROM A MI'KMAQ PERSPECTIVE (UNAMA'KI)* (2010).

²⁸ Anthony Davis et al., *The Paq'tnekek Mi'kmaq and Ka't (American Eel): A Case Study of Cultural Relations, Meanings, and Prospects*, 24 *CAN. J. NATIVE STUD.* 357, 361 (2004).

²⁹ Wallis & Wallis, *supra* note 27, at 126.

³⁰ Davis et al., *supra* note 28, at 377

³¹ One such story describes a great bird called the Storm Maker, who flapped its wings so powerfully that it sent all the eels out to sea. The Mi'kmaq bound its wings, but this caused scum to accrue on the water. They finally reached an agreement with Storm Maker, and it blew the scum away and let the eels come back (Davis et al., *id.* at 361). There is record of a 17th-century buówin (shaman) who would sit on the beach making eel spears and throwing them into the water (Figure 1, Point 4). When he collected the spears, each one would have an eel on the end of it (Frederick Johnson, *Notes on Micmac Shamanism*, 16 *PRIMITIVE MAN: QUARTERLY BULLETIN OF THE CATHOLIC ANTHROPOLOGICAL CONFERENCE* 53, 64 (1943)). Eel was offered to visitors as a practice of reciprocity (*id.* at 362). Eel images were also used for the recording of important treaties, like the peace treaty signed with the Penobscot (Figure 1, Point 5) (Wallis & Wallis, *supra* note 27, at 115).

³² William N. Fenton, *Locality as a Basic Factor in the Development of Iroquois Social Structure*, in *SYMPOSIUM ON LOCAL DIVERSITY IN IROQUOIS CULTURE* 47 (1951); ANNEMARIE SHIMONY, *CONSERVATISM AMONG THE IROQUOIS AT THE SIX NATIONS RESERVE* 55 (1961).

³³ Harold Blau, Jack Campisi, & Elisabeth Tooker, *Onondaga*, in Trigger, *supra* note 23, at 491; Marian White, William E. Engelbrecht, & Elisabeth Tooker, *Cayuga*, in Trigger, *supra* note 23, at 550.

³⁴ FREDERICK W. WAUGH, *IROQUOIS FOODS AND FOOD PREPARATION* (1916); DAVID ZEISBERGER'S *HISTORY OF NORTHERN AMERICAN INDIANS* (Archer Butler Hulbert & William Nathaniel Schwarze eds., 1910).

³⁵ CARRIE A. LYFORD, *IROQUOIS CRAFTS* 69 (1945).

Delaware peoples would track six or seven fish species that would arrive seasonally, including eel in the fall,³⁶ using a diversity of fishing tactics,³⁷ that is, until the Swedish fur trade and Crown land acquisition through the late 17th century pushed them into more sedentary farming.³⁸ Meanwhile, the Cherokee First Nation would traditionally not eat eels, which were seen as unclean,³⁹ but they served other purposes. Ball players would rub themselves with eel skin in order to make themselves slippery,⁴⁰ and women tied their hair with a tight piece of dried eel skin, which was thought to make it grow long.⁴¹

Due to direct and indirect impacts of colonialism, Indigenous peoples' relationship to the eel has changed. However, the magnitude and implications of this change are for the most part unknown. Catch records, challenging overall for American eel, have not been systematically kept for aboriginal sustenance and ceremonial fisheries in Canada or the United States.⁴² In general, there is a lack of research on the contemporary importance of the American eel for Indigenous peoples, revealing a gap between historical and contemporary anthropological documentation.

A notable exception is the research aimed at documenting the impact of the decline of the eel on the Mi'kmaq, undertaken by the Unama'ki Institute of Natural Resources (UINR), Paq'tnkek Fish and Wildlife Society, Mi'kmaq Alsumk Mowimsikik Koqoey Association, and other indigenous organizations, along with Parks Canada, Mount St. Vincent University, Acadia University, and other partners.⁴³ In this work, a multitude of factors are credited with the decline of the eel in Mi'kmaq culture. They include: the lack of physical access due to the reserve system, European settlement of fishing areas, government programmes that impede traditional fishing, changes in food preference, and environmental factors. Given the shared history of colonialism throughout Canada and the United States, one might predict that similar factors have affected other Indigenous peoples as well.

³⁶ MARSHALL JOSEPH BECKER & JOHN BEIERLE, *CULTURE SUMMARY: DELAWARE* (2003); WILLIAM WILMON NEWCOMB, *THE CULTURE AND ACCULTURATION OF THE DELAWARE INDIANS* (1956); Zeisberger, *supra* note 34. See Figure 1, Point 7 representing Delaware First Nation traditional settlement.

³⁷ Newcomb, *id.* at 16.

³⁸ *Id.*

³⁹ WILLIAM HARLEN GILBERT, *THE EASTERN CHEROKEES* (1978). See Figure 1, Point 8 representing the area where Cherokee First Nation settled after much migration and inter-Tribal conflict (JAMES MOONEY, *MYTHS OF THE CHEROKEE AND SACRED FORMULAS OF THE CHEROKEES* (1982, reprint of 1891 and 1900 monographs, originally published in the 7th and 19th Annual Reports of the Bureau of American Ethnology), at 15).

⁴⁰ MOONEY, *id.* 47.

⁴¹ *THE WAHNENAUHI MANUSCRIPT: HISTORICAL SKETCHES OF THE CHEROKEES, TOGETHER WITH SOME OF THEIR CUSTOMS, TRADITIONS, AND SUPERSTITIONS* 175 (Jack Frederick Kilpatrick ed., 1966 reprint).

⁴² ASMFC, *INTERSTATE FISHERY MANAGEMENT PLAN FOR AMERICAN EEL* 30 (2000), at <http://www.asmfc.org/americanEel.htm> (follow "Interstate Fishery Management Plan for American Eel" hyperlink) (visited 23 Nov. 2012) [hereinafter ASMFC, Interstate Eel FMP].

⁴³ The fruits of this work are assembled at <http://www.speciesatrisk.ca/eel/AboriginalMaterials.asp> (visited 17 April 2013).

As the historical literature makes clear, the impact of this change is not just material, but reverberates through cultural knowledge and political and social structures. With the eel so central to Mi'kmaq knowledge and economic activities, its decline has significant impacts on their ability to exercise self-governance, which involves the stewardship and management of such a central resource.⁴⁴ Indeed, a UINR report notes: "Because of the longevity of the eel, changes in abundance and distribution are seen between generations. The eels we have here today may not be here for our children and grandchildren."⁴⁵ Such implications for resource management and long-term self-governance provide yet another reason as to why it is so important to close the gap in contemporary documentation. More research is needed, in partnership with Indigenous peoples, to determine the meaning of eel within indigenous cultures and the real impacts of the decline of the American eel, before more of this knowledge is diminished.

2.2 Current Capture and Trade Trends

Across North America, eels were a major source of protein for early settlers. From the 17th century to the mid-20th century, eels were also a working-class staple.⁴⁶ In the postwar period, eel consumption in North America has largely disappeared, save for some aboriginal populations and ethnic groups which have brought eel consumption traditions with them. Current eel fisheries, particularly in Atlantic Canada and the mid-Atlantic states, are dependent on European and Asian markets.⁴⁷

Eel consumption is still a major activity in Europe, especially in northern countries and Spain, the largest consumer of glass eels.⁴⁸ The "rich, pure fish flavour" still appeals to the entire continent, with approximately 20 million pounds a year still being eaten.⁴⁹ The European market prefers live eels, especially silver ones, which are typically bigger and have a higher fat content. In turn, the fat content of silver eels facilitates a preference for smoked products. Glass eels are primarily used as appetizers. The demand for, and value of, live eels make air freight an economic means of transport.

Japanese consumers prefer their local species, *Anguilla japonica*, but have run short of this stock (fatter, more flavourful, according to Japanese consumers).⁵⁰ As a consequence, they now depend on imports from North

⁴⁴ Davis et al., *supra* note 28, at 359.

⁴⁵ Denny & Paul, *supra* note 27, at 5.

⁴⁶ Schweid, *supra* note 12, at 95.

⁴⁷ ASMFC, Interstate Eel FMP, *supra* note 42, at 12.

⁴⁸ S. Ringuet, F. Muto, & C. Raymakers, *Eels: Their Harvest and Trade in Europe and Asia*, 19 TRAFFIC BULLETIN 80 (2001); Willem Dekker, *Status of the European Eel Stock and Fisheries*, in *EEL BIOLOGY* 237 (K. Aida, K. Tsukamoto, & K. Yamauchi eds., 2003).

⁴⁹ Schweid, *supra* note 12, at 17.

⁵⁰ ASMFC, Interstate Eel FMP, *supra* note 42, at 12.

America,⁵¹ typically through a commercial operation involving glass eel capture, grow-out operations in China, and processing through smoking, immersing in a sauce, and grilling for vacuum-packing and export to Japan as “kabayaki.” This operation has created a significant demand for elvers, pushing the price to records of more than US\$2,000 per pound.⁵²

Estimates of commercial catches of American eel, their values and, to a lesser extent, the number of active fishermen are difficult to obtain, largely because of the small-scale and broad geographic area of the commercial fishery and inadequate statistical collection.⁵³ General catch trends show that the fishery remained relatively small for the first half of the 20th century. Fishing pressure increased during the 1960s and peaked in the 1970s and early 1980s in response to high prices and strong markets.⁵⁴ The total North American harvest (Canada-United States) increased from an average of 1,430 tonnes annually between 1950 and 1955 to an unprecedented peak of 3,145 tonnes in 1979.⁵⁵ Canadian landings reached more than 1,200 tonnes in the 1970s. Landings started to decline in the early 1990s, despite high prices and strong demand.⁵⁶ The adoption of stricter regulatory measures by the different management authorities has maintained fishing effort at relatively low levels.

Current reported catches for the commercial fishery in Canada are below 500 tonnes per year,⁵⁷ unevenly distributed between four fishing areas: Quebec’s St. Lawrence River and Estuary, Southern Gulf of St. Lawrence, Maritimes, and Newfoundland. The largest catches are taken in the Southern Gulf of St. Lawrence, which supports a significant yellow eel fishery mainly in New Brunswick and Prince Edward Island but also extending to Nova Scotia.⁵⁸ According to a recent report, more than 500 commercial licences

⁵¹ The European Union (EU) implemented a temporary ban on eels that has been in effect since November 2010 (CFP Reform Watch, Commission Decides to Implement a Temporary Export Ban on Eels (1 November 2010), at <http://cfp-reformwatch.eu/2010/11/commission-decides-to-implement-a-temporary-export-ban-on-eels/>) (visited 17 April 2013). The measure was adopted as a consequence of the species being included in CITES Appendix II in July 2007, effective on 13 March 2009 (CITES, *Notification to the Parties: Amendments to Appendices I and II of the Convention adopted by the Conference of the Parties at Its 14th Meeting, The Hague (Netherlands), 3–15 June 2007*, No. 2007/022 (26 July 2007), at <http://www.cites.org/eng/notif/2007/E022.pdf>) (visited 17 April 2013). While species listed under Appendix II can be traded internationally with a permit issued by the state of export, the EU Scientific Review Group concluded that any export would have harmful effects in the conservation status of the eel and recommended the implementation of the temporary ban.

⁵² Personal communication with Kate Taylor, ASMFC, FMP Coordinator (October 2012).

⁵³ DFO, *Status of American Eel and Progress on Achieving Management Goals*, DFO CAN. SCI. ADVIS. SEC. SCI. ADVIS. REP. 2010/62 (2010), at 21 [hereinafter DFO, Status and Progress].

⁵⁴ ASMFC, STOCK ASSESSMENT REPORT 2012, *supra* note 6, at 21.

⁵⁵ COSEWIC, *supra* note 2, at 56.

⁵⁶ *Id.*

⁵⁷ *Id.* at 57.

have been issued for this region, but most of them are inactive.⁵⁹ Additionally, three Aboriginal groups hold communal commercial eel licences.⁶⁰ Average annual catch between 2005 and 2009 was 180 tonnes, while total catches in 2009 and 2010 were 173 and 174 tonnes, respectively.⁶¹

The next most active area is the Maritimes (formerly Scotia-Fundy) Region, encompassing New Brunswick and Nova Scotia waters flowing into the Bay of Fundy and the Atlantic coast of Nova Scotia. With approximately 400 commercial licences (although many of them inactive), catch average between 1997 and 2002 was 142 tonnes, but decreased to 103 tonnes between 2004 and 2007, partly as a consequence of mandated decreases in fishing effort.⁶² Most of the 16 First Nations and two Aboriginal People Councils in the Maritimes Region hold food, social and ceremonial licences and/or communal commercial licences.⁶³ Since the late 1980s, the region also supports the only elver fishery in Canada. The fishery has been limited to nine licences.⁶⁴ The annual elver fishery catch rose from 26 kg to 4,122 kg in 1997. Recent catches for 2009, 2010, and 2011, have been 2,011 kg, 1,573 kg, and 3,530 kg, respectively.⁶⁵

The Quebec St. Lawrence River and Estuary fishery had, as of 2010, 55 licences and a combined annual catch average of 89.5 tonnes for yellow and silver eels for the 2005 to 2009 period.⁶⁶ The Newfoundland and Labrador Region, which reduced licence numbers from 316 to 165 in 2004, reports a catch average of 59 tonnes for the 2005 to 2009 period.⁶⁷ Two Aboriginal groups participate in the commercial and/or recreational eel fishery in Newfoundland: the Qalipu (Federation of Newfoundland Indians) and the Miawpukek First Nation.⁶⁸

Before its closure, Ontario had a significant commercial fishery for American eel. Landings in the 1970s reached a record of 228.2 tonnes,

⁵⁸ The inland and tidal waters of New Brunswick and Nova Scotia that contribute to the fishery are those that flow in the Northumberland Strait or the Gulf of St. Lawrence. Other waters of these provinces also contribute to the Maritimes fishery, which are subject to a different management regime.

⁵⁹ In 2010, 181 licences had been issued in New Brunswick, 150 in Nova Scotia, and 204 in Prince Edward Island (Government of Canada, *supra* note 4, at 280).

⁶⁰ Elsipogtog First Nation, Esgenoopeetitj First Nation, and Indian Island First Nation.

⁶¹ Government of Canada, *supra* note 4, at 277.

⁶² DFO, Status and Progress, *supra* note 53, at 17.

⁶³ Personal communication with Greg Stevens, Senior Advisor, Fisheries and Aquaculture Management, Fisheries and Oceans Canada (28 March 2013).

⁶⁴ Government of Canada, *supra* note 4, at 280.

⁶⁵ Personal communication with Greg Stevens, Senior Advisor, Fisheries and Aquaculture Management, Fisheries and Oceans Canada (20 July 2012).

⁶⁶ DFO, Status and Progress, *supra* note 53, at 16.

⁶⁷ *Id.* at 18. See also WILDLIFE DIVISION, DEPARTMENT OF ENVIRONMENT AND CONSERVATION, NEWFOUNDLAND AND LABRADOR, MANAGEMENT PLAN FOR THE AMERICAN EEL (*ANGUILLA ROSTRATA*) IN NEWFOUNDLAND AND LABRADOR (2010), at 13 [hereinafter NFL EEL MANAGEMENT PLAN].

⁶⁸ NFL EEL MANAGEMENT PLAN, *id.* at 16.

equivalent to 20 percent of the Canadian landings. Catches declined during the 1980s and early 1990s to around 100 tonnes, and were further reduced in the following years. Between 1997 and 2003, commercial landings ranged from 11 to 41 tonnes.⁶⁹ The fishery was ultimately closed in 2004.

Beside the commercial and aboriginal fishery, some yellow and silver eels are also caught recreationally in eastern Canada, and particularly as a winter spear fishery in the Southern Gulf of St. Lawrence and Newfoundland regions.⁷⁰ However, information on catches and landings are not available for the recreational fishery.⁷¹

3. STATUS OF SCIENTIFIC KNOWLEDGE: UNDERSTANDINGS, ADVANCES, AND CHALLENGES

3.1 Life Cycle, Habitats, Abundance, and Threats

Our present understanding of the abundance, life cycle, and preferred habitats of American eel and the most serious threats to their existence has been most recently reviewed in the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessment and status report of the American eel.⁷² Here we provide a brief summary of our understanding of eel biology, based largely on the COSEWIC report.

The American eel uses a very broad diversity of habitats. During their oceanic migrations, eels migrate across vast expanses of open ocean and, upon arrival in continental waters, exploit all salinity zones. Catadromy (most of the life cycle occurs in fresh water followed by migration to and spawning at sea) is no longer seen as obligatory for eels, but rather is a facultative life history option. In freshwater habitats, preferred habitat can be found in both lakes and rivers including all waters extending from the high-water mark down to at least 10 m depth. Growing eels (the yellow eel stage) are primarily benthic, and use substrate (rock, sand, mud), and bottom debris (woody debris, submerged vegetation) for protection and cover. Interstitial spaces comprised of rock piles and logs are important to American eel as cover, particularly during daylight hours because of their primarily nocturnal behaviour. Given the high abundance of eels often observed in tributaries, these waters seem to comprise a very important component of eel habitat.⁷³

Overwintering requirements and usage remain incompletely understood, in both fresh and saltwater habitats. Recent research, however, found that American eels commonly winter in mud bottoms in both bay and estuary

⁶⁹ Government of Canada, *supra* note 4, at 275.

⁷⁰ COSEWIC, *supra* note 2, at 69; NFL EEL MANAGEMENT PLAN, *supra* note 67, at 15.

⁷¹ Government of Canada, *supra* note 4, at 277–279.

⁷² COSEWIC, *supra* note 2.

⁷³ *Id.*

habitats in the southern Gulf of St. Lawrence.⁷⁴ Eels also conceal themselves in the bottom during daytime in non-winter periods. It was estimated that American eels in eastern Canada spend about 74 percent of their entire yellow phase concealed in the substrate.⁷⁵

Eel densities in fresh water typically diminish with distance from the sea. In Europe, it has been reported that dispersal of eels into fresh water can be heavily influenced by density-dependent effects, that is, the higher the density, the stronger the motivation to continue to disperse upstream. Dispersal may be influenced by many factors (e.g., density-dependent effects of eels, prey and predator density and distribution, physical factors such as obstacles), including human-made obstacles. The ability of eels to overcome obstacles is size-dependent. Small eels (less than ten cm long) are able to creep up damp vertical surfaces, but larger eels are generally unable to bypass large waterfalls and dams. Connectivity among important inland habitats is thus crucial to ensure eels are able to disperse effectively and take advantage of the best growth conditions in various rearing habitats.⁷⁶

Habitat requirements for the oceanic migration of adults, spawning in the Sargasso Sea,⁷⁷ and incubation of embryos are largely unknown. The northern limit of spawning by Atlantic eels (*Anguilla* spp.) in the Sargasso Sea is related to thermal fronts and surface water masses, with spawning taking place south of east-west thermal fronts that separate southern Sargasso Sea surface water from the mixed Subtropical Convergence Zone water to the north.⁷⁸

The abundance of the American eel has been in decline since the most recent peak in the 1980s.⁷⁹ Time series data used to estimate percent change in indices of abundance from the 1950s to the 2000s (three generations of eels) are uniformly negative (from -7.1% to -96.2%) in the western portion of the species' range. Trends are mixed in the eastern portion of its range.⁸⁰ Indices of abundance from fishery landings series indicated a negative change. Eel abundance relative to the 1980s is very low for Lake Ontario and the St. Lawrence River according to fisheries-independent data. Between 1996 and 1997 and 2010, estimates of the total number of maturing eels declined by 65 percent in the Great Lakes and upper St. Lawrence River area, despite the reduction in mortality from commercial fisheries (see Section 4.3.2). An index of year class strength indicated a substantial decline of juvenile eels migrating

⁷⁴ J.P.N. Tomie, *The Ecology and Behaviour of Substrate Occupancy by the American Eel* (2011) (unpublished M.Sc. thesis, University of New Brunswick).

⁷⁵ *Id.*

⁷⁶ COSEWIC, *supra* note 2.

⁷⁷ J. Schmidt, *The Breeding Places of the Eel*, 211 *PHILOS. TRANS. R. SOC. LONDON* 179 (1922).

⁷⁸ R.C. Kleckner & J.D. McCleave, *The Northern Limit of Spawning by Atlantic Eels (Anguilla spp.) in the Sargasso Sea in Relation to Thermal Fronts and Surface Water Masses*, 46 *J. MAR. RES.* 647 (1988).

⁷⁹ COSEWIC, *supra* note 2.

⁸⁰ DFO, *Status and Progress*, *supra* note 53.

upstream in a tributary of the lower St. Lawrence River between 1999 and 2005. Trends in some areas (New Brunswick) are mixed while other areas (Newfoundland, southwest Nova Scotia) indicate some declines between the 1980s and the 2000s.⁸¹

At present, there is little understanding of specific factors that influence the production of eels in either fresh water, estuarine/coastal areas, or in the ocean. Although alterations to the marine environment (e.g., climate change and shifting salinity, temperature and current fields) may very well impact eel survival at both the larval and silver eel stages, anthropogenic factors during the continental life stages must be considered as more immediate threats.⁸² In fresh waters, habitat fragmentation and turbine mortalities are significant causes of mortality. For example, the St. Lawrence River watershed in Canada contains some 8,411 dams of at least 2.5 m in height.⁸³ Overall, these obstacles are estimated to prevent or restrict access to at least 12,140 km² of eel freshwater habitat in the St. Lawrence River and Lake Ontario system. In addition to extensive habitat loss due to barriers, hydroelectric turbines are direct agents of mortality. On the main stem of the St. Lawrence River below Lake Ontario, there are two hydro complexes, the Moses-Saunders Dam completed in 1959 and the Beauharnois Dam completed in 1961. Silver eels exiting Lake Ontario are subjected to an estimated accumulated turbine mortality of 40 percent after their passage through the two generating stations. This additive turbine mortality contributes to almost 75 percent of the anthropogenic mortality during downstream migration and reduces the annual spawning escapement from the St. Lawrence River by 40 percent.⁸⁴

Finally, a handful of additional threats pose risks during the continental phase of the eel's life cycle, including vulnerability to fisheries and the bioaccumulation of contaminants. An exotic swim bladder nematode parasite (*Anguillicoloides crassus*) may be negatively affecting eels. The parasite has been found in Nova Scotia (Cape Breton Island), New Brunswick, and Lake Ontario. Supplementation of eels by stocking of wild recruits (now suspended) may also pose risks.⁸⁵

⁸¹ *Id.*; COSEWIC, *supra* note 2, at v and 59–60.

⁸² COSEWIC, *id.*

⁸³ Guy Verreault, P. Dumont, & Y. Mailhot, *Habitat Losses and Anthropogenic Barriers as a Cause of Population Decline for American Eel (Anguilla rostrata) in the St. Lawrence Watershed, Canada*, ICES CM 2004/S:04 (2004).

⁸⁴ G. Verreault & P. Dumont, *An Estimation of American Eel Escapement from the Upper St. Lawrence River and Lake Ontario in 1996 and 1997*, in *BIOLOGY, MANAGEMENT, AND PROTECTION OF CATADROMOUS EELS* 243 (D.A. Dixon ed., 2003).

⁸⁵ The efforts to reverse the declining status of American eel in the upper parts of the St. Lawrence River were supported through a restocking programme. Over seven million individuals were stocked in the upper Richelieu River in 2005 and in the upper St. Lawrence River and Lake Ontario in 2006. The stocking programme was discontinued following findings of swimbladder parasites in eels stocked in

3.2 Knowledge Gaps and the OTN Eel Research Project

The multidisciplinary OTN eel research project is addressing some of the main unknowns of American eel life cycle, some of which have clear policy relevance. One set of questions at the forefront of its research agenda is the dynamics, through space and time, of adult eels as they move to their breeding grounds. On the North American east coast, the diverse paths eels take back to the Sargasso Sea and the behavioural mechanisms responsible for such a feat remain among the great mysteries in animal biology. Advances in this area will inform management measures to protect migration paths, and will provide insight into the open-ocean habitat requirements of spawning eels. Investigation of such issues may require cross-boundary scientific cooperation to get a fuller picture of migration dynamics.

Another key area of the OTN research is the identification of different migratory pathways experienced during the continental phase, research that is being supported by eel otolith analyses. A variety of migratory patterns have been described.⁸⁶ Eels may spend their entire lives in estuaries, or they may move through a variety of different bodies of water. Generally speaking, anguillid eels found at higher latitudes exhibit a greater probability of remaining in the lower reaches of watersheds in brackish water. The upper St. Lawrence-Great Lakes population component exhibit true catadromy with little evidence of an estuarine phase in the life cycle. Although eels are genuinely panmictic, there appears to be strong selection on specific alleles that may explain life-history differences among continental population components, although the differences can also be partly phenotypic.⁸⁷

Using a combination of acoustic pingers and moored hydrophones, the OTN team has demonstrated that yellow eels have very restricted movements within the St. Lawrence River and estuary, but a small proportion migrate to the brackish section of the estuary over several years. Downstream migration of silver eels occurs at night during the ebbing tide and picks up speed as the year advances. Eels exhibit stop and go behaviour, with some eels suspending movement for weeks in different freshwater parts of the river before resuming their migration. A moored array of hydrophones at Cabot Strait recorded out migrating eels in December, but also indicated a very low survival of eels migrating out of the Gulf of St. Lawrence (overall detection rate of less than four percent of released eels). One possible cause of this is predation. The

Lake Ontario and of undesirable characteristics of escaping silver eels originating from stocked eels (Government of Canada, *supra* note 4, at 279).

⁸⁶ Daverat et al., *supra* note 7.

⁸⁷ C. Côté et al., *Differential Effects of Origin and Salinity Rearing Conditions on Growth of Glass Eels of the American Eel, Anguilla rostrata: Implications for Stocking Programmes*, 74 J. FISH BIOL. 1934 (2009); Côté et al., *supra* note 11. The genetics of the American eel is the primary research area of Professor Louis Bernatchez, in the Biology Department at Laval University, who leads a research effort funded through a separate NSERC strategic grant.

tracking of large silver eels in the Gulf of St. Lawrence using satellite tags that record depth and temperature before being released from tagged eels on a pre-determined date revealed an unexpectedly high predation rate from porbeagle sharks.⁸⁸ This raises the possibility that migrating eels may represent a reliable, predictable food resource for porbeagle sharks.

The development of coupled physical-biological models of the eel migration is another way of exploring the variety of behaviours that could be adopted by eels under specific conditions of oceanic circulation and temperature.⁸⁹ These models are designed to provide researchers with plausible migration scenarios that may then be tested using direct observations of migratory behaviour. To obtain this detailed tracking data from the North Atlantic Ocean, while attempting to avoid the high predation in the Gulf, the OTN research team conducted satellite tagging of eels in Nova Scotia. The team aims to record the oceanic movements of eels to the Sargasso Sea and, in combination with physical-biological models, to describe the mechanisms employed by eels to complete their spectacular migrations.

4. CURRENT MANAGEMENT

Three images best describe the management framework for American eel: a slippery global governance framework, limited bilateral cooperation, and a fragmented domestic framework.

4.1 Slippery Global Governance Framework

Getting a grip on the international legal normative framework applicable to the American eel is not easy as multiple conventions and soft law documents are relevant. Key agreements include the UN Convention on the Law of the Sea (LOSC),⁹⁰ the Convention on Biological Diversity (CBD),⁹¹ and potentially the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).⁹² While a plethora of non-legally binding documents, such as Agenda 21⁹³ and the Rio Declaration on Environment and Development,⁹⁴

⁸⁸ M. Béguer-Pon et al., *Shark Predation on Migrating Adult American Eels (*Anguilla rostrata*) in the Gulf of St. Lawrence*, 7 PLoS One 46830 (2012).

⁸⁹ The models are developed in collaboration with professors Keith Thompson and Jinyu Shen, Dalhousie University.

⁹⁰ United Nations Convention on the Law of the Sea, December 10, 1982, 1833 U.N.T.S. 397 [hereinafter LOSC].

⁹¹ Convention on Biological Diversity, 5 June 1992, 1760 U.N.T.S. 79 [hereinafter CBD].

⁹² Convention on International Trade in Endangered Species of Wild Fauna and Flora, 3 March 1973, 993 U.N.T.S. 243 [hereinafter CITES].

⁹³ Agenda 21: Programme of Action for Sustainable Development, 14 June 1992, U.N. GAOR, 46th Sess. Agenda Item 21, UN Doc. A/Conf.151/26 (1992).

⁹⁴ Rio Declaration on Environment and Development, 13 June 1992, U.N. Doc. A/CONF.151/26 (Vol. 1); 31 I.L.M. 874 (1992).

provide guidance for principled coastal and ocean governance,⁹⁵ the Food and Agriculture Organization of the United Nations (FAO) has been the main purveyor of fisheries-specific guidance through its Code of Conduct for Responsible Fisheries⁹⁶ and numerous technical guidelines.

4.1.1 *United Nations Convention on the Law of the Sea*

The provisions of LOSC are both directly and tangentially applicable to the American eel. Article 67 of the Convention specifically sets out state responsibilities for managing catadromous species like eels. A coastal state in whose waters catadromous species spend the greater part of their life cycle has management responsibility and must ensure the ingress and egress of migrating fish.⁹⁷ Harvesting is prohibited on the high seas and any fishery within exclusive economic zones (EEZs) would be subject to other fisheries conservation obligations for the EEZ set out in the Convention.⁹⁸ Where catadromous fish migrate through the EEZ of another state, whether as juvenile or maturing fish, the coastal state and the other state concerned are required to manage such fish by agreement.⁹⁹ Such agreement must ensure the species' rational management, which is not defined.¹⁰⁰

Various other LOSC provisions may tangentially apply to eel management. For example, all states are required to protect and preserve the marine environment.¹⁰¹ States are obligated to minimize to the fullest extent possible the release of toxic substances¹⁰² and to take measures necessary to protect rare or fragile ecosystems as well as the habitat of depleted, threatened, or endangered species and other forms of marine life.¹⁰³ States also have a general obligation to cooperate with each other in the conservation and management of living resources in areas of the high seas.¹⁰⁴

⁹⁵ For example, Chapter 17 of Agenda 21 in para 17.6 encourages each coastal state to establish or strengthen integrated management mechanisms while Principle 15 of the Rio Declaration urges states to apply the precautionary approach. For a broader discussion, see *TOWARDS PRINCIPLED OCEANS GOVERNANCE: AUSTRALIAN AND CANADIAN APPROACHES AND CHALLENGES* (Donald R. Rothwell & David L. Vanderzwaag eds., 2006).

⁹⁶ FAO Code of Conduct for Responsible Fisheries, 31 October 1995, FAO Doc. 95/20/Rev/1; 1995 W.T.S. 3 [hereinafter FAO Code].

⁹⁷ LOSC, *supra* note 90, at Art. 67(1).

⁹⁸ *Id.* at Art. 67(2).

⁹⁹ *Id.* at Art. 67(3).

¹⁰⁰ For further discussions, see John Warren Kindt, *The Law of the Sea: Anadromous and Catadromous Fish Stocks, Sedentary Species, and the Highly Migratory Species*, 11 SYRACUSE J. INT'L & COM. 9, 39–40 (1984); Cyril De Klemm, *Migratory Species in International Law*, 29 NAT. RESOURCES J. 935, 970–973 (1989).

¹⁰¹ LOSC, *supra* note 90, at Art. 192.

¹⁰² *Id.* at Art. 194(3)(a).

¹⁰³ *Id.* at Art. 194(5).

¹⁰⁴ *Id.* at Art. 118.

Arguably a gap exists within LOSC relating to American eel, which is considered a single, panmictic breeding population.¹⁰⁵ Article 67 merely requires management cooperation between the coastal state where the catadromous species spends the greater part of its life cycle and the state through which the species migrates in the EEZ. Drafters of the Convention did not seem to have in mind the possible need for broader cooperation for a panmictic catadromous species found from the southern tip of Greenland to the northeast coast of South America and into inland areas of the Mississippi and Great Lakes drainages.¹⁰⁶

4.1.2 *Convention on Biological Diversity*

The CBD calls upon its parties to undertake a long list of measures to promote the conservation and sustainable use of biodiversity, with many being relevant to American eels. For example, parties are required to establish a system of protected areas, promote the protection of ecosystems and natural habitats,¹⁰⁷ and encourage the recovery of threatened species through the development and implementation of management plans or strategies.¹⁰⁸ Preserving traditional practices and lifestyles of indigenous and local communities relating to biological diversity is urged.¹⁰⁹ Parties have a general duty to cooperate in conserving biological diversity in areas beyond national jurisdiction and on other matters of mutual interest.¹¹⁰

Numerous decisions and guidelines have been adopted by CBD parties over the years having relevance to coastal and marine environmental protection,¹¹¹ with two decisions standing out for potential relevance to American eel management. Decision VII/11, adopted in 2004, sets out implementation guidelines for the ecosystem approach.¹¹² The guidelines emphasize the need to pay attention to spatial and temporal scales of ecosystems where river basins or large marine areas may require new environmental mechanisms to engage stakeholders across administrative borders and a redesigning of assessment and monitoring efforts.¹¹³

¹⁰⁵ ASMFC, STOCK ASSESSMENT REPORT 2012, *supra* note 6, at 24.

¹⁰⁶ *Id.*

¹⁰⁷ CBD, *supra* note 91, at Art. 8(a).

¹⁰⁸ *Id.* at Art. 8(f).

¹⁰⁹ *Id.* at Art. 8(j).

¹¹⁰ *Id.* at Art. 5.

¹¹¹ See A. Charlotte de Fonteubert, David R. Downes, & Tundi S. Agardy, *Biodiversity in the Seas: Implementing the Convention on Biological Diversity in Marine and Coastal Habitats*, 10 GEO. INT'L ENVTL. L. REV. 753 (1998).

¹¹² The decision adds implementation guidelines and annotations to the 12 ecosystem approach principles first adopted in May 2000 at COP 5 through Decision V/6 on the Ecosystem Approach.

¹¹³ Decision VII/11, Ecosystem Approach: Implementation Guidelines, paras. 7.4 & 7.8 (2004).

Decision X/2, adopted in October 2010 and establishing a Strategic Plan for Biodiversity 2011–2020, sets out 20 biodiversity targets,¹¹⁴ with three particularly relevant to eel management. Target 6 urges that by 2020

all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species.

Target 11 calls for at least 17 percent of terrestrial and inland water areas, and 10 percent of coastal and marine areas, to be included in ecologically representative and well-connected systems of protected areas by 2020. Target 12 urges by 2020 the prevention of extinction of human-threatened species and the improvement and sustainment of their conservation status, particularly those most in decline.

The Executive Secretary of the CBD has helped convene a series of regional workshops to facilitate the identification of ecologically or biologically significant marine areas (EBSAs) through the application of scientific criteria. A Wider Caribbean and Western Mid-Atlantic Regional Workshop was held in Brazil, 30 April–5 May 2012.¹¹⁵ Participants identified the Sargasso Sea as an EBSA and noted its importance as a spawning ground for both American and European eels. Such recognition should substantially support an initiative by the Sargasso Sea Alliance, a consortium of the Bermuda government, leading conservation and marine science organizations, and individuals, to discuss and develop appropriate management and protection measures for the Sargasso high sea areas.¹¹⁶

4.1.3 *Convention on International Trade in Endangered Species*

Through trade control levers CITES seeks to prevent endangered and threatened species from going extinct. Commercial trade is not allowed for species listed under Appendix I, is restricted for species listed under Appendix II, and is subject to special permits for species listed under Appendix III.¹¹⁷

¹¹⁴ Decision X/2, The Strategic Plan for Biodiversity 2011–2020 and the Aichi Biodiversity Targets (2010).

¹¹⁵ CBD, *Report of the Wider Caribbean and Western Mid-Atlantic Regional Workshop to Facilitate the Description of Ecologically or Biologically Significant Marine Areas*, UNEP/CBD/SBSTTA/16/INF/7 (2012).

¹¹⁶ Regarding the case for protection, see Laffoley et al., *supra* note 8.

¹¹⁷ For species listed on Appendix I no commercial trade is allowed and any allowable trade, for example for scientific purposes, would be subject to strict import and export permit requirements (CITES, *supra* note 92, at Art. III). Trade in Appendix II listed species would be restricted and require an export permit from the state of export with the permit verifying the export is not considered detrimental to the species' survival (*id.* at Art. IV).

While the European eel was added to CITES Appendix II in 2007,¹¹⁸ a similar listing has not occurred for the American eel. The United States undertook public consultations regarding a possible proposal to the March 2013 16th Conference of the Parties to CITES for listing the American eel on Appendix II.¹¹⁹ However, the United States subsequently decided not to proceed with the listing request.

4.1.4 *FAO Code of Conduct and Technical Guidelines*

The Code of Conduct for Responsible Fisheries, adopted by the FAO Conference in October 1995, suggests principles and standards applicable to the conservation of all fisheries¹²⁰ and thus is also applicable to American eel fisheries. States are urged to take measures to conserve biodiversity of aquatic habitats and ecosystems, to protect endangered species, and to allow depleted stocks to be restored.¹²¹ States are encouraged to integrate fisheries interests into coastal area management processes.¹²² A precautionary approach to fisheries management is expressly called for.¹²³ Bilateral and regional cooperation in scientific research is urged given the transboundary nature of many aquatic ecosystems.¹²⁴

The FAO has adopted over 20 guidelines to further flesh out the Code of Conduct¹²⁵ with those on the ecosystem approach and the precautionary approach being particularly important. Guidelines on the Ecosystem Approach to Fisheries (EAF),¹²⁶ issued in 2003, highlight the need to reconsider institutional arrangements for fisheries management in light of broad ecosystem boundaries¹²⁷ and call for the formulation of EAF management plans that describe critical habitats and establish management measures to reduce adverse environmental impacts.¹²⁸ Guidelines on the Precautionary Approach to Capture Fisheries and Species Introductions, published in 1996,¹²⁹ suggest a

¹¹⁸ Department of the Interior, Fish and Wildlife Service, *Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); Sixteenth Regular Meeting: Taxa Being Considered for Amendments to the CITES Appendixes*, Extended Version of Fed. Reg. Notice 77 FR 21798 (2012), at 11.

¹¹⁹ *Id.*

¹²⁰ FAO Code, *supra* note 96, at para. 1.3.

¹²¹ *Id.* at para. 7.2.2.

¹²² *Id.* at para. 6.9.

¹²³ *Id.* at para. 7.5.1.

¹²⁴ *Id.* at para. 6.4.

¹²⁵ See Dawn A. Russell & David L. VanderZwaag, *The International Law and Policy Seascape Governing Transboundary Fisheries*, in RECASTING TRANSBOUNDARY FISHERIES MANAGEMENT ARRANGEMENTS IN LIGHT OF SUSTAINABILITY PRINCIPLES: CANADIAN AND INTERNATIONAL PERSPECTIVES 9, 18 (Dawn A. Russell & David L. VanderZwaag eds., 2010).

¹²⁶ FAO Fisheries Department, *The Ecosystem Approach to Fisheries*, FAO TECHNICAL GUIDELINES FOR RESPONSIBLE FISHERIES No. 4, Suppl. 2 (2003).

¹²⁷ *Id.* at 21.

¹²⁸ *Id.* at 26–27.

suite of possible precautionary measures for various types of fisheries including new or developing fisheries, over-utilized or fully utilized fisheries, and traditional or artisanal fisheries.¹³⁰ Setting of precautionary target and limit reference points for fisheries is generally encouraged.¹³¹

4.2 Limited Bilateral Cooperation

Despite the long-standing tradition of informal and formal coordination and cooperation for fisheries scientific research and management between Canada and the United States, formal and targeted cooperation in addressing American eel issues has been limited with three main avenues evident. First, the Great Lakes Fishery Commission, established pursuant to a 1954 agreement¹³² and tasked with facilitating scientific research, suggesting fisheries management measures, and controlling sea lamprey populations, has been a forum for sharing information and fostering research on the American eel.¹³³ A bi-national American Eel Task Group, created in 2006, aimed to assist recovery of eels in the St. Lawrence River and Lake Ontario¹³⁴ and was reportedly working on a memorandum of understanding to that effect. However, this initiative has been put on hold partly due to the differing listing processes of Ontario and Fisheries and Oceans Canada (DFO) under their respective species at risk legislation.¹³⁵ The Task Group is presently inactive.¹³⁶

Second, the Gulf of Maine Council on the Marine Environment, established in 1989 by the premiers of New Brunswick and Nova Scotia and the governors of Massachusetts, Maine, and New Hampshire, has raised public awareness on the plight of American eels¹³⁷ and has included restoration of

¹²⁹ FAO, *Precautionary Approach to Capture Fisheries and Species Introduction*, FAO TECHNICAL GUIDELINES FOR RESPONSIBLE FISHERIES No. 2 (1996).

¹³⁰ *Id.* at 13–16.

¹³¹ *Id.* at 10.

¹³² Convention on Great Lakes Fisheries between the United States and Canada, September 10, 1954, 238 U.N.T.S. 97.

¹³³ See, for example, Louis Bernatchez, Caroline Côté, & Martin Castonguay, *Genetic Structure of the American Eel with Emphasis on the St. Lawrence River Basin* (2011), at <http://www.glfc.org/research/reports/Bernatchez.2011.htm> (visited 10 December 2012). The Strategic Vision of the Great Lakes Fisheries Commission 2011–2020 pledges to continue various partnering programmes to restore Great Lakes ecosystems, at <http://www.glfc.org/pubs/SpecialPubs/StrategicVision2012.pdf> (visited 10 December 2012), at 27.

¹³⁴ Rob MacGregor et al., *Declines of American Eel in North America: Complexities Associated with Bi-national Management*, in INTERNATIONAL GOVERNANCE OF FISHERIES ECOSYSTEMS: LEARNING FROM THE PAST, FINDING SOLUTIONS FOR THE FUTURE 357, 370 (M.G. Schechter, N.J. Leonard, & W.W. Taylor eds., 2008).

¹³⁵ Personal communication with John M. Dettmers, Senior Fisheries Biologist, Great Lakes Fishery Commission (27 February 2013).

¹³⁶ *Id.*

¹³⁷ See Gulf of Maine Council on the Marine Environment, *American Eels: Restoring a Vanishing Resource in the Gulf of Maine* (2007), at http://www.gulfofmaine.org/council/publications/american_eel_low-res.pdf (visited 10 December 2012).

coastal and ocean habitats as one of its goals. Under the Council's 2007–2012 Action Plan, 49 new habitat restoration projects were funded with an estimated 145 miles of streams opened to fish passage.¹³⁸ The Action Plan 2012–2017 pledges continuation of providing Gulf of Maine habitat restoration grants and technical assistance for restoring coastal ecosystems.¹³⁹

Third, the Canada-U.S. Transboundary Resources Steering Committee, established in 1995 as an informal arrangement to facilitate federal coordination of scientific research and fisheries management in the Gulf of Maine region,¹⁴⁰ has at least placed American eel on the “radar screen.” While the bilateral arrangement has primarily focused on developing scientific advice and allocating quotas for three shared cod, haddock, and yellowtail flounder stocks on Georges Bank,¹⁴¹ a Species at Risk Working Group has developed a Canada-U.S. transboundary species at risk matrix that tracks the listing and recovery efforts for marine species at risk in the two countries.¹⁴² American eel is listed on the matrix,¹⁴³ but since neither country has proceeded with formal listing under the species at risk legislation (see Section 4.3), no cooperative recovery discussions have occurred to date.

4.3 Fragmented Domestic Framework

4.3.1 United States American Eel Management Framework

American eel are managed via a multi-level government framework in the United States. The most active participants in this framework are the states themselves. American eel are harvested in every state on the Atlantic coast, and each state has established its own management infrastructure. The states also coordinate efforts via an interstate commission, the Atlantic States Marine Fisheries Commission (ASMFC). Finally, the federal government through the Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration (NOAA) has had, to date, some involvement in the regulation of the American eel fishery, but its role may become much greater if a pending Endangered Species Act listing of the American eel as “endangered” is approved.

¹³⁸ Gulf of Maine Council on the Marine Environment, *Action Plan 2012–2017* (2012), at 11, at <http://www.gulfofmaine.org/actionplan> (visited 10 December 2012).

¹³⁹ *Id.* at 4.

¹⁴⁰ For a detailed overview, see Emily J. Pudden & David L. VanderZwaag, *Canada- United States Bilateral Fisheries Management in the Gulf of Maine: Struggling towards Sustainability under the Radar Screen*, in Russell & VanderZwaag, *supra* note 125, at 177, 180–190.

¹⁴¹ *Id.* at 182–185.

¹⁴² *Id.* at 188.

¹⁴³ Copy of matrix is on file with the authors.

U.S. Interstate Management Efforts: The Atlantic States Marine Fisheries Commission

The ASMFC, one of three interstate marine fisheries commissions in the United States, coordinates the management and conservation of the transboundary coastal fisheries¹⁴⁴ in the 15 Atlantic coast states from Maine to Florida within the states' territorial seas and inland waters.¹⁴⁵ Coordination is achieved through the Commission's Interstate Fisheries Management Program (ISFMP).¹⁴⁶ Each state has one vote in any Commission meeting.¹⁴⁷

The ISFMP, in coordination with member states and research teams, develops interstate fishery management plans (FMPs) providing a comprehensive species-specific management document that identifies goals for the species, the species' current status, ecological challenges affecting the species, and management actions needed to support the species goals.¹⁴⁸ Following the Commission's adoption of an FMP, all state agencies must promulgate regulations implementing the FMP within their state.¹⁴⁹ The state regulations can be more restrictive than those set out in the FMP, but they cannot be less restrictive.¹⁵⁰ The Atlantic Coastal Fisheries Cooperative Management Act of 1993 provided the ASMFC with authority to ensure member state compliance with FMPs.¹⁵¹ If the Commission determines a state is not compliant, it must notify the U.S. Secretary of Commerce, who has the authority to declare a moratorium on fishing in the non-compliant state's fishery.¹⁵²

In order to balance the conservation of the American eel with sustaining its commercial, recreational, scientific, and educational uses, the ASMFC approved the first FMP for American eel in 1999.¹⁵³ The eel was declining in abundance, but at that time there was little understanding of the eel's status as a species, the ecological impacts on the population, or the management solutions needed to restore the eel.¹⁵⁴ The 1999 FMP required states to collect

¹⁴⁴ The ASMFC coordinates the management and conservation of 22 Atlantic coastal species or species groups, including the American eel (*id.*).

¹⁴⁵ States' territorial seas generally extend three miles from their baselines. American eel are traditionally prosecuted only in rivers, therefore, the fishery is not subject to federal fishery jurisdiction. Furthermore, although the ASMFC is not a federal agency, it adopted management practices from the pre-existing state and federal fisheries management programmes. See ASMFC, at <http://www.asmf.org> (follow "Interstate Fisheries Management" hyperlink) (visited November 23, 2012).

¹⁴⁶ ASMFC, at <http://www.asmf.org/interstate.htm> (visited 23 November 2012).

¹⁴⁷ ASMFC, ATLANTIC STATES MARINE FISHERIES COMMISSION COMPACT & RULES AND REGULATIONS 9 (2003), at <http://www.asmf.org> (follow "About Us" hyperlink; then follow "ASMFC Compact: Rules & Regulations" hyperlink) (visited 23 November 2012) [hereinafter ASMFC Compact].

¹⁴⁸ ASMFC, Interstate Eel FMP, *supra* note 42, at iv.

¹⁴⁹ *Id.*

¹⁵⁰ *See id.*

¹⁵¹ See 16 U.S.C.A. § 5104 (2012).

¹⁵² 16 U.S.C.A. §§ 5105–06 (2012)

¹⁵³ ASMFC, Interstate Eel FMP, *supra* note 42, at ii.

¹⁵⁴ *Id.* at iv.

eel harvest data, conduct an annual abundance survey, maintain or tighten existing commercial fishery regulations, implement recreational limits of fifty eel per person bait possession, and set a six-inch minimum size for all eel harvested.¹⁵⁵ Maine and South Carolina are the only exceptions to the six-inch minimum size limit because both states have glass eel fisheries.¹⁵⁶ The FMP was amended in 2006, establishing additional reporting and control measures.¹⁵⁷

In addition to creating and implementing FMPs, the Commission undertakes peer-reviewed stock assessments to understand the health of the American eel population. The first stock assessment, completed in 2006, was “inconclusive” regarding the status of the American eel stock.¹⁵⁸ Additionally, the Commission requested in 2004 that the FWS and the National Marine Fisheries Service (NOAA Fisheries) conduct an American eel status review.¹⁵⁹ That report, released in 2007, concluded that the eel population had been

extirpated from some portions of its historical freshwater habitat over the past 100 years . . . [and the species abundance has declined] likely as a result of harvest or turbine mortality, or a combination of factors.¹⁶⁰

FWS also concluded that, at that time, listing the American eel as either “endangered” or “threatened” was not warranted.¹⁶¹

In response to stock assessment reports in 2005 and 2006, and considering that the yellow eel population declined in the prior two decades and that the stock was “at or near low levels,”¹⁶² the Commission’s American Eel Management Board (the Board) introduced a second addendum to the eel FMP.¹⁶³ The 2008 FMP Addendum increased emphasis on improving upstream and downstream passage of silver eel, allowing more silver eel to reach the Sargasso Sea to spawn.¹⁶⁴ It stopped short, however, of imposing commercial

¹⁵⁵ *Id.* at v.

¹⁵⁶ See ASMFC, ADDENDUM II TO THE INTERSTATE FISHERY MANAGEMENT PLAN FOR AMERICAN EEL 3 (2008), at http://www.asmf.org/speciesDocuments/eel/fmps/addendum%20II-AmericanEel_FINAL.pdf [hereinafter Addendum II] (visited 23 November 2013).

¹⁵⁷ The 2006 FMP Addendum gave states two options. Option 1 required states to create commercial fishing permits with mandatory reporting of eel catch and effort. Option 2 required states to attach mandatory purchase-reporting requirements to dealer permits and implement a commercial permit and reporting programme (ASMFC, ADDENDUM I TO THE INTERSTATE FISHERY MANAGEMENT PLAN FOR AMERICAN EEL 8 (2006), at <http://www.asmf.org/speciesDocuments/eel/fmps/addendumI.pdf> [hereinafter Addendum I]) (visited 23 November 2013).

¹⁵⁸ Addendum II, *supra* note 156, at 2.

¹⁵⁹ *Id.* at 3.

¹⁶⁰ *Id.* (quoting 50 C.F.R. § 17 (2012)).

¹⁶¹ *Id.* at 3.

¹⁶² *Id.*

¹⁶³ *Id.*

¹⁶⁴ *Id.*

fishery management measures until another stock assessment was completed, citing evidence that imposing “further restrictions on the American eel harvest would significantly impact fishermen.”¹⁶⁵

The American Eel Stock Assessment Committee finalized another stock assessment in May 2012, concluding that the American eel stock is “depleted.”¹⁶⁶ The Commission is currently considering a draft FMP Addendum III in response to the “depleted” stock assessment.¹⁶⁷ The draft addendum considers a number of management options for the commercial and recreational eel fishery, including closure of glass eel fisheries, gear reductions, dealer requirements (residency, reporting, licensing), increased monitoring across life stages, and habitat recommendations.¹⁶⁸

Additional State Controls

All Atlantic coast states allow commercial harvesting of the American eel, but vary in how they manage those fisheries. All states have to comply with FMP requirements at a minimum, but can implement additional management options such as shutting down the fishery, capping licences, and setting permit and gear fees.

Glass eel and elver fisheries are prohibited in every Atlantic coast state except Maine and South Carolina.¹⁶⁹ South Carolina’s glass eel fishery is minimal, as only ten permits are available for in-state and out-of-state residents.¹⁷⁰ Maine has a sizeable glass eel and elver fishery, however. As the fishery grew, the state passed laws restricting the number of licences by establishing a lottery system and, more recently, by capping the elver fishery licences, allowing only those with an elver licence each of the prior three years to apply for a renewal.¹⁷¹ Poaching of glass eels and elvers is considered to be a “serious problem” in many states, but enforcement is low due to the fact that the fishery is very mobile and usually executed at night.¹⁷²

¹⁶⁵ *Id.* at 5.

¹⁶⁶ ASMFC, STOCK ASSESSMENT REPORT 2012, *supra* note 6, at 4.

¹⁶⁷ The American Eel Board of the ASMFC approved a draft Addendum III for public consultation on 21 February 2013. See ASMFC, News Release: ASMFC American Eel Board Approves Draft Addendum III for Public Comment (21 February 2013).

¹⁶⁸ ASMFC, DRAFT ADDENDUM III TO THE FISHERY MANAGEMENT PLAN FOR AMERICAN EEL FOR PUBLIC COMMENT (March 2013), at <http://www.asafc.org/> (follow “Managed Species” hyperlink; then follow “American eel” hyperlink) [hereinafter ASMFC, Draft Addendum III] (visited 17 April 2013).

¹⁶⁹ ASMFC, STOCK ASSESSMENT REPORT 2012, *supra* note 6, at 20.

¹⁷⁰ *Id.*

¹⁷¹ ME. REV. STAT. ANN. tit. 12, § 6505-A (amended 2011). Despite this measure, catches have increased significantly. According to preliminary data, glass eel harvest for 2012 reached more than 20,000 pounds, more than double the harvest of 2011 and four times the average annual harvest between 2007 and 2011 (ASMFC, Draft Addendum III, *supra* note 168, at 14).

¹⁷² ASMFC, STOCK ASSESSMENT REPORT 2012, *supra* note 6, at 20.

The yellow/silver American eel is commercially harvested much more widely on the Atlantic coast. States manage the eel using a variety of regulatory tools ranging from licensing requirements to size restrictions.¹⁷³

The minimum standards set out in the American eel FMP, supplemented by the patchwork of state regulations, have historically been the sole source of management of the eel population. However, declining catches and the recognition that the stock is officially “depleted” have exposed the fishery to greater oversight from the federal government.

United States Management Role and Pending Endangered Species Act Listing

Although the federal government does not have day-to-day management responsibilities for the American eel,¹⁷⁴ the FWS is a non-voting member of the Commission and provides research and input on habitat improvement, dam relicensing projects, improved access such as eel passage projects, and conservation programmes.¹⁷⁵ Additionally, representatives from FWS and NOAA Fisheries are on the Commission’s Eel Technical Committee.¹⁷⁶ Finally, FWS also provides much-needed funding for species conservation and stock assessment modelling.

The other manner in which the federal government can get involved in the management of the American eel is via an Endangered Species Act (ESA) listing.¹⁷⁷ The ESA was enacted to “provide a means whereby the ecosystems

¹⁷³ In Maine, the sizeable yellow/silver eel pot fishery is managed using licensing requirements, minimum size limits, gear or mesh size restrictions, and trip level reporting. New Hampshire, Massachusetts, Rhode Island, and Connecticut all require commercial licences and trip level reporting. The New York yellow/silver eel fishery takes place mainly in Lake Ontario, the Hudson River, the upper Delaware River, and on the coast. Fishing in the Hudson River is subject to minimum and maximum size restrictions to limit exposure to PCBs, and fishing in the freshwater portions of the river and its tributaries has been prohibited since 1976 because of PCB exposure risk. Harvesting on the St. Lawrence River is limited to bait only. New Jersey imposes commercial licensing regulations and minimum mesh and size limits. Delaware requires catch reporting and a minimum size limit. The Maryland and Virginia yellow/silver eel pot fisheries are primarily located in the Chesapeake Bay, and are subject to licensing, reporting, and mesh size requirements. North Carolina has a small coastal yellow/silver eel pot fishery that is subject to licensing, reporting, and mesh size and bait limit rules. South Carolina issues licences and permits, requires reporting, and imposes various gear restrictions on its coastal eel fishery. Georgia does not have a specific eel licence but does require catch reporting. Finally, the yellow/silver eel fishery in Florida is subject to permit and mesh size requirements. For a thorough description of each of the Atlantic states’ regulatory requirements, see ASMFC, STOCK ASSESSMENT REPORT 2012, *id.* at 20.

¹⁷⁴ The American eel is considered a United States Fish and Wildlife Service [hereinafter USFWS] trust resource, however, and is managed by the USFWS on federally owned lands.

¹⁷⁵ See ASMFC Compact, *supra* note 147, at 4.

¹⁷⁶ See ASMFC, PROCEEDINGS OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION AMERICAN EEL MANAGEMENT BOARD iv (1 May 2012), at <http://www.asmfc.org> (follow “Managed Species” hyperlink; then follow “American Eel” hyperlink; then follow “Meetings & Minutes Summaries”) (visited 23 November 2012).

¹⁷⁷ 16 U.S.C.A. § 1531 (2011).

upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species.”¹⁷⁸ In the last ten years, FWS has been petitioned twice for an ESA listing of the American eel. The first petition in 2004 resulted in a 2007 final determination from FWS that an ESA listing was “not warranted” at that time.¹⁷⁹ The political climate has changed since 2007 due to the new presidential administration, and in 2010, the Council for Endangered Species Act Reliability (CESAR), a non-profit organization, petitioned FWS for ESA listing of the American eel.¹⁸⁰ With respect to regulatory activity, CESAR specifically noted that the ASMFC, the “only regulatory authority currently exercised [,] . . . has done little over the past decade” to address the decline of the species.¹⁸¹ Based on the decline of the American eel and the lack of adequate regulatory management, CESAR urged FWS to list the American eel as “threatened.”¹⁸²

In September 2011, FWS issued a 90-day finding (more than a year after the date it received the petition) that ESA listing may be warranted, stating that the CESAR petition included enough information to conduct a status review.¹⁸³ The results of the status review must be published within 12 months of receiving a petition.¹⁸⁴ As of August 2012, FWS had still not published the status review of the American eel. Concerned by the lack of regulatory action regarding its petition, CESAR filed a complaint against FWS seeking a declaratory judgment stating that FWS’ failure to comply with the ESA statutory status review time frame constituted a violation of the ESA, and

¹⁷⁸ *Id.*

¹⁷⁹ 12-Month Finding on a Petition To [*sic*] List the American Eel as Threatened or Endangered, 72 Fed. Reg. 22, 4967 (2 Feb 2007). Despite finding habitat decline, USFWS found that the “highly resilient” eel was still “widely distributed over the majority of its historical range” (*id.* at 4995). Furthermore, there was no evidence that parasites or contaminants were causing population-level effects, and there was no indication of mortality due to turbines, non-native species, or predation (*id.* at 4996).

¹⁸⁰ See COUNCIL FOR ENDANGERED SPECIES ACT RELIABILITY, PETITION TO LIST THE AMERICAN EEL (*ANGUILLA ROSTRATA*) AS A THREATENED SPECIES UNDER THE ENDANGERED SPECIES ACT (2010), at http://www.fws.gov/northeast/newsroom/pdf/American_eel_petition_100430.pdf (visited 25 November 2012). The CESAR petition cited a steep decline in the eel population since the 1980s and held a number of factors responsible: dam operations that have contributed to an 84 percent loss of American stream habitat, overutilization by commercial fishing, a swimbladder parasite, inadequacy of existing regulatory mechanisms, climate change, stream acidification, turbine injury, and mercury and PCB contamination (*id.* at 1–2).

¹⁸¹ *Id.*

¹⁸² *Id.* at 1.

¹⁸³ 90-Day Finding on a Petition To [*sic*] List the American Eel as Threatened, 76 Fed. Reg. 189, 60431 (September 29, 2011). Listing a species under the ESA following the receipt of a petition is a multi-step regulatory process. First, USFWS must determine whether the petition presents “substantial information” such that granting the petition may be justified, and issues an opinion in the form of a 90-day finding (16 U.S.C.A. § 1533 (2011)). If USFWS determines “the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted [,]” the ESA requires the Secretary of Commerce to “promptly” initiate a status review of the species (*id.*).

¹⁸⁴ 16 U.S.C.A. § 1533 (2011).

sought an injunction to compel the Secretary of the Interior to make certain a date by which FWS would complete the status review.¹⁸⁵ At the time of writing, the date of completion for the status review had not been set.

Once completed, the status review may make one of three different determinations with respect to CESAR's petition. First, the Secretary could find that the petitioned action is "not warranted."¹⁸⁶ Second, the Secretary could find that the petitioned action is warranted, and will "promptly publish" a proposed regulation implementing the listing.¹⁸⁷ If the American eel is listed under the ESA, FWS would lead the management of the eel in coordination with other federal agencies¹⁸⁸ and states,¹⁸⁹ and would authorize take permits, if appropriate, to private landowners and researchers.¹⁹⁰ Finally, the Secretary could find that the petitioned action is "warranted but precluded," that is, data support the need to list the American eel, but the listing is precluded by other pending ESA proposals of higher priority.¹⁹¹

4.3.2 *Canadian Eel Management Framework*

The catadromous nature of the species and its wide natural distribution in eastern Canada result in a fragmented domestic governance framework. Freshwater fisheries in Canada are subject to a complex patchwork of jurisdiction between the federal, provincial, and territorial governments developed and evolving since the first Fisheries Act in 1868.¹⁹² As a consequence of the

¹⁸⁵ Complaint at 2–3, *Center for Environmental Science Accuracy and Reliability (f/k/a Council for Endangered Species Act Reliability) v. Salazar*, No. 1:12-cv-01311 (D. D.C. 7 Aug. 2012), at <http://www.courthousenews.com/2012/08/09/Eel.pdf> (visited 23 November 2012).

¹⁸⁶ 16 U.S.C.A. § 1533 (2011).

¹⁸⁷ *Id.*

¹⁸⁸ 16 U.S.C.A. § 1536 (2011).

¹⁸⁹ 16 U.S.C.A. § 1535 (2011).

¹⁹⁰ 16 U.S.C.A. § 1538 (2011).

¹⁹¹ 16 U.S.C.A. § 1533 (2011).

¹⁹² Under the Constitution Act, 1867, 30 & 31 Vict. Ch. 3 (U.K.), *reprinted in* R.S.C. 1985, app. II, no. 5, the federal Parliament was assigned responsibility for sea coast and inland fisheries (§91.12), while provinces were assigned responsibility for matters of property and civil rights (§92.13) and the management of public lands (§92.5). During the initial years of Confederation, it was interpreted that the federal government had exclusive authority for the management of all fisheries in Canada. However, in later years the provinces disputed this interpretation (L.S. PARSONS, *MANAGEMENT OF MARINE FISHERIES IN CANADA* 19 (1993)). Several judicial decisions clarified the authorities of the two levels of government pertaining to fisheries (*id.*). Over time, a complex system of delegation of federal administrative authority to the provinces and territories has evolved on the basis of constitutional provisions, judicial decisions, and federal-provincial negotiations (*id.* at 19–23). Currently, freshwater fisheries administration is delegated to the province in Quebec and Ontario. In the Maritime Provinces, delegation has taken place for trout enhancement only. In Newfoundland, the federal government retains full management authority for all fisheries in accord with the 1949 Terms of Union (*see id.*; DFO, *FRESHWATER INITIATIVE: DISCUSSION DOCUMENT* (1999), at vi, at http://www.dfo-mpo.gc.ca/regions/central/pub/initiative/pdf/initiative_e.pdf) (visited 22 November 2012). The regulation of fish processing plants falls under the provincial power over property and civil rights, outside federal jurisdiction.

different constitutional and administrative arrangements, three jurisdictions have authority to manage American eel: the federal Minister of Fisheries and Oceans (including three DFO administrative regions: Gulf, Maritimes, and Newfoundland and Labrador), the province of Ontario, and the province of Québec. The federal government has a lead role for the protection of fish habitat under the Fisheries Act. Additionally, a greater role of the federal government is also undertaken with respect to freshwater and marine species at risk, although each province has also enacted laws and regulations for the protection of endangered species potentially applicable to freshwater species.

Concerns about the status of American eel in all provinces in the 1990s and early 2000s stressed the need for an on-going inter-jurisdictional forum for the discussion and coordination of eel conservation activities.¹⁹³ For this purpose, DFO and the provinces of Quebec and Ontario established the Canadian Eel Working Group (CEWG) and the Canadian Eel Science Working Group (CESWoG), which met for the first time in 2003.¹⁹⁴ The work of these two committees led to the development of a federal-provincial Canadian-wide American eel management plan released in draft form in April 2007.¹⁹⁵ The long-term goal of the draft management plan was to rebuild overall abundance of American eel in Canada to its level in the mid-1980s, while the short-term goal is to reduce eel mortality from all sources by 50 percent relative to the 1997 to 2002 average.

The Management Plan has yet to receive formal approval.¹⁹⁶ However, the short-term goal of the draft management plan has been adopted

¹⁹³ D.K. Cairns & J.M. Casselman (co-chairs), *Inaugural Meeting of the Canadian Eel Science Working Group*, DFO CAN. SCI. ADVIS. SEC. PROCEED. SER. 2004/017 (2004) at 1.

¹⁹⁴ Rob MacGregor et al., *Declines of American Eel in North America: Complexities Associated with Binational Management*, 69 AM. FISH. SOC. SYMP. 713 (2009). The Canadian Eel Science Working Group has met at least once a year since 2003. There are no published proceeding records for the Canadian Eel Working Group.

¹⁹⁵ DFO, *Fifth Meeting of the Canadian Eel Science Working Group, 3–5 October 2007*, DFO CAN. SCI. ADVIS. SEC. PROCEED. SER. 2008/027 (2009), at 33. An updated version of the draft was adopted in February 2009 (DFO, *Seventh Meeting of the Canadian Eel Science Working Group, 14–16 October 2009*, DFO. CAN. SCI. ADVIS. SEC. PROCEED. SER. 2011/035 (2011), at 14).

¹⁹⁶ The extensive process for its elaboration and adoption has had an unintended negative consequence. Indeed, DFO had developed formal integrated fisheries management plans for some eel fisheries in the 1990s and early 2000s, in compliance with the Sustainable Fisheries Framework (DFO, SUSTAINABLE FISHERIES FRAMEWORK (2009), at <http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/sff-cpd/overview-cadre-eng.htm>) (visited 17 April 2013). The adopted Integrated Fisheries Management Plans were: a) DFO, INTEGRATED EEL FISHERY MANAGEMENT PLAN: EASTERN NEW BRUNSWICK AREA, GULF REGION, 2007–2010, at http://www.glf.dfo-mpo.gc.ca/fofolios/00161/docs/nb-eel-anguille_2007_2010-eng.pdf [hereinafter DFO, Gulf IFMP] (visited 17 April 2013); b) DFO, SCOTIA-FUNDY ELVERS INTEGRATED FISHERIES MANAGEMENT PLAN (1998), at <http://www2.mar.dfo-mpo.gc.ca/fisheries/res/imp/98elver.html> [hereinafter DFO, Scotia-Fundy Elver IFMP] (visited 17 April 2013); and c) DFO, 1999–2003 INTEGRATED EEL MANAGEMENT PLAN FOR NEWFOUNDLAND AND LABRADOR (NAFO DIVISIONS 2J3KLP4R) (1999 (on file with authors)) [hereinafter DFO, Eel IFMP - NFL]. These management plans have not been updated, probably awaiting the adoption of the federal-provincial management plan, thus leaving the fisheries without updated formal and publicly available management direction.

as a management objective by the different competent authorities, achieving some level of informal coordination across jurisdictions. The efforts appear to be insufficient: the last assessment on the progress on achieving management goals reveal that the short-term objective has generally not been met.¹⁹⁷ Several reasons explain this result, including the high cost of some management measures, the lack of technological solutions for some issues (e.g., reduction in turbine mortality), and the lack of means to assess target reductions.

A further complexity in the Canadian legal landscape for eel management—and a complexity that was not addressed in the eel draft management plan—is the “special position of aboriginal peoples [in the fishery, as] recognized in Canadian constitutional provisions, in land claim settlements, in treaties, and at international law.”¹⁹⁸ A series of judgments in the 1970s and 1980s secured state recognition of an Aboriginal right to harvest resources for subsistence and ceremonial purposes.¹⁹⁹ In 1999, the landmark Marshall decision (a case that stemmed from alleged violations of federal laws and regulations in the fishing and selling of eel by members of a Mi’kmaq band) further recognized a treaty right to participate in the commercial fishery to sustain a “moderate livelihood,” subject to reasonable and justified limitations for conservation and management purposes.²⁰⁰ The Supreme Court has also asserted the federal, provincial, and territorial governments’ legal duty to consult and, where appropriate, accommodate when the Crown contemplates conduct that might adversely impact potential or established Aboriginal or treaty rights.²⁰¹

Fisheries Management

Eel fishing effort is unevenly distributed in its Canadian range, with some areas subject to intensive fisheries while others are totally unexploited.²⁰² The stage targeted by fisheries (glass eel, elver, yellow eel, and silver eel) also varies geographically.²⁰³ Currently, the eel fishery concentrates in four areas:

¹⁹⁷ DFO, Status and Progress, *supra* note 53.

¹⁹⁸ M.E. Turpel, *Aboriginal Peoples and Marine Resources: Understanding Rights, Directions for Management* in CANADIAN OCEAN LAW AND POLICY 393, 394 (David VanderZwaag ed., 1992).

¹⁹⁹ R. v. Denny, Paul and Sylliboy (1990), 5 CCC (3d) 322; R. v. Sparrow, [1990] 1 SCR 1075.

²⁰⁰ Marshall decision, *supra* note 19.

²⁰¹ Delgamuukw v. British Columbia, [1997] 3 SCR 1010, 153 DLR (4th) 193; Haida Nation v. British Columbia (Minister of Forests), 2004 SCC 73, [2004] 3 SCR 511; Taku River Tlingit First Nation v. British Columbia (Project Assessment Director), 2004 SCC 74, [2004] 3 SCR 550; Mikisew Cree First Nation v. Canada (Minister of Canadian Heritage), 2005 SCC 69; [2005] 3 SCR 388. See also: Ronalda Murphy, Richard Devlin, and Tamara Lorincz, *Aquaculture Law and Policy in Canada and the Duty to Consult with Aboriginal Peoples*, in AQUACULTURE LAW AND POLICY: TOWARDS PRINCIPLED ACCESS AND OPERATIONS 293 (David L. VanderZwaag & Gloria Chao eds., 2006).

²⁰² Government of Canada, *supra* note 4, at 279.

²⁰³ *Id.*

St. Lawrence River and estuary in Québec, the southern Gulf of St. Lawrence, the Maritimes, and Newfoundland.²⁰⁴ Ontario closed the commercial fishery in 2004 and the recreational fishery in 2005.²⁰⁵

The Quebec eel fishery in the St. Lawrence River and estuary takes place in four main fishing areas (Montreal archipelago, Lake Saint Pierre, St. Lawrence freshwater estuary, and St. Lawrence marine estuary),²⁰⁶ with the main fishing areas being Lake Saint Pierre and the brackish estuary. The fishery targets mainly silver eels.²⁰⁷ The commercial fishery is regulated through licences, fishing seasons, gear restrictions, and minimum size.²⁰⁸ Recreational fisheries for American eel in Quebec waters are managed through fishing licences and closed seasons established for each of the 29 defined recreational fishing zones in Québec.²⁰⁹ Between 2002 and 2009, Quebec implemented a buy-back programme on commercial fishing licences that considerably reduced the fishing effort.²¹⁰ As of 2010, 55 licences were still in effect for the Quebec silver and yellow eel fishery.²¹¹ This measure, together with a decline of eel abundance from Lake Ontario, explains a 53 percent reduction in reported catches in the 2005–2009 period, compared to the 1997–2002 average considered in the draft management plan.²¹²

The tidal waters of the southern Gulf of St. Lawrence support a significant yellow eel fishery, mainly in New Brunswick and Prince Edward

²⁰⁴ *Id.* at 279–280.

²⁰⁵ *Id.* at 279.

²⁰⁶ Serge Tremblay, *La gestion et la réglementation de la pêche commerciale de l'anguille d'Amérique (Anguilla rostrata) au Québec*, in *THE AMERICAN EEL IN EASTERN CANADA: STOCK STATUS AND MANAGEMENT STRATEGIES. PROCEEDINGS OF EEL MANAGEMENT WORKSHOP, 13–14 JANUARY 1997, QUEBEC CITY, CAN. TECH. REP. FISH. AQUAT. SCI.* 2196, at 47, 48, & 53 (R.H. Peterson ed., 1997). A third area, Richelieu River, was closed in 1998 (Government of Canada, *supra* note 4, at 277–278; Décret 847–2012 concernant le Plan de gestion de la pêche 2012–2013, G.O.Q. 2012.II.4326, Art. 8 [*Quebec Fisheries Management Plan 2012–2013*]). A small unlicensed fishery takes place in the Magdalen Islands (Îles de la Madeleine) (Government of Canada, *supra* note 4, at 280).

²⁰⁷ Government of Canada, *supra* note 4, at 279.

²⁰⁸ Quebec Fishery Regulations, 1990, S.O.R./90–214; Quebec Fisheries Management Plan 2012–2013, *supra* note 206. The management plan establishes fishing seasons, gear and gear specifications, quotas, and minimum size for different commercial fish species in each distinct segment of Quebec's waterways. The American eel commercial fishery is authorized with different gears and fishing seasons in 23 segments of Chaleurs Bay, Îles de la Madeleine, Rivière des Outaouais, Lake Saint-François, St. Lawrence River, Lake St. Louis, and Lake St. Pierre. Minimum size in all areas is 20 cm.

²⁰⁹ Quebec Fishery Regulations, 1990, S.O.R./90–214; Ordonnance générale 2012 modifiant le Règlement de pêche du Québec, Avril 2012; Sport fishing in Quebec including salmon fishing: Main rules - Season 2012–2014, at <http://www.mrn.gouv.qc.ca/english/publications/online/wildlife/fishing-regulations/news.asp> (visited 25 November 2012). The 29 recreational fishing zones were defined pursuant to the provisions of An Act Respecting the Conservation and Development of Wildlife, R.S.Q., c. C-61.1.

²¹⁰ In the lower St. Lawrence, commercial fishing licences were reduced from 67 to 21 in 2009; in Lake St. Pierre from 42 to 6 (Government of Canada, *supra* note 4, at 280).

²¹¹ 34 for yellow eel, and 21 for silver eel, all in NFBZ 10 (*id.* at 280–281).

²¹² DFO, Status and Progress, *supra* note 53, at 17.

Island but also extending to Nova Scotia.²¹³ In this region, fishing licences, closed areas, fishing seasons, minimum size, and gear restrictions are the management tools used to regulate both the commercial²¹⁴ and recreational²¹⁵ eel fisheries. Additionally, daily catch limits have been established for the eel recreational fishery.²¹⁶ Despite American eel fisheries in this fishing area being under the responsibility of only one federal agency (DFO, Gulf Region), DFO has adopted the practice of establishing province-specific management measures. Although generally there has been an effort to harmonize these management measures, provincial regulations differ in some aspects for both commercial and recreational fisheries.

Management measures, and particularly closed seasons, closed fishing areas, and minimum size, have been increasingly restrictive. However, they have not been sufficient to reduce fishing mortality as required in the draft

²¹³ The inland and tidal waters of New Brunswick (NB) and Nova Scotia (NS) that contribute to the fishery are those that flow in the Northumberland Strait or the Gulf of St. Lawrence. Hereinafter they are referred to as Gulf NB and Gulf NS. Other waters of these provinces also contribute to the Maritimes fishery, which are subject to different management regimes.

²¹⁴ The current eel regulations for the commercial fishery in the Gulf Region are included in the Maritime Provinces Fishery Regulation, S.O.R./93-55, Part V and in Variation orders 2007-010, 2012-021, 2012-083, and 2013-005 issued by DFO's Regional Director for the Gulf Region. The regulations contain different management measures depending on the province, the nature of the waters (inland or tidal), and the gears used (pots, traps, or spears). The commercial eel fishery in inland waters is closed in Gulf NB and Prince Edward Island (PEI). Gulf NS allows an inland eel fishery with eel pots and/or traps between 1 September and 24 October. Gulf NB and PEI also have closed the tidal eel fishery with spears, while Gulf NS allows a commercial spear fishery in tidal waters from 15 January to 30 April. The three provinces authorize a commercial eel fishery with eel pots and/or traps in tidal waters for one or two seasons during the year, although PEI has closed some tidal waters to commercial fisheries and NS has closed some tidal waters for eel trap and pot fisheries. Minimum size for all commercial fisheries is 53 cm.

²¹⁵ The eel regulations for the recreational fishery in the Gulf Region are included in the Maritime Provinces Fishery Regulation, S.O.R./93-55, Part V and in Variation orders 2010-04, 2009-119, 2006-110 and 2002-003 issued by DFO's Regional Director for the Gulf Region. As in the case of commercial fisheries, the management regimes vary according to the province, the nature of the waters (inland or tidal), and the gears used (pots, traps, or spears). Recreational eel fisheries in inland waters are closed in PEI, restricted to pots and to some inland waters of NB, and restricted to pots and traps in NS. The season for the inland recreational fishery with pots in NB extends from 1 January to 29 December, and a minimum size requirement of 20 cm is in place. In inland waters of NS, a recreational fishery with traps and pots can take place between 1 September and 24 October, with a minimum size requirement of 53 cm. In tidal waters, both NB and PEI allow a recreational fishery with spears only and during one or two seasons during the year. The minimum size in PEI is 25 cm, while in NB it is 53 cm except for the winter season. NS allows a recreational fishery in tidal waters with traps and pots between 1 September and 24 October, with the exception of the East River of Pictou. A recreational fishery with spears is allowed to take place in tidal waters between 15 January and 15 March. The minimum size is 53 cm for all recreational fisheries in Gulf NS.

²¹⁶ The daily catch limit in Gulf NB and Gulf NS is ten eels (Maritime Provinces Fishery Regulation, S.O.R./93-55), while in PEI the daily limit is six eels (variation order 2002-003 by the DFO Regional Director for the Gulf Region). A requirement to retain all eels was imposed on the winter recreational spear fishery to prevent high-grading, that is, the practice of discarding dead, injured, or small eels in order to make room to catch larger eels within the daily bag limit.

management plan. Reported landings in the Gulf Region in 2004–2008 showed an increase of 46.2 percent with respect to the 1997–2002 reference level, largely due to an increased abundance in that region.²¹⁷

The Maritimes Region, encompassing New Brunswick (Bay of Fundy) and Nova Scotia (Bay of Fundy and Atlantic coast), supports a commercial fishery for yellow and silver eels with approximately 400 commercial licences, although many are reportedly inactive.²¹⁸ The fishery is regulated through fishing seasons, gear restrictions, and minimum size measures.²¹⁹

Since the late 1980s this area supports the only elver fishery in Canada,²²⁰ with nine elver fishery licences. Eight elver licences allow the holder to catch 900 kg, while one allows a 270 kg catch.²²¹ As a matter of policy, elver licences are not issued for rivers with established large eel fisheries.²²² Each river is also subject to a catch limit of 300 kg.²²³ Although the adopted management measures have allowed a 27 percent reduction in the reported landings of larger eels to 2007, compared to the 1997–2002 average, this decrease is insufficient to comply with the objectives stated in the draft management plan. Additionally, there are concerns of incomplete reporting for the 2004–2007 period.²²⁴

The eel fishery in the province of Newfoundland and Labrador is restricted to the island of Newfoundland. The commercial fishery consists of an inland and coastal eel pot fishery and a fyke net fishery targeting silver and yellow eel, which is distributed throughout the province but concentrated in the southwest and northeast coasts.²²⁵ The recreational fishery consists mostly of winter harvesting (spearing) through the ice.²²⁶ The province regulates the

²¹⁷ DFO, Status and Progress, *supra* note 53, at 17.

²¹⁸ Government of Canada, *supra* note 4, at 280. The number of commercial eel licences was frozen in May 1993, while the number of recreational eel licences has been frozen at current levels since February 1997 (DFO, Status and Progress, *supra* note 53, at 13).

²¹⁹ Maritime Provinces Fishery Regulations, S.O.R./93-55, Part IV, subject to any variation orders that may be issued. Minimum size is 35 cm since 2005, with the exception of southwestern New Brunswick (including the Saint John River) where a 30 cm minimum size has been in force since 1998 (DFO, Status and Progress, *supra* note 53, at 13). Since May 2005, there is a mandatory requirement for escape mechanisms (1 inch by 1/2 inch openings) in fishing gears (*id.*).

²²⁰ Exploratory licences for glass eels have been issued for the Miramichi River in the southern Gulf of St. Lawrence and for Newfoundland, but no commercial elver fishery developed (DFO, Eel IFMP - NB, *supra* note 196 at 30; DFO, Eel IFMP - NFL, *supra* note 196, at 7 and 10–11).

²²¹ Government of Canada, *supra* note 4, at 280; and personal communication with Greg Stevens, Senior Advisor, Fisheries and Aquaculture Management, Fisheries and Oceans Canada (11 April 2013). Licence holders were authorized to catch an additional 100 kg for restocking purposes, but restocking activities are now suspended.

²²² DFO, Scotia-Fundy Elver IFMP, *supra* note 196, ¶1.2 and 4.2.5.

²²³ *Id.*

²²⁴ DFO, Status and Progress, *supra* note 53, at 17–18.

²²⁵ DFO, Eel IFMP - NFL, *supra* note 196, at 2.

²²⁶ Government of Canada, *supra* note 4, at 280; NFL EEL MANAGEMENT PLAN, *supra* note 67, at 15.

fishery through commercial and recreational licences,²²⁷ eel fishing seasons,²²⁸ gear restrictions,²²⁹ and minimum length requirements.²³⁰ The licences identify the freshwater bodies where the activity can take place,²³¹ as well as a maximum gear amount for each commercial licence holder. No new commercial licences have been issued since 1998,²³² and no new recreational licences have been issued since 1999.²³³ Additionally, the number of licences was practically halved in 2004.²³⁴ Although landings decreased by 47 percent with respect to the 1997–2002 average, practically achieving the objectives of the draft management plan, this reduction is attributed to market conditions rather than the implementation of these more restrictive management measures.²³⁵

Fish Habitat Protection

American eel faces serious anthropogenic threats in the form of destruction and disruption of habitat, particularly freshwater habitat. Dams, and particularly turbines, are considered one of the most important current threats to eel survival.²³⁶ Legislation and administrative practices aim to address these threats through the prevention of further habitat degradation, and through recovery of habitat.

²²⁷ Newfoundland and Labrador Fishery Regulations, S.O.R./78-443, § 34.

²²⁸ Fishing for eels in inland waters with pots is allowed between 1 July and 31 October, and in coastal waters between 1 June and 31 October. Fishing with fyke nets in inland waters is authorized only between early August (two days before the “black moon” in August) and 31 October; and in coastal waters between 1 June and 31 October (DFO, Eel IFMP - NFL, *supra* note 196, at 10). The fishing seasons were reduced by one month in 1998. A winter spear fishery is also allowed between 1 November and 31 March (Newfoundland and Labrador Fishery Regulations, S.O.R./78-443, § 34). The fyke net fishery closes when scheduled salmon rivers are closed to angling due to low water levels and high water temperatures, a situation that occurred in 2012 (DFO, Eel IFMP - NFL, *supra* note 196, at 12).

²²⁹ A three-year gear reduction programme was initiated in 1997 to ensure that all fishers comply with the regional standard for maximum gear amounts. At the end of the three-year reduction programme, all eel fishers were limited to a maximum of 75 eel pot (25 pots in inland waters and 50 pots in coastal waters) and 15 fyke nets (DFO, Eel IFMP - NFL, *supra* note 196, at 9–10). Salmonid bycatch exclusion devices were made mandatory for fyke nets in 1999 (*Id.* at 11). At least one-third of the width of all rivers and streams must be left open at all times (*id.* at 10). The use of bait is not permitted in eel fyke nets (*id.*).

²³⁰ The minimum retention size for eels is currently 30 cm. This minimum size was increased in 2005 from 20 cm.

²³¹ Fishers can only harvest from rivers that have been traditionally fished and identified in their licences (DFO, Status and Progress, *supra* note 53, at 13).

²³² *Id.*; DFO, Eel IFMP - NFL, *supra* note 196, at 9.

²³³ DFO, Eel IFMP - NFL, *supra* note 196, at 9.

²³⁴ DFO, Status and Progress, *supra* note 53, at 13.

²³⁵ *Id.* at 18.

²³⁶ Turbine passage is a major cause of mortality for seaward migrants of rivers in which eel are able to ascend past hydro dams. Turbine mortality in the two dams on the St. Lawrence River main stem can reach 26 percent at a single dam and cumulates at least 40 percent for silver eel migrating from Lake Ontario to the estuary (see Section 3.1). Cumulative mortalities have been estimated for the Ottawa and its tributary, the Mississippi. Survival of eel ascending this system is estimated to be as low as 2.8 percent due to turbine mortality alone (Government of Canada, *supra* note 4, at 284).

The Canadian legislative and regulatory framework offers a number of provisions to protect fish habitat. The main provisions in this respect are the Fisheries Act²³⁷ Sections 20 and 35, the implementation of which is guided by several policies and operational guidelines.²³⁸ Section 20 requires the owner or occupier of a river or stream obstruction to construct and maintain fish passage if the Minister determines it to be necessary for the public interest.²³⁹ Section 35, in turn, prohibits any work, undertaking, or activity that results in the harmful alteration or disruption, or the destruction, of fish habitat, unless prior authorization from the Minister is obtained.²⁴⁰ DFO's policy in implementing these two provisions is to address fish passage requirements of new works and undertakings under Section 35 of the Fisheries Act, while Section 20(1) is reserved for resolving issues involving existing obstructions.²⁴¹ Despite the seemingly strong fish habitat protection provisions provided under the Fisheries Act, they have shown severe limitations to effectively protect fish habitat.²⁴² Furthermore, recently enacted legislation further weakens the fish habitat provisions.²⁴³

DFO and other organizations have led some noteworthy initiatives to address habitat loss and direct mortality of American eel caused by dams and

²³⁷ Fisheries Act, RSC, 1985, c F-14.

²³⁸ These include DFO, POLICY FOR THE MANAGEMENT OF FISH HABITAT (1986) and DFO, PRACTITIONERS GUIDE TO FISH PASSAGE FOR DFO HABITAT MANAGEMENT STAFF, VERSION 1.1 (2007) [hereinafter DFO, PRACTITIONERS GUIDE].

²³⁹ Fisheries Act, *supra* note 237, § 20.1.

²⁴⁰ *Id.*, § 35.1 and §35.2 b). In implementing §35 according to existing fish habitat policies, the construction of adequate fish passage may be considered: a) a condition to determine that the work, undertaking or activity does not cause harmful alteration, disruption, or destruction (HADD) to the fish habitat and thus the issuing of a letter of advice; or b) a mitigation measure considered in the decision to issue a HADD permit. Other situations in which works and undertakings may proceed are described in § 35.2 a), c), and d).

²⁴¹ See DFO, PRACTITIONERS GUIDE, *supra* note 238. In the case of existing obstructions, with §20(1) being a discretionary power, DFO's policy is to solve problems proactively and cooperatively working with the owners of obstructions (*Id.* at 6).

²⁴² DFO's implementation of §35 to works and undertakings has been criticized and its effectiveness questioned. See COMMISSIONER ON ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, REPORT OF THE COMMISSIONER ON ENVIRONMENT AND SUSTAINABLE DEVELOPMENT TO THE HOUSE OF COMMONS: PROTECTING FISH HABITAT (2009)). This is particularly the case for American eel, which traditionally has not been considered a priority species for research on dam passages and the implementation of s. 35 and s. 20 of the Fisheries Act (see, for example, CHIF AND DFO, MOVING FORWARD WITH THE RESEARCH AGENDA: UNDERSTANDING IMPACTS OF HYDRO ON FISH AND FISH HABITAT IN FRESHWATER. JOINT RESEARCH PLAN FOR PUBLIC AND PRIVATE ORGANIZATIONS IN CANADA (December 2007) at 11, at <http://www.dfo-mpo.gc.ca/science/coe-cde/chip-chif/doc/chif-eng.pdf>) (visited 17 April 2013).

²⁴³ As a result of an amendment passed into law on June 2012 and taking effect on a future date, s 35(1) of the Fisheries Act will prohibit any work, undertaking, or activity that results in serious harm to fish that are part of a commercial, recreational, or aboriginal fishery, or to fish that support such a fishery. It limits the current scope of the fish habitat protection provision by: a) limiting protection to habitat of fish that are part of a commercial, recreational, or aboriginal fishery; and b) limiting protection to cases of permanent alteration or destruction of habitat (Jobs, Growth and Long-term Prosperity Act, S.C. 2012, c. 19).

other barriers. For example, DFO implemented a study focused on the identification of barriers, estimation of habitat loss, and prioritization of barriers that need to be reopened in Ontario, Québec, and the Maritime Provinces.²⁴⁴ Similarly, Ontario Power Generation has undertaken a trap and transfer pilot study since 2008 in the vicinity of the two largest hydropower dams in the St. Lawrence River to evaluate the impact on silver eel survival and escapement, and is showing promising results.²⁴⁵ Fish-friendly turbines are being developed, but their implementation in existing facilities is not cost-effective.²⁴⁶

Although these initiatives are positive steps, they still have to translate into effective and decisive action for the recovery of lost or disrupted eel habitat. A recent assessment concluded that there has not been any demonstrated progress in reducing mortality of eels during passage through turbines in medium and large hydroelectric generating stations.²⁴⁷ As is discussed below, critical habitat identification under the Species at Risk Act²⁴⁸ (SARA) would significantly improve the prospects for habitat protection. However, this legal tool is not yet available for American eel.

Species at Risk Act and Provincial Legislation on Endangered Species

Considering the dramatic declines of American eel, in particular in Lake Ontario and the upper St. Lawrence River, COSEWIC assessed the species in 2006, concluding that it was a species of special concern. The independent assessment by COSEWIC triggers for the federal government the obligation to consider the listing of the species under SARA as a species of special concern, a listing that in turn results in the obligation to manage the species to prevent it from becoming endangered or threatened.²⁴⁹ The listing of American eel underwent an extended consultation process, but no decision has been made to date.²⁵⁰

²⁴⁴ Government of Canada, *supra* note 4, at 284.

²⁴⁵ First results show that 67.1 percent of large yellow/silver eels are completing their migration to the Middle Estuary within two years after being transferred and show similar energy content and sexual development as non-transferred silver eel (*id.*).

²⁴⁶ *Id.*

²⁴⁷ DFO, Status and Progress, *supra* note 53, at 2.

²⁴⁸ Species at Risk Act, S.C. 2002, c. 29 [hereinafter SARA].

²⁴⁹ *Id.* at §§ 6, 65–72.

²⁵⁰ For details on the listing process, the limitations of SARA, and the poor performance of the federal government in listing species at risk, in particular with respect to marine species, see David VanderZwaag & Jeffrey Hutchings, *Canada's Marine Species at Risk: Science and Law at the Helm, but a Sea of Uncertainties*, 36 OCEAN DEV. & ENVTL. L. 219 (2005); Arne Mooers et al., *Biases in Legal Listing under Canadian Endangered Species Legislation*, 21 CONSERV. BIOL. 572 (2007); Scott Findlay et al., *Species Listing under Canada's Species at Risk Act*, 23 CONSERV. BIOL. 1609 (2009); Jeffrey Hutchings & Marco Festa-Bianchet, *Canadian Species at Risk (2006–2008), with Particular Emphasis on Fishes*, 17 INT'L REV. 53 (2009); Arne Mooers et al., *Science, Policy, and Species at Risk in Canada*, 60 BIOSCIENCE 843 (2010).

In 2012, COSEWIC re-assessed the species and concluded that eel in Canada should be considered a single designatable unit with a threatened status.²⁵¹ A listing decision based on the COSEWIC re-assessment is not expected before 2014. If listed, the species would benefit from stronger protection measures for its individuals, residences, and critical habitat²⁵² and a formal and on-going recovery planning process.²⁵³

Some provinces have also adopted measures under the provincial legislation to protect vulnerable species. Ontario listed the species as endangered under the Ontario Endangered Species Act²⁵⁴ on 30 June 2008,²⁵⁵ while habitat protection under the general habitat provisions will be triggered on 30 June 2013 unless a habitat regulation is developed before that date.²⁵⁶ A recovery strategy has been drafted but is still pending adoption.²⁵⁷ In Newfoundland and Labrador, eel has also been listed according to the provincial Endangered Species Act²⁵⁸ as a vulnerable species,²⁵⁹ and a management plan has been adopted pursuant to Section 13(1) of the Act.²⁶⁰ Since the provincial government does not have direct management responsibilities for American eel, the purpose of the management plan is to contribute to management by identifying knowledge gaps, facilitating directed studies within the province, and sharing information with other management agencies. In Quebec, the species is considered as likely to be designated as threatened or vulnerable²⁶¹ under Section 9 of the Act Respecting Threatened or Vulnerable Species.²⁶² None

²⁵¹ COSEWIC, *supra* note 2.

²⁵² SARA prohibits the killing, harm, harass, capture, or taking of an individual listed as an extirpated, endangered, or threatened species (§ 32), and damage or destruction of the residence of one or more listed individuals (§ 33). It contains provisions for the protection of identified critical habitat of listed species (§§ 56–64) and environmental assessment for impacts of federal related projects to species at risk (§ 79). It further provides substantial enforcement measures (§§ 85–119) and encouragement of financial support for recovery activities (§ 11). For more information on the protection mechanisms of SARA, see KATE SMALLWOOD, A GUIDE TO CANADA'S SPECIES AT RISK ACT (2003); VanderZwaag & Hutchings, *supra* note 250. For a critical review of the federal government's implementation of SARA, see ROYAL SOCIETY OF CANADA EXPERT PANEL, SUSTAINING CANADA'S MARINE BIODIVERSITY: RESPONDING TO THE CHALLENGES POSED BY CLIMATE CHANGE, FISHERIES, AND AQUACULTURE 201, 207 (2012).

²⁵³ SARA, *supra* note 248, §§ 37–55.

²⁵⁴ Ontario Endangered Species Act, S.O. 2007, c. 6.

²⁵⁵ Ontario Regulation 230/08 Species at Risk in Ontario List, Schedule 2 (Endangered Species Act, 2007).

²⁵⁶ Ontario Endangered Species Act, *supra* note 254, § 10(1), (3).

²⁵⁷ ROB MACGREGOR et al., DRAFT RECOVERY STRATEGY FOR THE AMERICAN EEL (*ANGUILLA ROSTRATA*) IN ONTARIO (2010).

²⁵⁸ Newfoundland and Labrador Endangered Species Act, S.N.L. 2001, c. E-10.1.

²⁵⁹ Newfoundland and Labrador Regulation 57/02, Endangered Species List Regulations under the Endangered Species Act (O.C. 2002-274), amended by Newfoundland and Labrador Regulations 157/04, 17/06, 116/07, 9/08, 114/09, and 68/10, Schedule C.

²⁶⁰ NFL EEL MANAGEMENT PLAN, *supra* note 67.

²⁶¹ Ministerial Order Concerning the Establishment of a List of Threatened or Vulnerable Vascular Plant Species which Are Likely to Be so Designated and a List of Threatened or Vulnerable Wildlife Species Which Are Likely to Be so Designated, RRQ, c E-12.01, r 4 (Que).

²⁶² Act Respecting Endangered or Vulnerable Species, R.S.Q., c. E-12.01 (Que).

of the Maritime Provinces have listed American eel under their provincial endangered species legislation.²⁶³

5. FUTURE DIRECTIONS FOR AMERICAN EEL SCIENCE AND MANAGEMENT

The previous sections portray a challenging road for American eel conservation and sustainable use. The current situation is marked by a strong market demand for eels, particularly elvers, many gaps in knowledge both in natural and social sciences, and an incomplete management regime that has as yet had limited success in halting the eels' decline. A renewed commitment and a more decisive, integrated, and proactive action are required to address the multiple challenges ahead. Possible avenues to improve scientific knowledge and to forge stronger management arrangements for the elusive eel are discussed next.

5.1 Directions for Natural Science

The oceanic migration of American eel *leptocephalus* larvae from their deep-sea spawning site in the southwestern Sargasso Sea to the continental shelf is still pretty much a black box, as is the migration of glass eels across the shelf to estuaries and rivers and during the first year of continental life. The same can be said for the oceanic migration of maturing eels from rivers and estuaries to the continental shelf and the deep Atlantic Ocean. Although the larval and maturing eel migrations are of equal importance, the OTN will focus on the latter by attempting to elucidate the spatial and temporal dynamics of the oceanic migrations of adult eels as they move to their spawning grounds in the Sargasso Sea. On the North American east coast, the diverse paths adult eels take back to the Sargasso Sea are unknown but such knowledge may provide guidance for management measures to protect migration pathways. Further investigation of such issues will require cross-boundary scientific cooperation to get a fuller picture of migration dynamics.

Studies of the oceanic component of the adult migration by deploying satellite pop-up tags and developing coupled biological-physical models in the Gulf of St. Lawrence and the North Atlantic Ocean are needed to explore the feasibility, in terms of arrival times and energy expenditures, of different migration scenarios. These modelling efforts should be pursued.

²⁶³ New Brunswick Endangered Species Act, S.N.B. 1996, c. E-9.101; Prince Edward Island Wildlife Conservation Act, R.S.P.E.I. 1988, c. W-4.1; Nova Scotia Endangered Species Act, S.N.S. 1998, c. 11.

Migratory pathways can be simulated based on physical models of the oceanographic field and tracking particles that are governed by different responses to temperature and salinity, and possess different degrees of directional bias expressed through varying rates of swimming speed and compass orientation. Modelled migratory trajectories may then serve to predict migratory mechanisms and pathways that must be evaluated by empirical observations in situ. A new generation of pop-up tags employing geomagnetism for geolocation may provide the in situ empirical observations necessary to test the validity of model-based hypotheses of migratory performance.

Another important future direction for eel research relates to population genetics and eel life histories. There is an apparent paradox between important regional variability in life history traits during the juvenile (yellow) eel stage in continental waters on the one hand, and evidence for a single panmictic population on the other. Recently, researchers have found local genetic differences generated by spatially varying selection among American glass eels from different sampling sites in eastern Canada characterized by different sea-surface temperatures when they enter continental waters.²⁶⁴ Latitudinal differences in juvenile growth rate after adjustment for growing season temperatures that may have genetic origins have also been reported.²⁶⁵ This research avenue should be pursued.

Another issue that deserves attention is the marine prey-predator relationships of eel. Satellite tagging of eels has revealed an unexpectedly high rate of predation by warm-gutted predators on American eels in the lower estuary of the St. Lawrence River and Gulf of St. Lawrence (see Section 3.2). The predator was identified as the porbeagle shark. As the pupping grounds of female porbeagle sharks apparently are located in the Sargasso Sea,²⁶⁶ it seems plausible that eels and sharks form a strong predator-prey relationship with sharks tracking the migration of eels south to their respective reproductive sites. Given the high levels of predation documented and the diminishing out migration of silver eels from the Great-Lakes-Upper St. Lawrence area, this predation may represent a major source of mortality, contributing to significant reductions in an already reduced eel spawner biomass. Complicating this issue further, porbeagle shark are themselves under consideration for protection,²⁶⁷ raising the possibility of legislative and management conflicts among jurisdictions and species vying for protected status. Future research

²⁶⁴ Côté et al., *supra* note 11.

²⁶⁵ B.M. Jessop, *Geographic Effects on American Eel (Anguilla rostrata) Life History Characteristics and Strategies*, 67 CAN. J. FISH. AQUAT. SCI. 326 (2010).

²⁶⁶ S.E. Campana, W. Joyce, & M. Fowler, *Subtropical Popping Ground for a Cold-water Shark*, 67 CAN. J. FISH. AQUAT. SCI. 769 (2010).

²⁶⁷ Porbeagle shark has been assessed as endangered in its Canadian range of distribution (COSEWIC, COSEWIC ASSESSMENT AND STATUS REPORT ON THE PORBEAGLE SHARK *LAMNA NASUS* IN CANADA (2004)) but the Governor General in Council, on the recommendation of the Minister of the Environment, decided not to add the species to Schedule I of the Species at Risk Act (Order Giving Notice of

should aim to test the hypothesis that porbeagle sharks are major predators of American eels during their migration in the Gulf of St. Lawrence and in the Atlantic Ocean. The use of a new generation of miniature satellite tags and chat tag technology²⁶⁸ will provide information on predation rates of tagged eels by predators such as porbeagle sharks.

Finally, we know next to nothing about the biology of American eels distributed south of their Sargasso Sea spawning grounds. Although American eels have been captured in the fresh waters of the Caribbean Islands and South America, we know nothing of their abundance, demographic structure, or their migration routes at the leptocephalus stage or at the adult silver eel stage. The importance of this segment of the panmictic eel population to the overall abundance of the species and its overall population dynamic is unknown and merits attention in the future.

5.2 Social Science Directions

The complex relationships among eel, aboriginal traditional uses in North America, and commercial exploitation to provision foreign markets constitute a valuable case study to analyse theories of knowledge²⁶⁹ with actor-network theory standing out as a particularly useful approach. The actor-network theory emphasizes the need to track and understand the complex array of actors and actions at multiple levels that influence scientific, technological, and social discourses.²⁷⁰ A further idea is that non-humans can be understood as agents, or actors, in networks and thus, the relationship between humans and non-humans should be a particular priority for sociological research.²⁷¹

Decisions not to Add Certain Species to the List of Endangered Species, P.C. 2006-769, C. Gaz. 2006.II.1127). In the United States, porbeagle shark is considered a species of concern under the NOAA Fisheries Proactive Conservation Program. Although the listing of the species under the Endangered Species Act was petitioned in 2010, NOAA Fisheries concluded that the petitions did not present substantial scientific information, indicating the petitioned actions may be warranted and consequently decided not to initiate a status review (NOAA, Fisheries Service, Proactive Conservation Program, at http://www.nero.noaa.gov/prot_res/CandidateSpeciesProgram/ (visited 21 January 2013)). Recently, the international community listed porbeagle shark under CITES Appendix II, thereby restricting its international trade (CITES, Press Release, CITES Conference Takes Decisive Action to Halt Decline of Tropical Timber, Sharks, Manta Rays and a Wide Range of Other Plants and Animals (14 March 2013), at http://www.cites.org/eng/news/pr/2013/20130314_cop16.php (visited 17 April 2013).

²⁶⁸ Satellite tags mounted on predators act as hydrophones to record acoustic pingers mounted on prey species.

²⁶⁹ For a review of various sociological theories, see Richard Lempert, *The Inevitability of Theory*, 98 CAL. L. REV. 877 (2010).

²⁷⁰ See, for example, Bruno Latour, *Networks, Societies, Spheres: Reflections of an Actor-Network Theorist*, 5 INT'L J. COMM. 796 (2011); Reza Dibadj, *Postmodernism, Representation, Law*, 29 U. HAW. L. REV. 377 (2007).

²⁷¹ BRUNO LATOUR, *POLITICS OF NATURE: HOW TO BRING THE SCIENCES INTO DEMOCRACY* (2004); Mrill Ingram, *Keeping Up with the E. Coli: Considering Human-Nonhuman Relationships in Natural Resources Policy*, 50 NAT. RES. J. 371 (2010).

The actor-network perspective may be particularly valuable for the examination of American eel in two significant ways. First, the elusive character of the creature itself, along with the difficulty of creating any sense of scientific certainty about the basic facts of the eels' life cycle, recommends an approach to knowledge which emphasizes its social origins. Such an approach, mindful of the incomplete knowledge on eel as network agent, would advocate for a stronger emphasis on a precautionary approach in relevant management regimes.

Second, the close connections to the species of Aboriginal populations over the long history in North America suggest an actor-network formulation in which eels are extended a ceremonial equality. The industrial era provides a more exploitative view of eels, but contrasting aboriginal perspectives raise questions about actual, and preferred, relationships. Further research on Indigenous peoples' historical and contemporary relationship to eel has the potential to provide valuable insights into these questions. There is a particular need for research on customary and/or ecological knowledge and use, as well as their cultural connections. Furthermore, strengthening the understanding of the aboriginal relationship with eels may significantly contribute to a management regime that fulfils federal fiduciary responsibilities towards Aboriginal and treaty rights, as required under the Canadian Constitution Act²⁷² and called for under international instruments.²⁷³

5.3 Management Directions

Envisioning future directions for American eel management remains difficult in light of the many current governance uncertainties and realities. Although the effective implementation of coordinated domestic management measures in Canada and the United States under existing legal frameworks would go a long way to address the threats to the species, that scenario has so far remained elusive. As discussed in Section 4, neither Canada nor the United States has been able to finalize a consistent and substantive management plan for American eel that covers the range of eels' distribution under their jurisdiction. Key known threats, and particularly habitat fragmentation and turbine mortalities, have not been adequately addressed. Stronger protective nets under species

²⁷² Constitution Act, 1982, § 35, being Schedule B of the Canada Act 1982 (U.K.), 1982, c. 11.

²⁷³ For example, under Article 25 of the United Nations Declaration on the Rights of Indigenous Peoples (U.N. Res. 61/295, 13 September 2007), Indigenous peoples have "the right to maintain and strengthen their distinctive spiritual relationship with their traditionally owned or otherwise occupied and used lands, territories, waters and coastal seas and other resources and to uphold their responsibilities to future generations in this regard." Under Article 26, Indigenous peoples "have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired." Indigenous peoples "have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources" and the "right to determine and develop priorities and strategies for the development or use of their lands or territories and other resources" (Arts. 28 and 32).

at risk legislation would trigger various recovery responsibilities, but neither Canada nor the United States has yet decided to list American eel.

Domestic management measures alone would in any case be insufficient to adequately address the governance challenges of the species. Recent scientific research confirming panmixia makes broader cooperation among range coastal states a necessary element of any governance framework. Some steps in that direction have already been taken by Canada and the United States, but cooperation attempts have not been finalized and are reportedly on hold for the time being. Various management suggestions offered by academics and practitioners to establish a regional conservation organization, possibly along the lines of the North American Salmon Conservation Organization,²⁷⁴ have not been followed.

Garnering political will to address new management initiatives for American eel may be problematic in light of the relatively low public profile to date of this catadromous species. No political structure like the European Union exists for fostering broad regional cooperation to conserve American eels in the North Atlantic.²⁷⁵ Nevertheless, at least three possible ways forward stand out.

First, Canada and the United States might take seriously the mandate emanating from Article 67 of the LOSC, namely, a requirement to enter into a bilateral agreement where a catadromous species migrates across EEZs.²⁷⁶ The two countries could take a more proactive and precautionary approach to American eel conservation by negotiating at least a bilateral framework agreement to enhance scientific cooperation and to pledge development of further measures to conserve the American eel. Considering the high demand for glass eel and the potential impacts of this fishing practice on the sustainability of the species, discussion of common and precautionary approaches for the regulation of elver fisheries might be a priority.

Second, the on-going initiative of the Sargasso Sea Alliance to establish the Sargasso Sea as a marine protected area²⁷⁷ might be built upon to spawn broader inter-regional cooperation in studying and protecting the American eel. Through the evolving process of developing new management arrangements for the Sargasso Sea, development of a conservation strategy, memorandum of understanding, or other agreement might be considered to address the broader ecosystem linkages raised by the American eel.²⁷⁸ The identification of the Sargasso Sea as ecologically or biologically significant marine

²⁷⁴ See, for example, MacGregor et al., *supra* note 194, at 20. The ASMFC, STOCK ASSESSMENT REPORT 2012, *supra* note 6, at 18–19, endorsed a similar approach by stating that “[i]deally, there would be an ‘International Northwest Atlantic Eel Council.’”

²⁷⁵ Through Council Regulation (EC) No. 1100/2007, the European Union has required Members States to prepare eel management plans setting target levels of escapement and considering restocking measures.

²⁷⁶ See text accompanying *supra* note 99. Adult eels from Canada may traverse the U.S. EEZ en route to the Sargasso Sea while juveniles may transit via ocean currents on their route into Canadian waters.

²⁷⁷ See text accompanying *supra* notes 115 and 116.

area under the CBD represents an important endorsement to the initiative. However, Canada has yet to join in the international efforts to protect this Atlantic ecosystem.²⁷⁹

Third, the cooperative path offered by the Convention on the Conservation Migratory Species of Wild Animals might be followed. The Convention encourages the forging of new agreements among range states of migratory species. A framework memorandum of understanding for the conservation and wise use of American eels might at least be considered involving all states contributing to the apparent common spawning population. While neither Canada nor the United States is party to the CMS,²⁸⁰ the Convention does allow states to join subsidiary agreements even without having party status.²⁸¹ A broader agreement under the CMS umbrella with broad participation of coastal states in the range of American eel distribution may also facilitate the necessary cooperation and sharing of scientific information required to assess all components of the panmictic species and develop coordinated management objectives. Scientific and management cooperation between North America and Europe may also be a fruitful avenue to pursue considering the close biological proximity of the American eel and the European eel (*Anguilla anguilla*), including partially overlapping spawning sites.

As the mysteries of eel unravel, management needs and challenges come to the forefront. In addressing them, the continuing calls from the international community for strengthening precautionary and ecosystem approaches to coastal and ocean management continue to offer aspirational goals.²⁸²

²⁷⁸ From 2–4 December 2012 the Sargasso Sea Alliance convened a technical preparatory meeting to discuss a draft political declaration, the Hamilton Declaration, which is expected to be formalized at an inter-ministerial meeting in 2014. States bordering the Sargasso Sea and range states of key species will likely pledge to further cooperate in conservation efforts and commit to establish a Sargasso Sea Commission in Bermuda (*Hamilton Declaration Negotiations Initiated*, SARGASSO SEA ALLIANCE NEWSLETTER (December 2012), at <http://archive.constantcontact.com/fs169/1109154724045/archive/1111908328655.html>; and personal communication with David Freestone, Executive Director, Sargasso Sea Alliance (15 April 2013)).

²⁷⁹ Canada did not attend the technical preparatory meeting held in December 2012 (*id.*).

²⁸⁰ As of 1 December 2012 (National Participation in the Convention on the Conservation of Migratory Species of Wild Animals and Its Agreements, at http://www.cms.int/about/all_countries_eng.pds) (visited 11 December 2012). CMS, 23 June 1979, 1651 U.N.T.S. 333.

²⁸¹ For example, while the United States is not a party, it is a participant in three MOUs (marine turtles in the Indian Ocean and Southeast Asia, Pacific Island cetaceans and sharks)(*Id.*). American eel, of course, would need to be listed under Appendix I or II of the CMS (CMS, Arts. III, IV).

²⁸² On the need for precautionary and large-scale ecosystem approaches, see Louis A. Vélez-Espino & Marten A. Koops, *A Synthesis of the Ecological Processes Influencing Variation in Life History and Movement Patterns of American Eel: Towards a Global Assessment*, 20 REV. FISH BIOL. FISH. 163 (2010).