

**DAMAGE TO FISHERIES BY DAMS:
THE INTERPLAY BETWEEN INTERNATIONAL
WATER LAW AND INTERNATIONAL FISHERIES LAW**

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I. INTRODUCTION

There can be various reasons why on-stream dams are constructed and operated on rivers. Some dams are built to create new water supplies for irrigation or domestic use that can be stored in the reservoirs behind the impoundments. Other dams are built to generate hydro-electric energy that can be produced by running the water stored in reservoirs through turbines. There are also dams built to regulate flows to avoid downstream flooding during storms. More often than not, there are “multipurpose” on-stream dams that are designed to serve a mix of water supply, energy and flood control purposes.¹

Globally, the presence of on-stream dams is pervasive and extensive. A 2000 report by the World Commission on Dams found that there were more than 45,000 dams in over 150 countries.²

Although some dams are geographically located in watersheds within a single nation, other dams are located in watersheds that span multiple nations. For example, in North America the Columbia River/Snake River watershed spans Canada and the United States and the Colorado River watershed spans Mexico and the United States.³ There are numerous on-stream dams in both the Columbia River/Snake River and Colorado River watersheds.⁴ Similarly, there are on-stream dams located on the Mekong River (which flows through multiple

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¹ See generally, John Echeverria et al., *RIVERS AT RISK: THE CONCERNED CITIZEN'S GUIDE TO HYDROPOWER* (Island Press 1989).

² World Commission on Dams, *Dams and Development: A New Framework for Decision-Making* (2000 Report) p. 8.

³ Eric A. Stene, *The Central Valley Project, Introduction* (United States Department of the Interior, <http://www.usbr.gov/history/cvpintro.html>) (last visited June 2016); See generally Philip Fradkin, *A RIVER NO MORE: THE COLORADO RIVER AND THE WEST* (University of Arizona Press, 1981).

⁴ Eric A. Stene, *The Central Valley Project, Introduction* (United States Department of the Interior, <http://www.usbr.gov/history/cvpintro.html>) (last visited June 2016); See generally Philip Fradkin, *A RIVER NO MORE: THE COLORADO RIVER AND THE WEST* (University of Arizona Press, 1981).

nations in Southeast Asia)⁵, the Danube River (which flows through multiple nations in Europe)⁶, the Indus River watershed (which spans India and Pakistan)⁷, the Brahmaputra River watershed (which flows through China, India and Bangladesh)⁸, the Tigris/Euphrates watershed (which flows through multiple nations in the Middle East)⁹ and the Nile River (which flows through multiple nations in northern Africa).¹⁰

Regardless of the reasons why on-stream dams are constructed and operated, and regardless of whether on-stream dams are located in watersheds that span multiple nations, there is a set of environmental impacts commonly associated with such construction and operation. This article examines the impacts of on-stream dams on ecosystems and fisheries through the dual lens of international water law and international fisheries law, as well as international law on the obligation to assess transboundary environmental impacts. The article also discusses how efforts to reduce greenhouse gases that contribute to global warming are impacting the legal and policy context for evaluating the environmental effects of on-stream hydro-electric dams.

II. EFFECT OF ON-STREAM DAMS ON FISHERIES/AQUATIC HABITAT AND FISHERS

Before discussing the legal frameworks for evaluating the environmental impacts of on-stream dams, at the outset it is useful to first identify the different ways that fisheries and aquatic ecosystems can be affected by such facilities. This identification will provide an ecological foundation for the legal analysis that follows.

A. DAMS AS BARRIERS TO FISH PASSAGE

The presence of an on-stream dam can serve as a barrier for fish that traditionally migrate upstream and downstream of where the dam is located. For example, on the west coast of North America, wild Pacific salmon begin their life in inland freshwaters, migrate to the ocean for several years and then return to their natal inland freshwaters to spawn¹¹. On-stream dams in the Fraser River watershed in Canada, the Columbia River/Snake River watershed in Canada and the United States and the Sacramento River/San Joaquin River watershed in the

⁵ Agreement on Cooperation for Sustainable Development of the Mekong River Basin (Chiang Rai, April 5, 1995), printed in 34 *ILM* 864 (1995).

⁶ J. Linnerooth, *The Danube River Basin: Negotiating Settlements to Transboundary Environmental Issues*, 30:3 *NATURAL RESOURCES JOURNAL* 629 (1990).

⁷ D. Caponera, *International Water Resources Law in the Indus Basin*, in M. Ali, G. Radosevich and A. Ali Kahn (eds), *WATER RESOURCES POLICY FOR ASIA* (Balkema, Rotterdam, 1987).

⁸ Deryck O. Lodrick, *Brahmaputra River*, <http://www.brtannica.com/place/Brahmaputra> River (last visited June 2016).

⁹ A. Kibarogiu, A. Kirshner, S. Mehring, R. Wolfrum (eds), *WATER LAW AND COOPERATION IN THE EUPHRATES-TIGRIS REGION* (2013).

¹⁰ Owen McIntyre, *ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW* (Ashgate 2007) p. 181.

¹¹ Trout Unlimited, *Healing Troubled Waters: Preparing Trout and Salmon Habitat for a Changing Climate* 3 (August 2007).

United States serve as downstream and upstream barriers to migratory salmon.¹² Since the construction of these dams on the west coast of North America, the salmon fishery in the region has suffered significant declines.¹³

Other examples of dam impacts on migratory fisheries include the Porto Primavera Dam on the Parana River in Brazil and the Pak Mun Dam on the Mekong River in Thailand.¹⁴ The Porto Primavera Dam resulted in an 80% reduction in fish catch upstream of the facility, and the Pak Mun dam blocked fish migration to the Mun River, one of the most fishery productive tributaries to the Mekong River.¹⁵

B. CREATION OF SLACK WATER CONDITIONS ABOVE AND BELOW DAMS

On-stream dams and associated reservoirs change the natural flow (velocity) of a river. This change can create “slack water” conditions both above and below the dam, in which the velocity of the natural flow of a river is greatly reduced. Slack water conditions can result in algae growth and reduced oxygen levels that impact fisheries.¹⁶

The environmental impacts associated with slack water conditions on the Danube River in Europe was a central issue in the 1997 decision by the International Court of Justice (“ICJ”) in the *Gabcikovo-Nagymaros* case.¹⁷ In this case, the ICJ considered allegations that slack water conditions resulting from an on-stream dam located in Slovakia had led to an algae bloom and degraded aquatic habitat for fisheries in waters located in Hungary.¹⁸

The adverse effects related to slack water have also become a concern on the Volta River in Africa.¹⁹ There is evidence that low flow conditions below the Akosombo Dam in Ghana (on the Volta River) have resulted in the spread of weeds that harbor snails that serve as intermediate hosts for lethal intestinal

¹² Matthew D. Evendens, *FISH VERSUS POWER: AN ENVIRONMENTAL HISTORY OF THE FRASER RIVER* (Cambridge University Press 2004); David Wegner, *Snake River Dam Breaching: River and Salmon Politics in the George W. Bush Administration* 33 *GOLDEN GATE UNIVERSITY LAW REVIEW* (2003).

¹³ Melanie E. Kleiss, *The Salmon Hatchery Myth: When Bad Policy Happens to Good Science*, 6 *MINNESOTA JOURNAL OF LAW, SCIENCE AND TECHNOLOGY* 420 (2004); See generally Jim Lichatowich, *SALMON WITHOUT RIVERS* (1999).

¹⁴ World Commission on Dams, *Dams and Development: A New Framework for Decision-Making* (2000 Report) p. 84.

¹⁵ World Commission on Dams, *Dams and Development: A New Framework for Decision-Making* (2000 Report) p. 84.

¹⁶ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana).

¹⁷ *Case Concerning the Gabcikovo-Nagymaros Project (Hungary/Slovakia)* (International Court of Justice, The Hague, 25 September 1997).

¹⁸ *Case Concerning the Gabcikovo-Nagymaros Project (Hungary/Slovakia)* (International Court of Justice, The Hague, 25 September 1997).

¹⁹ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana).

diseases.²⁰ Research undertaken by the Volta Basin Research Project at the University of Ghana has documented the rise of these intestinal diseases and associated child mortality since the Akosombo Dam was constructed in the 1960s.²¹

C. EFFECT OF DAMS ON WATER TEMPERATURE, SALINITY AND SEDIMENT TRANSPORT

When an on-stream dam changes the timing or reduce the amount of water released downstream, this can result in an increase in water temperatures below the dam. The increase in water temperatures below a dam can have particularly acute adverse impacts on coldwater fisheries such as salmon. Salmon have a limited tolerance for higher water temperatures.²² They prefer water temperatures below fifty-five degrees (Fahrenheit), suffer reduced growth and survival rates as water temperatures get closer to sixty degrees (Fahrenheit) and are generally unable to survive in water warmer than sixty degrees (Fahrenheit).²³ Instream water temperatures tend to be hottest in the summer, which is also when water stored behind dams is in highest demand for agriculture and irrigation.²⁴ The result is that there are often reduced releases of upstream water from dams at the time of year when increased air temperatures are pushing water temperatures up.²⁵ The reduced volume of water flowing downstream caused downstream waters to warm and salmon mortality rates to rise.²⁶

The presence of on-stream dams can also affect the salinity levels of waters below the dams due to seawater intrusion.²⁷ When the amount of freshwater flowing downstream is reduced by on-stream dams the seawater pushes farther upstream.²⁸ Rising salinity levels can affect freshwater fisheries with low tolerance for higher salt concentrations.²⁹ In the United States, for instance, saltwater intrusion resulting from the operation of dams in the Sacramento

²⁰ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana).

²¹ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana).

²² Trout Unlimited, *Healing Troubled Waters: Preparing Trout and Salmon Habitat for a Changing Climate* (2007 Report).

²³ Trout Unlimited, *Healing Troubled Waters: Preparing Trout and Salmon Habitat for a Changing Climate* (2007 Report).

²⁴ Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1, 6 (2016).

²⁵ Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1, 6 (2016).

²⁶ Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1, 6 (2016).

²⁷ Paul Stanton Kibel, *Sea Level Rise, Saltwater Intrusion and Endangered Fisheries – Shifting Baselines for the Bay Delta Conservation Plan*, 38 ENVIRONS 259, 263-265 (2015).

²⁸ Paul Stanton Kibel, *Sea Level Rise, Saltwater Intrusion and Endangered Fisheries – Shifting Baselines for the Bay Delta Conservation Plan*, 38 ENVIRONS 259, 263-265 (2015).

²⁹ Paul Stanton Kibel, *Sea Level Rise, Saltwater Intrusion and Endangered Fisheries – Shifting Baselines for the Bay Delta Conservation Plan*, 38 ENVIRONS 259, 263-265 (2015).

River/San Joaquin River watershed in California has adversely impacted delta smelt, a freshwater fish now listed as endangered.³⁰

The presence of on-stream dams can also trap sand and gravel that would otherwise be carried downstream.³¹ To the extent the presence of sand and gravel serve as important elements of aquatic habitat for fisheries downstream, the interference of dams with natural sediment transport can adversely impact fisheries.³²

D. EFFECTS OF DAMS ON FISHERS DEPENDENT ON IMPACTED FISHERIES

In considering the harm that on-stream dams can cause to fisheries, it is critical to remember that this harm goes beyond biodiversity and ecological considerations. In many watersheds, freshwater fisheries serve as an important food source for local populations and/or support local commercial fishers.³³ The loss of fisheries caused by on-stream dams can therefore affect poverty conditions in watershed communities and the economic viability of the fishing sector.³⁴

For example, in connection with the Ghana's Akosombo Dam on the Volta River (discussed above), slack water conditions have had an adverse impact on the shrimp fishery below the dam.³⁵ Because many riverside communities below the Akosombo Dam rely on such shrimp as a basic food supply, the decline of the shrimp fishery on the lower Volta River has health and nutritional impacts for the local population.³⁶

As another example, on the west coast of North America there are many local fishers whose livelihood is dependent on the health and abundance of fisheries such as salmon. Local fishers in this region have banded together to form the Pacific Coast Federation of Fishermen's Associations ("PCFFA").³⁷ PCFFA is now a leading advocate for efforts to change the way on-stream dams operate (in

³⁰ Paul Stanton Kibel, *Sea level Rise, Saltwater Intrusion and Endangered Fisheries – Shifting Baselines for the Bay Delta Conservation Plan*, 38 ENVIRONS 259 (2015).

³¹ Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1, 7 (2016).

³² Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1, 7 (2016).

³³ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana)

³⁴ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana)

³⁵ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana)

³⁶ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana)

³⁷ Dan Bacher, *How Water Exports Are Killing California Jobs and Salmon*, COUNTERPUNCH (February 12, 2010).

terms of fish passage and downstream releases) to restore Pacific coast fisheries.³⁸

Recognition of how on-stream dams can impact local communities and fishers dependent on fisheries is important to understanding how certain principles of international water law and international environmental law – such as equitable utilization, meeting vital human needs, avoidance of significant environmental harm and transboundary environmental impact assessment (discussed further below) – apply to the construction and operation of on-stream dams.

E. STORAGE DAMS VERSUS RUN-OF-THE-RIVER DAMS

In addition to on-stream storage dams, in which large amount of water are retained in reservoirs for diversion as well as later release to generate electricity, there are also run-of-the-river dams. In contrast to a storage dam, a run-of-the-river dam does not involve out-of-stream diversions and is operated so that a river's natural flow is passed through turbines to generate electricity.³⁹ Run-of-the-river dams have the same adverse impacts as storage dams in terms of upstream/downstream fish migration and sediment transport. However, run-of-the-river dams tend not to have the adverse downstream temperature and slack water problem associated with storage dams since the timing and volume of releases below a run-of-the river dam is similar to natural conditions.⁴⁰

There have also been instances where on-stream dams were proposed as run-of-the-river facilities (with reduced anticipated adverse downstream environmental impacts) but then upon approval and completion were operated as storage dams. For example, the proponents of the Thailand's Pak Mun Dam on the Mekong River described the project as a run-of-the-river facility that would have minimal downstream impacts on instream conditions and fisheries.⁴¹ Since its construction, however, Pak Mun Dam's gates remain closed much of the time to better coordinate releases with energy demand.⁴² The operation of Pak Mun Dam as a storage dam rather than a run-of-the-river dam had therefore led to much more significant adverse downstream impacts than were predicted when the dam originally proposed.⁴³

III. GENERAL PRINCIPLES OF INTERNATIONAL FISHERIES LAW

There is a well-developed body of international fisheries law but this body of law has focused primarily on ocean fisheries or anadromous fisheries (which spend

³⁸ Dan Bacher, *How Water Exports Are Killing California Jobs and Salmon*, COUNTERPUNCH (February 12, 2010).

³⁹ Stephanie M. Smith, *The Damming of Nature: How China is Expanding Its Dam Infrastructure and Potential Negative Downstream Effects on Fisheries of the Yaluzangby-Brahmaputra River*, 9 GOLDEN GATE UNIVERSITY ENVIRONMENTAL LAW JOURNAL 701, 702 (2016).

⁴⁰ Sudha Ramachandran, *Water Wars: China, India and the Great Dam Rush*, THE DIPLOMAT (April 3, 2015).

⁴¹ Patrick McCully, *SILENCED RIVERS: THE ECOLOGY AND POLITICS OF LARGE DAMS*, (2001), p. 15.

⁴² Patrick McCully, *SILENCED RIVERS: THE ECOLOGY AND POLITICS OF LARGE DAMS*, (2001), p. 15.

⁴³ Patrick McCully, *SILENCED RIVERS: THE ECOLOGY AND POLITICS OF LARGE DAMS*, (2001), p. 15.

at least part of their life cycle in the ocean).⁴⁴ Although there is little international law dealing directly with rights and obligations relating to freshwater fisheries, there are general legal principles established in the context of ocean/anadromous fisheries and shared natural resources that may be pertinent and relevant to the evaluation of disputes over rights and obligations respecting freshwater fisheries.

A. UNITED NATIONS CONVENTION ON THE LAW OF THE SEA AND THE UNITED NATIONS STRADDLING STOCKS TREATY

In regard to ocean and anadromous fisheries, two of the primary sources of international law are the 1982 United Nations Convention on the Law of the Sea (“UNCLOS”)⁴⁵ and the 1996 United Nations Treaty on Straddling and Migratory Fish Stocks (“UN Straddling Stocks Treaty”).⁴⁶ Both of these treaties address the rights and obligations of nations in regard to fish stocks that are located exclusively in the international high seas, that move between the international high seas and coastal nations’ 200 mile off-shore exclusive economic zone (“EEZ”), or that move between different nations’ EEZs.⁴⁷ The provisions of these two agreements dealing with ocean/anadromous fish stocks that “straddle” and “migrate” between the waters of different nations may provide guidance in regard to freshwater fisheries that straddle and migrate between the waters of different nations.⁴⁸

Article 63(1) UNCLOS provides: “Where the same stock or stocks of associated species occur within the exclusive economic zone of two or more coastal states, these States shall seek, either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary to co-ordinate and ensure the conservation and development of such stocks.”⁴⁹ Article 64(1) of UNCLOS is titled “Highly migratory species” and provides: “The coastal states and other States whose nationals fish in the region for the highly migratory species listed in Annex I shall co-operate directly or through appropriate international organizations with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both with and beyond the exclusive economic zone.⁵⁰ In regions for which no appropriate international organization exists, the coastal State and other States whose nationals harvest these species in the region shall co-operate to establish

⁴⁴ Donald C. Baur, Tim Eichenberg and Michael Sutton, *OCEAN AND COASTAL LAW AND POLICY* (2008), pp. 303-332.

⁴⁵ The Third United Nations Convention on the Law of the Sea, December 10, 1982, 21 I.L.M. 1245 (entered into force November 16, 1994).

⁴⁶ The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁴⁷ Donald C. Baur, Tim Eichenberg and Michael Sutton, *OCEAN AND COASTAL LAW AND POLICY* (2008), p. 305.

⁴⁸ Donald C. Baur, Tim Eichenberg and Michael Sutton, *OCEAN AND COASTAL LAW AND POLICY* (2008), pp. 306, 308-309.

⁴⁹ Article 63(1), The Third United Nations Convention on the Law of the Sea, December 10, 1982, 21 I.L.M. 1245 (entered into force November 16, 1994).

⁵⁰ Article 64(1), The Third United Nations Convention on the Law of the Sea, December 10, 1982, 21 I.L.M. 1245 (entered into force November 16, 1994).

such an organization and participate in its work.”⁵¹ Taken together Articles 63(1) and 64(1) of UNCLOS provide that coastal nations have an affirmative obligation to cooperate to ensure the conservation of fish species that straddle or migrate between multiple coastal state off-shore waters.⁵²

The UN Straddling Stocks Treaty sought to provide further guidance on the participatory rights of different nations in terms of the regional fishery management organizations described in Articles 63(1) and 64(1) of UNCLOS.⁵³ These participatory rights would, in turn, help determine the respective rights and obligations of nations whose nationals actively fished in the area or for the species regulated by a particular regional fishery management organization.⁵⁴ Article 11 of the UN Straddling Stocks Treaty provides:

In determining the nature and extent of participatory rights for new members of a subregional or regional fisheries management organization, or for new participants in a subregional or regional fisheries management organization, States shall take into account, inter alia: (a) the status of the straddling fish stocks and highly migratory fish stocks and the existing levels of fishing effort in the fishery; (b) the respective interests, fishing patterns and fishing practices of new and existing members or participants; (c) the respective contributions of new and existing members or participants to conservation and management of the stocks, and to the collection and provisions of accurate data and to the conduct of scientific research on the stocks; (d) the needs of coastal fishing communities which are dependent mainly on fishing for the stocks; (e) the needs of coastal States whose economies are overwhelmingly dependent on the exploitation of living marine resources; and (f) the interests of developing States from the subregion or region in whose area of national jurisdiction the stocks also occur.⁵⁵

From Article 11 of the UN Straddling Stocks Treaty the following two general principles emerge that may also be relevant to freshwater fisheries.⁵⁶ First, the

⁵¹ Article 64(1), The Third United Nations Convention on the Law of the Sea, December 10, 1982, 21 I.L.M. 1245 (entered into force November 16, 1994).

⁵² Articles 63(1) and 64(1), Article 64(1), The Third United Nations Convention on the Law of the Sea, December 10, 1982, 21 I.L.M. 1245 (entered into force November 16, 1994).

⁵³ Donald C. Baur, Tim Eichenberg and Michael Sutton, OCEAN AND COASTAL LAW AND POLICY (2008), pp. 308-309.

⁵⁴ Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁵⁵ Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁵⁶ Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and

extent to which a nation is contributing to the conservation of straddling/migratory fish stocks should be taken into account in the allocation of rights to catch such fish stocks.⁵⁷ Second, when determining the respective rights of nations to catch straddling/migratory fish stocks, consideration should be given to local communities dependent on such stocks and to nations whose economies are greatly reliant on such fish stocks.⁵⁸

B. ICJ FISHERIES DECISION IN ICELAND-UNITED KINGDOM CASE

In the 1970s, prior to the international codification of the 200-mile EEZ in the 1982 UNCLOS, a fisheries dispute developed between Iceland and the United Kingdom over the cod fishery off-shore of Iceland.⁵⁹ Due to concerns about overfishing of its off-shore cod fishery, Iceland unilaterally extended its 12-mile offshore exclusive fishing zone to 200 miles.⁶⁰ British fishing vessels, which had traditionally fished well within the 200-mile zone, refused to recognize Iceland's claims.⁶¹

The two nations agreed to submit the dispute to the International Court of Justice (ICJ) which rendered its decision in 1974 in the *Icelandic Fisheries Case*.⁶² The ICJ held:

Both states have an obligation to take full account of each other's rights and of any fishery conservation measures the necessity of which is shown to exist in those waters. It is one of the advances of maritime international law, resulting from the intensification of fishing, that the former laissez-faire treatment of the living resources of the high seas has been replaced by a recognition of a duty to have due regard to the rights of other states and the needs of conservation for the benefits of all. Consequently, both Parties have the obligation to keep under review the fishery resources in the disputed waters and to examine together, in light of scientific and other available information, the measures required for conservation, development and equitable exploitation of those resources.⁶³

Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁵⁷ Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁵⁸ Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁵⁹ 1974 I.C.J. 3 (1974).

⁶⁰ 1974 I.C.J. 3 (1974).

⁶¹ 1974 I.C.J. 3 (1974).

⁶² 1974 I.C.J. 3 (1974).

⁶³ 1974 I.C.J. 3 (1974).

In this 1974 ruling, the ICJ articulated general international law principles that would later be incorporated into the 1982 UNCLOS. More specifically, the ruling found that nations have an affirmative obligation to work together for the conservation of fisheries, and that in fulfilling this obligation nations have a related duty to take each other's respective interest in the fishery into appropriate consideration.⁶⁴ Taken together, these findings suggest that unilateral actions by one nation (or vessels flying that nation's flag) that undermined the conservation of fisheries or that disregarded the interest of other nations in such fisheries were inconsistent with modern international fisheries law.

Although the ICJ *Icelandic Fisheries Case* involved ocean fisheries, the general principles noted above might also apply to disputes between nations involving the conservation of and respective rights and obligations relating to freshwater fisheries or fisheries that migrate through inland waters.

C. CANADA-UNITED STATES PACIFIC SALMON TREATY: FISHING RIGHTS GROUNDED IN ORIGINATIONS

Salmon on the west coast of North America begin their life-cycle in inland freshwater streams.⁶⁵ From there, they head downstream to the Pacific Ocean where they spend several years and then return to their natal inland freshwater streams to spawn.⁶⁶ Different salmon runs travel in different directions and routes during their life period in the ocean.⁶⁷

Vessels flying the Canadian and United States flags fish for salmon in off-shore ocean waters.⁶⁸ Offshore Canadian fishers often catch salmon that originate and spawn in freshwater streams in Alaska, Washington, Oregon and California in the United States (such as the Yukon River watershed, Columbia River/Snake River watershed and Sacramento River/San Joaquin River watershed).⁶⁹ Similarly, offshore United States fishers often catch salmon that originate and spawn in freshwater streams in British Columbia in Canada (such as the Fraser River watershed).⁷⁰ From a practical standpoint, it is difficult if not impossible for the vessels fishing offshore to know whether they are catching salmon whose natal streams are in Canada or the United States.⁷¹ As M.P. Shepard and A.W. Argue explain in their book *The 1985 Pacific Salmon Treaty: Shared Conservation*

⁶⁴ 1974 I.C.J. 3 (1974).

⁶⁵ M.P. Shepard and A.W. Argue, *THE 1985 PACIFIC SALMON TREATY: SHARING CONSERVATION BURDENS AND BENEFITS* (University of British Columbia Press 2005), pp. 4-9.

⁶⁶ M.P. Shepard and A.W. Argue, *THE 1985 PACIFIC SALMON TREATY: SHARING CONSERVATION BURDENS AND BENEFITS* (University of British Columbia Press 2005), p. 9.

⁶⁷ M.P. Shepard and A.W. Argue, *THE 1985 PACIFIC SALMON TREATY: SHARING CONSERVATION BURDENS AND BENEFITS* (University of British Columbia Press 2005), p. 9.

⁶⁸ M.P. Shepard and A.W. Argue, *THE 1985 PACIFIC SALMON TREATY: SHARING CONSERVATION BURDENS AND BENEFITS* (University of British Columbia Press 2005), p. 9.

⁶⁹ M.P. Shepard and A.W. Argue, *THE 1985 PACIFIC SALMON TREATY: SHARING CONSERVATION BURDENS AND BENEFITS* (University of British Columbia Press 2005), p. 9.

⁷⁰ M.P. Shepard and A.W. Argue, *THE 1985 PACIFIC SALMON TREATY: SHARING CONSERVATION BURDENS AND BENEFITS* (University of British Columbia Press 2005), p. 9.

⁷¹ M.P. Shepard and A.W. Argue, *THE 1985 PACIFIC SALMON TREATY: SHARING CONSERVATION BURDENS AND BENEFITS* (University of British Columbia Press 2005), p. 9.

Burdens and Benefits, “With respect to such migrations, the man-made boundaries established by diplomats almost two centuries ago have no relevance. Fish bound for Canadian and United States rivers intermingle or are present and harvestable off the coasts of both countries.”⁷²

In the 1995 Pacific Salmon Treaty, Canada and the United States addressed this situation by basing respective fishing rights on the concept of “originations.”⁷³ Pursuant to Article III(a) of the treaty, fishing rights are allocated so as to “provide for each Party to receive benefits equivalent to the production of salmon originating in its waters.”⁷⁴ This approach is consistent with Article 11(c) of the UN Straddling Stocks Treaty, which suggests in allocating the respective fishing rights of nations consideration should be given to the extent each nation contributes to the conservation of the fish stocks in question.⁷⁵

According to international fisheries law scholar J.A. Yanagida:

The purpose of the equity principle [in the Pacific Salmon Treaty] is sensible enough. It recognizes that downstream fishermen depend substantially on the country that has jurisdiction over the spawning grounds. To ensure that salmon have unimpeded access to upriver spawning grounds, the country of origin may have to remove natural obstructions, build fish passes, forgo hydro-electric development and control pollution. If stocks are to be enhanced, the party upstream is best situated to do so. To accord that party adequate incentive to undertake these responsibilities, the equity principles provides that the country of origin should receive benefits equivalent to the production of salmon in its waters.⁷⁶

The corresponding implication of the originations approach relied upon in the Pacific Salmon Treaty is that countries whose facilities and activities reduce the amount of salmon originating in their inland freshwater stream should have their right to fish offshore for salmon reduced accordingly. The implications of the originations approach to fishing right allocation has significant implications for on-stream dams. That is, if on-stream dams in Canada or the United States block the upstream/downstream passage of migrating salmon or are operated in a manner that results in downstream aquatic habitat conditions that reduce the productivity of salmon stocks, the presence and operation of such dams should provide the basis for a downward adjustment of respective salmon fishing rights.

⁷² M.P. Shepard and A.W. Argue, *THE 1985 PACIFIC SALMON TREATY: SHARING CONSERVATION BURDENS AND BENEFITS* (University of British Columbia Press 2005), p. 9.

⁷³ J.A. Yanagida, *The Pacific Salmon Treaty*, 81(3) *AMERICAN JOURNAL OF INTERNATIONAL LAW* 577-592 (1987).

⁷⁴ Article III(a), Agreement Between the Government of Canada and the Government of the United States Concerning Pacific Salmon signed January 28, 1985 Annex IV amended May, 1991

⁷⁵ Article 11(c), The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N.

⁷⁶ J.A. Yanagida, *The Pacific Salmon Treaty*, 81(3) *AMERICAN JOURNAL OF INTERNATIONAL LAW* 577-592 (1987).

Although the originations approach in the Pacific Salmon Treaty relates to an anadromous fishery and off-shore fishing, the originations approach might also provide an appropriate basis for the allocation of rights to catch freshwater fisheries. To the extent there are fisheries that migrate through freshwater rivers and streams of multiple nations, when a nation constructs and operates on-stream dams that reduce the productivity of the freshwater fisheries in the region, the originations approach would warrant a corresponding reduction in the fishing rights of the nation causing such injury to the fisheries.

D. UNITED NATIONS ENVIRONMENT PROGRAMME PRINCIPLES ON SHARED NATURAL RESOURCES

In 1981, the United Nations General Assembly adopted the Environmental Law Guidelines and Principles on Shared Natural Resources, which were developed by a working group of legal experts convened by the United Nations Environment Programme (“UNEP Shared Natural Resources Principles”).⁷⁷

Principle 1 of the UNEP Shared Natural Resources Principles states that consistent with the concept of equitable utilization of shared natural resources, States must “co-operate with a view to controlling, preventing, reducing or eliminating adverse environmental effects which may result from the utilization of such resources. Such co-operation is to take place on an equal footing and take into account the sovereignty, rights and interests of the States concerned.”⁷⁸

Principle 3 of the UNEP Shared Natural Resources Principles provides that States have “the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction” and that “it is necessary for each state to avoid to the maximum extent possible and to reduce to the minimum extent possible the adverse environmental effects beyond its jurisdiction of the utilization of a shared natural resource so as to protect the environment, in particular when such utilization might (a) cause damage to the environment which could have repercussions on the utilization of the resource by another sharing State; (b) threaten the conservation of a shared renewable resource; (c) endanger the health of the population of another State.”⁷⁹

Principle 12 of the UNEP Shared Natural Resources Principles establishes that States are subject to liability in accordance with applicable international law for

⁷⁷ United Nations General Assembly Resolution 34/186 of 18 December 1919.

⁷⁸ United Nations Environment Programme, ENVIRONMENTAL LAW GUIDELINES AND PRINCIPLES ON SHARED NATURAL RESOURCES, http://www.unep.org/training/programmes/Instructor%20Version/Part_2/Activities/Interest_Groups/Decision-Making/Supplemental/Enviro_Law_Guidelines-Principles_rev2.pdf.

⁷⁹ United Nations Environment Programme, ENVIRONMENTAL LAW GUIDELINES AND PRINCIPLES ON SHARED NATURAL RESOURCES, http://www.unep.org/training/programmes/Instructor%20Version/Part_2/Activities/Interest_Groups/Decision-Making/Supplemental/Enviro_Law_Guidelines-Principles_rev2.pdf.

environmental damage resulting from violations of these obligations caused to areas beyond their jurisdiction.”⁸⁰

In regards to shared fisheries impacted by the presence and operation of on-stream dams, Principles 1 and 3 of the UNEP Shared Natural Resources Principles set forth an affirmative obligation of the country where such dams are located to reduce the impacts on fisheries that are present in other countries and avoid designing and operating such dams in a manner that threatens the conservation of fisheries that migrate through the waters of multiple countries. Principle 12 of the UNEP Shared Natural Resources Principles suggests that nations that fail to comply with Principles 1 and 3 may be held liable for damages to other nations’ fisheries that result from such non-compliance.

IV. UPSTREAM/DOWNSTREAM NATION RIGHTS AND OBLIGATIONS RELATING TO THE IMPOUNDMENT AND RELEASE OF WATER FROM ON-STREAM DAMS

With an understanding of the ways that on-stream dams can adversely affect fisheries and fishers, and with an understanding of general principles of international fisheries and shared natural resources law, we can now consider the application of general principles of international water law to the question of the impacts of on-stream dams on fisheries.

A. EQUITABLE UTILIZATION AND VITAL HUMAN NEEDS

Up until around 1900, there was some limited support for a principle of international water law known as “absolute territorial sovereignty.”⁸¹ Pursuant to this theory, when a watercourse flowed from upstream nations through downstream nations, the upstream nations were lawfully entitled to capture or otherwise use all of the water resources that passed through its boundaries without any obligations to downstream nations.⁸² Upstream nations might voluntarily opt to enter into treaties with downstream nations regarding water resources but such treaty arrangements were not mandated by generally accepted principles of international law. A well-known example of this approach is the 1895 opinion of United States Attorney General Judson Harmon concerning whether the United States had any legal obligations to Mexico that curtailed the United States’ use of Colorado River water.⁸³ In an opinion that became known as the “Harmon Doctrine,” Harmon found that the question of whether the United States should “take any action from considerations of comity is a question which should be decided as one of policy only, because, in my

⁸⁰ United Nations Environment Programme, ENVIRONMENTAL LAW GUIDELINES AND PRINCIPLES ON SHARED NATURAL RESOURCES, http://www.unep.org/training/programmes/Instructor%20Version/Part_2/Activities/Interest_Groups/Decision-Making/Supplemental/Enviro_Law_Guidelines-Principles_rev2.pdf.

⁸¹ Owen McIntyre, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (Ashgate 2007), pp. 13-17.

⁸² Owen McIntyre, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (Ashgate 2007), pp. 13-17.

⁸³ Official Opinions of the Attorneys-General of the United States (1985), 274, at 283.

opinion, the rules, principles and precedents of international law impose no liability or obligation upon the United States.”⁸⁴

In the 20th century, the principle of absolute territorial sovereignty in international water law gave way to the principle of “limited territorial sovereignty”, a principle that itself was based on the concept of “equitable utilization.”⁸⁵ Equitable utilization posits that in a transboundary watershed all nations in the watershed have rights to equitably utilize the water resources and all nations in the watershed have obligations to respect other nation’s rights to such equitable usage.⁸⁶ Further sources of international water law provided additional guidance on the scope and limits of what constituted equitable utilization.⁸⁷

Article 6(1) of the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (“1997 UN Watercourses Convention”) presents a non-exhaustive indicative list of factors which should be considered in determining what constitutes equitable utilization of international watercourses between multiple nations:

- a. Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character;
- b. The social and economic needs of the watercourse States concerned;
- c. The population dependent on the watercourse in each watercourse State;
- d. The effects of the use or uses of the watercourse in one watercourse State on other watercourse States;
- e. Existing and potential uses of the watercourse;
- f. Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect;
- g. The availability of alternatives, of corresponding value, to a particular planned or existing use.⁸⁸

Article 6(3) of the 1997 UN Watercourses Convention then explains: “The weight to be given each factor is to be determined by its importance in comparison with that of all other relevant factors. In determining what is a reasonable and equitable use, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.”⁸⁹

⁸⁴ Official Opinions of the Attorneys-General of the United States (1985), 274, at 283.

⁸⁵ Owen McIntyre, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (Ashgate 2007), pp. 23-40.

⁸⁶ Owen McIntyre, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (Ashgate 2007), pp. 23-40.

⁸⁷ Owen McIntyre, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (Ashgate 2007), pp. 23-40.

⁸⁸ Article 6(1), United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

⁸⁹ Article 6(3), United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

In connection with the impacts of on-stream dams on fisheries and fishers, there are at least two potential ways that the international water law principle of equitable utilization may be implicated.

First, the international water law principle of equitable utilization can be readily paired and integrated with the international fisheries law principle of originations set forth in the Pacific Salmon Treaty and Article 11(c) of the UN Straddling Stocks Treaty.⁹⁰ Article 6(1) of the 1997 UN Watercourses Convention provides that equitable utilization involves consideration of “ecological factors,” “economic needs of the watercourse States concerned,” “uses of the watercourse” and the “effects of the use or uses of the watercourse in one watercourse State on other watercourse States.”⁹¹ All of these factors are consistent with an originations approach to the allocation of fishing rights on international watercourses, in that a nation whose on-stream dams adversely impact fisheries and the fishers dependent on such fisheries would have their rights to catch such fisheries appropriately reduced vis-à-vis other nations that fish on the same international watercourse.⁹²

Second, there is a growing body of international water law which suggests that although there may be various factors considered in determining the equitable utilization of international watercourses, paramount consideration should be given to ensuring that “vital human needs” are met.⁹³ For instance, Article 10(2) of the 1997 UN Watercourses Convention provides that a dispute between uses of an international watercourse shall be resolved “with special regard being given to the requirements of vital human needs.”⁹⁴ Consistent with Article 10(2) of the 1997 UN Watercourses Convention, international water law scholars have suggested that vital human needs should enjoy a higher priority among the

⁹⁰ Article III(a), Agreement Between the Government of Canada and the Government of the United States Concerning Pacific Salmon signed January 28, 1985 Annex IV amended May, 1991; Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁹¹ Article III(a), Agreement Between the Government of Canada and the Government of the United States Concerning Pacific Salmon signed January 28, 1985 Annex IV amended May, 1991; Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁹² Article III(a), Agreement Between the Government of Canada and the Government of the United States Concerning Pacific Salmon signed January 28, 1985 Annex IV amended May, 1991; Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

⁹³ Owen McIntyre, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (Ashgate 2007) at 163.

⁹⁴ Article 10(2), United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

various factors considered in equitable utilization determinations.⁹⁵ The recognition of a privileged place in international water law for water to meet vital human needs, however, begs the question of what water usage qualifies as a vital human need?

To date, the focus of vital human needs has been on ensuring sufficient water to meet basic drinking water and sanitation needs with an eye towards avoidance of life-threatening dehydration and of diseases associated with poor human waste sanitation. However, for nations or vulnerable populations within nations whose basic food supply is tied to the presence of freshwater fisheries, the concept of vital human needs can be expanded to include the obligation to operate on-stream dams in a manner consistent with the conservation of such fisheries. To meet this obligation, nations that operate such on-stream dams may need to provide for fish passage through/around dams and for sufficient downstream releases to avoid slack water conditions, salinity and rising water temperatures below dams.

B. AVOIDANCE OF SIGNIFICANT ENVIRONMENTAL HARM AND ECOSYSTEM PROTECTION

In addition to the international water law principle of equitable utilization, there is also the obligation under international water law of each nation to avoid causing significant harm to other nations.⁹⁶

Article 7(1) of the 1997 UN Watercourses Convention provides “Watercourse States shall, in utilizing an international watercourse in their territories, take all appropriate measures to prevent the causing of significant harm to other watercourse States.”⁹⁷ Article 7(2) of the 1997 UN Watercourses Convention further adds that where significant harm nevertheless is caused to other watercourse States, the State whose use causes such harm shall take “all appropriate measures” to “eliminate or mitigate such harm and, where appropriate, to discuss the question of compensation.”⁹⁸

Similarly, Article 12 of the International Law Association’s 2004 Berlin Rules on Water Resources Law (“Berlin Water Resource Law Rules”) provides: “Basin States shall in their respective territories manage the waters of an international

⁹⁵ Owen McIntyre, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (Ashgate 2007) at 109; E. Hey, “Sustainable Use of Shared Water Resources: The Need for a Paradigmatic Shift in International Water Law”, in *The Peaceful Management of Transboundary Resources* (Graham Trotman/Martinus Nijhoff, Dordrecht/Boston/London, 1995) 127-152, at 127.

⁹⁶ Owen McIntyre, ENVIRONMENTAL PROTECTION OF INTERNATIONAL WATERCOURSES UNDER INTERNATIONAL LAW (Ashgate 2007) pp. 87-119.

⁹⁷ Article 7(1), United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

⁹⁸ Article 7(2), United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

drainage basin in an equitable and reasonable manner having due regard to their obligation not to cause significant harm to other basin States.”⁹⁹

Additionally, Articles 20 and 22 of the 1997 UN Watercourses Convention address the questions of ecosystem protection and invasive species in the transboundary river basin context.¹⁰⁰ Article 20 provides “Watercourse States shall, individually and where appropriate jointly, protect and preserve the ecosystems of international watercourses.”¹⁰¹ Article 22 provides “Watercourse states shall take all measures necessary to prevent the introduction of species, alien or new, into an international watercourse which may have effects detrimental to the ecosystem of the watercourse resulting in significant harm to other watercourse States.”¹⁰²

According to international water law expert Stephen McCaffrey, the “no significant harm” provision in Article 7 of the 1997 UN Watercourse Convention is likely to be construed broadly rather than narrowly to address adverse transboundary river impacts.¹⁰³ McCaffrey further notes that such significant harm is not limited to diversions or pollution of waters, but could encompass other activities that result in “obstruction of fish migration” or “interference with the flow regime” or that otherwise have “negative impacts on riverine ecosystems.”¹⁰⁴

Owen McIntyre, another recognized international water expert, explains that the “ecosystems approach employed enthusiastically in Articles 20-23 of the [1997 UN Watercourses Convention] might be expected to increase the likelihood of Article 7 being construed broadly, at least in relation to any ecological or environmental damage.”¹⁰⁵

There are several ways in which the presence and operation of on-stream dams could be implicated by the above-discussed provisions and principles of international water law relating to avoidance of significant harm, ecosystem protection and prevention of invasive species.

First, as Owen McIntyre observes, the concept of significant environmental harm can include obstruction of fish migration and changes to instream flow regimes

⁹⁹ Article 12, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

¹⁰⁰ Articles 20 and 22, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

¹⁰¹ Article 20, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

¹⁰² Article 22, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

¹⁰³ Stephen McCaffrey, *The Law of International Watercourses: Non-Navigational Uses* (Oxford University Press) at 348.

¹⁰⁴ Stephen McCaffrey, *The Law of International Watercourses: Non-Navigational Uses* (Oxford University Press) at 348.

¹⁰⁵ Owen McIntyre, *Environmental Protection of International Watercourses under International Law* (Ashgate 2007) at 92.

that negatively impact riverine ecosystems.¹⁰⁶ On-stream dams frequently block the upstream and downstream migration of fish and often alter natural flow regimes creating slack water conditions, increased water temperatures, higher salinity levels and reduced sediment/gravel transport.¹⁰⁷ Depending on the severity of consequences to other watercourse nations, such impacts from on-stream dams may qualify as significant harm. Pursuant to Article 7(1) and 7(2) of the 1997 UN Watercourses Convention and Article 12 of the 2004 Berlin Rules on Water Resources Law, nations that operate on-stream dams have an obligation to avoid such significant impacts on other watercourse nations and pursuant to Article 7(2) of the 1997 UN Watercourses Convention may be required to provide compensation for such harm.¹⁰⁸

Second, consistent with Articles 63(1) and 64(1) of UNCLOS¹⁰⁹, Article 11 of the UN Straddling Stocks Treaty¹¹⁰ and the ICJ's 1974 ruling in the *Icelandic Fisheries Case*,¹¹¹ nations with fisheries that migrate and move between their respective jurisdictional waters have an obligation to cooperate in efforts to conserve and sustainably manage such fisheries. The operation by one nation of an on-stream dam that undermined the conservation of a migratory fish species also present in the waters of another nation would implicate this obligation reflected in international fisheries law. More specifically, it would suggest an obligation on the part of the nation operating an on-stream dam to reach agreement with other nations whose fisheries are impacted by the dam on what measures are needed to conserve the fisheries in question. Such agreement may pertain to such issues as the installation of fish passage, the timing and quantity of downstream releases of water, and the replacement downstream of sediment/gravel trapped behind the dam.

Third, there are situations where the presence and operation of on-stream dams can contribute to the spread of invasive aquatic species. One example, discussed above, would be the invasive snails that have flourished in the Volta River in Ghana due to slack water conditions created by the Akosombo Dam.¹¹² Another example would be the spread of saline-tolerant fish species in rivers where

¹⁰⁶ Owen McIntyre, *Environmental Protection of International Watercourses under International Law* (Ashgate 2007) at 92.

¹⁰⁷ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana); Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1, 6 (2016); Paul Stanton Kibel, *Sea level Rise, Saltwater Intrusion and Endangered Fisheries – Shifting Baselines for the Bay Delta Conservation Plan*, 38 ENVIRONS 259 (2015).

¹⁰⁸ Article 7(2), United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

¹⁰⁹ Articles 63(1) and 64(1), The Third United Nations Convention on the Law of the Sea, December 10, 1982, 21 I.L.M. 1245 (entered into force November 16, 1994).

¹¹⁰ Article 11, The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc.A/Conf./164/37.

¹¹¹ 1974 I.C.J. 3 (1974).

¹¹² *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana)

reduced freshwater flow from upstream streams has led to saltwater intrusion.¹¹³ A final example would be where naturally muddy rivers (such as the Colorado River in North America) become increasingly clear due to sediments trapped behind dams, leading to the spread of fish adapted to clearwater rather than muddy-water conditions.¹¹⁴ As a result of sediments trapped in Hoover Dam and Glen Canyon Dam, native Colorado River fish stocks such as the endangered humpback chub are in decline while non-native fish stocks such as rainbow trout are expanding.¹¹⁵ These impacts from on-stream dams would implicate Article 22 of the 1997 UN Watercourse Convention, which requires nations to take necessary measures to prevent the introduction of invasive species that “may have effects detrimental to the ecosystem of the watercourse resulting in significant harm to other watercourse States.”¹¹⁶

V. INTERNATIONAL ENVIRONMENTAL IMPACT ASSESSMENT OBLIGATIONS RELATING TO THE CONSTRUCTION AND OPERATION OF ON-STREAM DAMS

Apart from the sources of international fisheries law and international water law already discussed, there are also provisions of international environmental law generally and international water law more specifically that pertain to the obligation of nations to conduct environmental impact assessment when transnational impacts are involved. As discussed below, the sources of international law on transboundary environmental impact assessment have particular application in regard to the construction and operation of on-stream dams and the effects of such dams on fisheries and fishers.

In terms of general international environmental law, the 1991 Espoo United Nations Convention on Environmental Impact Assessment in a Transboundary Context (“Espoo EIA Convention”) sets forth several relevant provisions.¹¹⁷ At the outset, it should be noted that the provisions of the Espoo EIA Convention only apply to the list of activities provided in Appendix I to the agreement.¹¹⁸ In terms of this chapter, it is important to note that Appendix I to the Espoo EIA Convention expressly lists “Large dams and reservoirs” among the activities covered by its provisions.¹¹⁹

¹¹³ Paul Stanton Kibel, *Sea level Rise, Saltwater Intrusion and Endangered Fisheries – Shifting Baselines for the Bay Delta Conservation Plan*, 38 ENVIRONS 259 (2015).

¹¹⁴ Mary Caperton Morton, *Releasing a Flood of Controversy on the Colorado River*, EARTH MAGAZINE (MARCH 2013).

¹¹⁵ Mary Caperton Morton, *Releasing a Flood of Controversy on the Colorado River*, EARTH MAGAZINE (MARCH 2013).

¹¹⁶ Article 22, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

¹¹⁷ Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹¹⁸ Appendix I, Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹¹⁹ Appendix I, Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

Article 2(1) of the Espoo EIA Convention states “The parties shall, either individually or jointly, take all appropriate and effective measures to prevent, reduce and control significant adverse transboundary environmental impacts from proposed activities.”¹²⁰ Article 2(3) provides “The party of origin shall ensure that in accordance with the provisions of this Convention an environmental impact assessment is undertaken prior to a decision to authorize or undertake a proposed activity listed in Appendix I that is likely to cause a significant adverse transboundary impact.”¹²¹

Article 4(1) of the Espoo EIA Convention states “The environmental impact assessment documentation to be submitted to the competent authority of the Party of origin shall contain, at a minimum, the information described in Appendix II.”¹²² Among other things, Appendix II requires an environmental impact assessment to include information on reasonable alternatives to the proposed activities, the potential environmental impact of the proposed activities and alternatives and an estimate of their significance, mitigation measures to keep adverse environmental impacts to a minimum, and monitoring programs for post-project analysis.¹²³

Article 7 of the Espoo EIA Convention provides additional guidance on the “post-project analysis” listed in Appendix II.¹²⁴ Article 7(1) provides for the preparation of post-project analysis to be undertaken “with a view to achieving the objectives listed in Appendix V.”¹²⁵ Appendix V provides that the objectives of post-project analysis include “(a) Monitoring compliance with the conditions as set out in the authorization or approval of the activity and the effectiveness of mitigation measures; (b) Review of an impact for proper management and in order to cope with uncertainties; (c) Verification of past predictions in order to transfer experience to future activities of the same type.”¹²⁶

The approach reflected in the Espoo EIA Convention is re-enforced in other water-specific international agreements, such as Article 12 of the 1997 UN Watercourses Convention¹²⁷, Article 3(1)(h) of the 1991 Helsinki Convention on the Protection and Use of Transboundary Watercourses and International

¹²⁰ Article 2(1), Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹²¹ Article 2(3), Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹²² Article 4(1) and Appendix II,), Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹²³ Appendix II, Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹²⁴ Article 7, Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹²⁵ Article 7(1), Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹²⁶ Appendix V, Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹²⁷ Article 12, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

Lakes¹²⁸, Article 29(1) of the Berlin Water Resource Law Rules,¹²⁹ and Principle 4 of the UNEP Shared Natural Resources Principles.¹³⁰ For example, Article 29(1) of the Berlin Water Resource Law Rules provides that nations “shall undertake prior and continuing assessment of the impact of programs, projects and activities that may have a significant effect on the aquatic environmental or the sustainable development of waters.”¹³¹ As another example, Principle 4 of the UNEP Shared Natural Resources Principles states that countries “should undertake environmental assessment before engaging in any activity with respect to a shared natural resource which may create a risk of significantly affecting the environment of another State or States sharing that resource.”¹³²

In regard to environmental impact assessment obligations related to on-stream dams, the provisions of Article 7 and Appendix V of the Espoo EIA Convention¹³³ and Article 29(1) of the Berlin Water Resource Law Rules¹³⁴ merit particular attention. These provisions highlight that the scope of environmental impact assessment for on-stream dams should not be limited to the initial construction of such facilities but instead should also encompass the continuing operations of such facilities. The “post-project analysis” provided for in the Espoo EIA Convention¹³⁵ and the “continuing assessment” provided for in the Berlin Water Resource Law Rules¹³⁶ speak to the ways that the continuing operations of dams can be modified and adjusted to reduce adverse environmental impacts on fisheries and fishers, and the role that on-going environmental assessment of dam operations can ensure that such modification and adjustment takes place. For example, if post-construction monitoring demonstrates that an on-stream dam is resulting in significant adverse impacts on fisheries, it may be possible to modify the dam to add appropriate fish passage or to modify water release schedules to improve downstream aquatic habitat.

¹²⁸ Article 3(1)(h), United Nations Economic Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992) 31 ILM 1312.

¹²⁹ Article 29(1), International Law Association, Berlin Rules on Water Resources Law, <http://www.asil.org/ilib/WaterReport2004.pdf>.

¹³⁰ Principle 4, United Nations Environment Programme, ENVIRONMENTAL LAW GUIDELINES AND PRINCIPLES ON SHARED NATURAL RESOURCES, http://www.unep.org/training/programmes/Instructor%20Version/Part_2/Activities/Interest_Groups/Decision-Making/Supplemental/Enviro_Law_Guidelines-Principles_rev2.pdf.

¹³¹ Article 29(1), International Law Association, Berlin Rules on Water Resources Law, <http://www.asil.org/ilib/WaterReport2004.pdf>.

¹³² United Nations Environment Programme, ENVIRONMENTAL LAW GUIDELINES AND PRINCIPLES ON SHARED NATURAL RESOURCES, http://www.unep.org/training/programmes/Instructor%20Version/Part_2/Activities/Interest_Groups/Decision-Making/Supplemental/Enviro_Law_Guidelines-Principles_rev2.pdf.

¹³³ Article 7 and Appendix V, Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹³⁴ Article 29(1), International Law Association, Berlin Rules on Water Resources Law, <http://www.asil.org/ilib/WaterReport2004.pdf>.

¹³⁵ Article 7 and Appendix V, Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹³⁶ Article 29(1), International Law Association, Berlin Rules on Water Resources Law, <http://www.asil.org/ilib/WaterReport2004.pdf>.

The Federal Power Act in the United States offers one model of a legal regime to assess the post-construction operations of on-stream dams.¹³⁷ Under this law, operators of most dams can obtain licenses to operate from the Federal Energy Regulatory Commission (“FERC”) for 40 years.¹³⁸ Five years prior to the expiration of a license, the operator must apply to FERC to relicense the dam.¹³⁹ As part of this relicensing process, the operator of the dam must conduct studies related to fisheries, and FERC must prepare a comprehensive environmental impact assessment, consult with fishery agencies regarding changes in operation to reduce adverse impacts on fisheries, and incorporate such changes in any new license to the dam operator.¹⁴⁰ The relicensing process under the Federal Power Act provides a regulatory mechanism to fulfil the “post-project analysis” and “continuing assessment” objectives set forth in the Espoo EIA Convention and the Berlin Water Resources Law Rules.

VI. RELATION OF HYDRO-ELECTRIC DAMS TO EFFORTS TO REDUCE GREENHOUSE GAS EMISSIONS ASSOCIATED WITH ENERGY PRODUCTION

As discussed in section II of this chapter, there can be a number of adverse impacts on fisheries associated with the construction and operation of on-stream dams. These impacts include barriers to fish passage, creation of slack water conditions above and below dams, and effects on water temperature, salinity and sediment/gravel transport below the dam.

Alongside the above-noted adverse environmental impacts of on-stream dams, an additional consideration has emerged in the context of efforts to reduce greenhouse gas emissions that cause global warming.¹⁴¹ Because one of the major sources of greenhouse gas emissions is the burning of fossil fuels (e.g. coal, natural gas) to generate electricity, a focus of greenhouse gas reduction policies has been on substituting fossil fuel energy sources with low/non-greenhouse gas generating energy sources (sometimes referred to “renewable” energy sources).¹⁴² Such renewable energy sources include solar, wind, wave, geothermal and, sometimes, hydro-electric facilities associated with on-stream dams.¹⁴³ For although on-stream dams can have significant adverse impacts on fisheries and fishers, the operation of hydro-electric facilities often generate little or no greenhouse gases.¹⁴⁴

¹³⁷ Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1 (2016).

¹³⁸ Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1 (2016).

¹³⁹ Hydropwer Reform Coalition, *Citizen’s Toolkit for Effective Participation in Hydropwer Relicensing* (2005).

¹⁴⁰ Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1 (2016).

¹⁴¹ Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

¹⁴² Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

¹⁴³ Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

¹⁴⁴ Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

The inclusion of on-stream hydro-electric facilities in the definition of renewable energy is understandably controversial within the environmental community generally and within the fish conversation/fishing community more specifically.¹⁴⁵ As a result of such concerns, some state, national and international definitions of renewable energy have either excluded hydro-electric facilities or imposed limitations on the circumstances under which hydro-electric facilities can be considered renewable.¹⁴⁶ For instance, under California's renewable portfolio standard, electricity produced by smaller on-stream dams (those capable of producing 30 megawatts or less) are considered renewable but on-stream dams with a capacity beyond 30 megawatts are not.¹⁴⁷

A comprehensive review of hydro-electric energy's place in climate change and renewable energy law and policy is beyond the scope of this chapter. For present purposes, it should be noted that in the context of climate change concerns the adverse impacts of on-stream dams on fisheries may be weighed by some (particularly those who operate hydro-electric facilities or those who receive low cost electricity from such facilities) against the potential of hydro-electric energy to contribute to reduced greenhouse gas emissions.¹⁴⁸ For instance, one of the advocates for removing the 30 megawatt cap on hydropower facilities under California's renewable portfolio standard is the National Hydropower Association, which represents operators of hydro-electric dams throughout the United States.¹⁴⁹

In the context of such weighing of environmental impacts, the acute adverse impacts on fisheries related to on-stream dams may lead to more careful consideration of alternative non-hydro renewable energy sources (such as solar, wind, wave or geothermal) that may have less adverse environmental impacts.

VII. CONCLUSION: ONGOING REVIEW AND MITIGATION OF FISHERY IMPACTS RELATED TO ON-STREAM DAM OPERATIONS

When drafting laws or negotiating treaties that focus on the construction and operation of on-stream dams in transboundary basins, the following considerations should be kept front-and-center.

First, the impact of on-stream dams on fisheries is not simply a matter of ecology and biodiversity. It may also be a matter of poverty and human health. There are situations where the fisheries impacted by on-stream dams serve as a basic food source for local populations, and in such situations the failure of dam operators to provide for fish passage or adequate releases of water to maintain fish habitat may improperly impinge on vital human needs under international water law principles.¹⁵⁰ There may also be situations where local communities are heavily

¹⁴⁵ Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

¹⁴⁶ Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

¹⁴⁷ Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

¹⁴⁸ Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

¹⁴⁹ Elizabeth Daigneau, *Is Hydropower a Renewable Energy or Not?*, GOVERNING (September 2013).

¹⁵⁰ *Remediation of the Environmental Impacts of the Akosombo and Kpong Dam in Ghana* (2008 report by the Volta Basin Research Project, University of Ghana).

dependent economically on the fisheries impacted by on-stream dams, and in such situations international water law and international fisheries law suggest the interests of such communities should be given careful consideration and that dam operators may have an obligation to compensate such communities for resulting injuries.¹⁵¹

Second, the international fisheries law principle of originations may provide guidance on decisions regarding the construction and operation of on-stream dams in transboundary watersheds.¹⁵² The originations principle provides that a nation's right to catch fish stocks that migrate through the waters of multiple nations should correspond to the extent to which the nation's facilities and activities contribute to or undermine the conservation of the fish stocks in question.¹⁵³ To the extent the on-stream dams in one nation reduce the abundance and health of fish stocks that migrate through the waters of another nation, the nation that operates its dams in this manner should find its right to catch such fish stocks reduced.¹⁵⁴

Finally, under international water law and general international environmental law, prior to constructing an on-stream dam that may have significant environmental effects on other nations, the nation where the dam will be located has an obligation to prepare an environmental impact assessment that addresses and appropriately mitigates these transboundary impacts.¹⁵⁵

Moreover, and of critical importance, consistent with the "post-project analysis" provisions of the Espoo EIA Convention¹⁵⁶ and the "continuous assessment" provisions of the Berlin Water Resources Law Rules¹⁵⁷, nations that operate on-stream dams have an obligation to environmentally assess the post-construction operations of such facilities. Many of the harmful effects of on-stream dams can be ameliorated by modifications to how such dams operate: fish passage elements can be added; the amount and timing of water releases downstream

¹⁵¹ Principle 12, United Nations Environment Programme, ENVIRONMENTAL LAW GUIDELINES AND PRINCIPLES ON SHARED NATURAL RESOURCES; Article 7(2), United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.

¹⁵² J.A. Yanagida, *The Pacific Salmon Treaty*, 81(3) AMERICAN JOURNAL OF INTERNATIONAL LAW 577-592 (1987).

¹⁵³ J.A. Yanagida, *The Pacific Salmon Treaty*, 81(3) AMERICAN JOURNAL OF INTERNATIONAL LAW 577-592 (1987).

¹⁵⁴ J.A. Yanagida, *The Pacific Salmon Treaty*, 81(3) AMERICAN JOURNAL OF INTERNATIONAL LAW 577-592 (1987).

¹⁵⁵ Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802; Article 12, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700; Article 3(1)(h), United Nations Economic Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992) 31 ILM 1312; Article 29(1), International Law Association, Berlin Rules on Water Resources Law, <http://www.asil.org/ilib/WaterReport2004.pdf>; Article 29(1), International Law Association, Berlin Rules on Water Resources Law, <http://www.asil.org/ilib/WaterReport2004.pdf>.

¹⁵⁶ Article 7 and Appendix V, Convention on Environmental Impact Assessment in a Transboundary Context (1991), 30 ILM 802.

¹⁵⁷ Article 29(1), International Law Association, Berlin Rules on Water Resources Law, <http://www.asil.org/ilib/WaterReport2004.pdf>.

can be changed to protect fisheries habitat below the dam; sediment and gravel can be supplemented to off-set sediment and gravel trapped behind the dam.¹⁵⁸ Such modifications are only likely to occur, however, if laws and treaties contain provisions obligating dam operators to conduct post-construction monitoring of impacts on fisheries and obligating the adoption of appropriate mitigation measures to address the fisheries impacts revealed through such monitoring.¹⁵⁹

On-going environmental assessment of dam operations gives effect to Article 20 of the 1997 UN Watercourses Convention which calls for nations to protect the ecosystems of international watercourses.¹⁶⁰ Because the aquatic ecosystems and fisheries entitled to such protection are present throughout the lifetime an on-stream dam operates, the environmental assessment of the effects on such ecosystems and fisheries must continue during the lifetime of the facility as well.

¹⁵⁸ See generally Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1 (2016).

¹⁵⁹ See generally Paul Stanton Kibel, *Passage and Flow Considered Anew: Wild Salmon Restoration Via Hydro Relicensing*, 37 PUBLIC LAND & RESOURCES LAW REVIEW 1 (2016).

¹⁶⁰ Article 20, United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, 21 May 1997), 36 ILM 700.