UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MAINE

ATLANTIC SALMON FEDERATION U.S., CONSERVATION LAW FOUNDATION, MAINE RIVERS, and NATURAL RESOURCES COUNCIL OF MAINE,

Plaintiffs

v.

BROOKFIELD RENEWABLE PARTNERS, L.P., MERIMIL LIMITED PARTNERSHIP, HYDRO-KENNEBEC LLC, BROOKFIELD WHITE PINE HYDRO LLC, BROOKFIELD POWER US ASSET MANAGEMENT LLC, and BROOKFIELD POWER US HOLDING AMERICA CO.

Defendants

Civil Action No. 1:21-cv-00257-JDL

**PLAINTIFFS' MOTION FOR PRELIMINARY INJUNCTION WITH INCORPORATED MEMORANDUM OF LAW**

**[Injunctive Relief Sought – Local Rule 9(b)]**

NOW COME Plaintiffs Atlantic Salmon Federation U.S., Conservation Law Foundation, Maine Rivers, and the Natural Resources Council of Maine ("Plaintiffs"), by and through undersigned counsel, and pursuant to Rule 65(a) of the Federal Rules of Civil Procedure hereby move for a preliminary injunction. The Plaintiffs bring to the Court's and the Defendants' attention that the fall downstream migration of the ESA-listed species – the Gulf of Maine Distinct Population Segment ("GOM DPS") of Atlantic salmon – has begun, as of October 15th, and will continue through the seasonal range of December 31st. *See* Complaint, ECF No. 1, ¶¶

10 & 47; Lusardi Decl. ¶ 9 at p.4. And further, spring outmigration will begin this coming April 1, 2022. *Id.* Each project "takes" migrating salmon, within the definition of "take" under the Endangered Species Act ("ESA"), 16 U.S.C. § 1532(19). The Kennebec River is the migration corridor to the ocean from the Sandy River spawning and rearing habitat area, which is located above the Weston project in Skowhegan. Each project – and the four of them cumulatively – block the migration and result in an array of related impediments and adverse impacts that "take" Atlantic salmon. Lusardi Decl. ¶¶ 8 &10.

Each project lacks authorization to "take" salmon under any incidental take permit issued by the National Marine Fisheries Service ("NMFS") under the ESA. Defendants are therefore in present and ongoing violation of the ESA. 16 U.S.C. § 1538(a)(1)(B). Indeed, Defendants have allowed this noncompliance with the ESA to exist continuously during all upstream and downstream migration seasons since December 31, 2019, when Defendants' last temporary incidental "take" permit unequivocally expired.[1]

This noncompliance is not a technical failing – Atlantic salmon are on the brink of extinction. Complaint ¶ 49; Lusardi Decl. ¶ 9. The Kennebec River plays a pivotal role in ever achieving survival and recovery of the species. *Id.*; *see* Complaint ¶ 50. The numbers within the Kennebec population are precariously low. *Id.* ¶ 60 (and references therein).

[1] And Defendants had been on advance notice of the December 31, 2019 expiration date for at least six and a half years prior (even seven and a half years considering the 2012 issuance of the Hydro-Kennebec Project's temporary take permit). The take permits were issued with two interim biological opinions of NMFS that had been issued following a section 7 consultation (16 U.S.C. § 1536), a consultation that – by way of background – was prompted by previous litigation in this Court claiming dam operators' violations of the ESA, including one common Defendant here: *Friends of Merrymeeting Bay v. Brookfield Power U.S. Asset Management*, LLC, No. 2:11-cv-35-GZS, 2013 WL 145506 (January 14, 2013). The 2012 Biological Opinion referenced in the *Friends* case, 2013 WL 145506 at *4, is the very same temporary incidental take authorization and interim Biological Opinion at issue here, and that by its terms expired on December 31, 2019. This puts Defendants today right back to where they were in 2012 before the temporary take authorizations had issued – i.e., in violation of section 9 of the ESA for operating the projects without take authorization under the Act.

Defendants have not taken adequate measures to reduce "takes" to the fullest extent possible, which would include immediately shutting down the turbines at three of the projects for the length of the downstream migration season, and operating at maximum capacity a sluice-passage facility at the problematic fourth Weston Project site. Pugh Decl. ¶ 10; Lusardi Decl. ¶ 11. These measures should be undertaken until and unless Defendants comply with the ESA by reacquiring valid incidental take authorization, if indeed such authorization can ever issue.

Plaintiffs rely upon the uncontroverted material facts of this matter, together with the expert opinions set forth in the declarations under oath of Donald H. Pugh Jr. and Robert A. Lusardi, and the exhibits attached to both declarations.[2]

Plaintiffs therefore respectfully request that this Court grant this preliminary injunction to decree that Defendants shall immediately undertake the measures of turbine shutdowns at Shawmut, Hydro-Kennebec, and Lockwood (and, at Lockwood, according to the sunset-to-sunrise schedule for the window of time coinciding with complications in upstream migration "take"), while continuing operations at maximum flows of each bypass facility at Shawmut, Hydro-Kennebec, and Lockwood (Pugh Decl. ¶ 10.A.i–C.i; Lusardi Decl. ¶ 11.A.i–C.i); and to immediately undertake the measures prioritizing the sluice bypass facility at Weston, with opening gates or operating units as options as set forth in the Pugh and Lusardi declarations. Pugh Decl. ¶ 10.D.i; Lusardi Decl. ¶ 11.D.i. This will reduce the percentage of takes caused by project operations and habitat degradation caused by the projects, under current conditions and status of project operations. Pugh Decl. ¶ 10; Lusardi Decl. ¶ 11.

---

[2] As noted in his declaration Don Pugh is an expert in fish passage, formerly with S.O. Conte Anadromous Fish Research Laboratory, with more than 20 years of experience, study, and expertise in analyzing fish passage at hydroelectric projects. Pugh Decl. ¶ 1. Dr. Rob Lusardi is an aquatic research ecologist and applied conservation biologist at the Center for Watershed Sciences, and Adjunct Faculty in the Department of Wildlife, Fish, and Conservation Biology at the University of California, Davis, with more than 15 years of experience, study, and expertise in analyzing the adverse impacts of hydroelectric projects on diadromous fish species. Lusardi Decl. ¶ 1.

# MEMORANDUM OF LAW

## I. RELEVANT FACTUAL AND PROCEDURAL BACKGROUND

Defendants act as operators and/or licensees of four hydropower projects on the Kennebec River. *See* Complaint, ECF No. 1, ¶¶ 1-3, 19-25. These four hydropower projects are: (1) the Lockwood Project, located at river mile 63, the first dam/hydroproject on the main stem of the Kennebec River, along the site originally known as Ticonic Falls; (2) the Hydro-Kennebec Project, located at river mile 64, the second dam/hydroproject on the main stem of the Kennebec River; (3) the Shawmut Project, located at river mile 70, the third dam/hydroproject on the main stem of the Kennebec River; and (4) the Weston Project, located at river mile 83, the fourth dam/hydroproject on the main stem of the Kennebec River. *Id*. ¶ 3. The lower Kennebec River watershed, where the four projects are located, is completely within designated critical habitat for the migrating GOM DPS of Atlantic salmon, the listed species in issue.[3] The combination of these four hydropower projects on the Kennebec River totally blocks Atlantic salmon access to the critical spawning and rearing habitat in the Sandy River area, located upstream from the four projects. *Id.* ¶ 9; Lusardi Decl. ¶ 10. The existence and operations of each project and each impoundment in issue are entirely within the designated critical habitat of the GOM DPS of Atlantic salmon, and adversely impact that critical habitat, resulting in unauthorized "takes" by death, injury, delayed mortality or harm by "significantly impair[ing] essential behavioral patterns including, breeding, spawning, rearing, migrating, feeding or sheltering." 50 C.F.R. § 222.102; 16 U.S.C. §§ 1532(19) & 1538(a). *Id.* ¶¶ 5-6, 10; Lusardi Decl. ¶ 10.

[3] 74 Fed. Reg. 29344 (June 19, 2009) (ESA listing); 74 Fed. Reg. 29,300 (Designation of Critical Habitat for Atlantic Salmon (Salmo salar) Gulf of Maine Distinct Population Segment) (June 19, 2009).

Each hydropower project is operating without authorization for each incidental "take" of the listed species. 16 U.S.C. § 1538(a)(1)(B). *Id.* ¶ 4. While it is impossible to eliminate all incidental takes at each project or over all four projects collectively in the near term, and while incidental "takes" will continue under any scenario for so long as the projects exist in operation in the Kennebec watershed (and the species remains listed as endangered), the measures urged by the Plaintiffs in this motion are the only adequate remedy to reduce to the fullest extent possible the ESA violations of incidental take at each project and by the four projects collectively, under the current circumstances. Lusardi Decl. ¶¶ 8 & 12; Pugh Decl. ¶¶ 8 & 11.

**A. Atlantic Salmon Life Cycle**

The seasonal migration periods in issue are April 1 through June 30, and October 15 through December 31 (the latter period involving post-spawn adults returning to the ocean as potential repeat spawners or kelts). Lusardi Decl. ¶ 9. The full upstream migration season is May 1 through November 10. *Id.* ¶ 9 at p.3. The GOM DPS Atlantic salmon life cycle in issue is detailed in the Complaint and contained in the Lusardi Declaration. Lusardi Decl. ¶ 9; Complaint, ECF No. 1, ¶¶ 39-50.

Atlantic salmon are anadromous fish, spending most of their adult life in the ocean but returning to freshwater to spawn. Lusardi Decl. ¶ 9. Atlantic salmon's life history includes spawning and rearing in rivers and extensive feeding migrations during their marine phase. *Id.* During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements. *Id.* Adult Atlantic salmon return to the rivers from the ocean and migrate to their natal stream to spawn; a small percentage (1-2%) of returning adults in Maine will stray to a new river. *Id.* Adults ascend rivers within the GOM DPS beginning in spring, and the ascent of adult salmon continues into fall. *Id*. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July. *Id*.

Atlantic salmon are repeat seasonal spawners. *Id.* In the fall, female Atlantic salmon select sites for spawning in rivers, and a single female may create several redds (nests) before depositing all her eggs. *Id.* After spawning, Atlantic salmon may either return to the sea immediately or remain in freshwater until the following spring before returning to the sea. *Id.* Embryos develop in redds, hatching in late March or April. *Id*. Newly hatched salmon, referred to as larval fry, alevin, or sac fry, remain in the redd for approximately six weeks (depending on water temperature) after hatching and are nourished by their yolk sac. *Id*. Survival from the egg to fry stage in Maine is estimated to range from 15 to 35%. *Id*. When salmon fry reach approximately 4 cm in length, young salmon – termed "parr" – remain in the river for 2 to 3 years before undergoing "smoltification," the process of physiological changes that parr undergo in order to transition from a freshwater environment to a saltwater marine environment. *Id*. In Maine, the vast majority of naturally reared parr (90% or more) remain in freshwater for two years with the balance remaining for either one or three years. *Id*.

Most smolts enter the sea during May to begin their first ocean migration, during which smolts must contend with changes in salinity, water temperature, pH, dissolved oxygen, pollution levels, and various predator assemblages. *Id*. The transition of smolts into seawater is usually gradual as they pass through a zone of fresh and saltwater mixing that typically occurs in a river's estuary. *Id.* The spring migration of post-smolts out of the coastal environment is generally rapid, within several tidal cycles, and follows a direct route. *Id.*

### B. Atlantic Salmon Habitat

The Kennebec River was once the most productive river in Maine, with Atlantic salmon runs in the hundreds of thousands. *Id.* Today, Atlantic salmon in the United States are on the edge of extinction, including Atlantic salmon in the Kennebec River. *Id*. Atlantic salmon's continued existence in the United States depends on further restoration of the Kennebec more than any other river.

In 2000, the Gulf of Maine Distinct Population Segment ("GOM DPS") of Atlantic salmon was first listed as an endangered species under the ESA. 65 Fed. Reg. 69459 (November 17, 2000) (determining "that the Gulf of Maine DPS is in danger of extinction throughout its range"). In 2009, that listing was expanded to include Atlantic salmon on the Kennebec, Penobscot, and Androscoggin Rivers. 74 Fed. Reg. 29344 (June 19, 2009). In June of 2009, designation of critical habitat for the GOM DPS of Atlantic salmon became final. 50 C.F.R. § 226.217; 74 Fed. Reg. 29300 (June 19, 2009). The lower Kennebec River watershed is completely within designated critical habitat for the migrating GOM DPS of Atlantic salmon (*id.*), and the vast majority of salmon spawning and rearing habitat in the Kennebec River Watershed is located above defendant Brookfield's four hydropower projects, in the critical habitat recovery units with the Sandy River spawning and rearing area. Lusardi Decl. ¶ 9 at p.5; Complaint, ECF No. 1, ¶ 54.

The combination of the four hydropower projects of Lockwood, Hydro-Kennebec, Shawmut, and Weston on the Kennebec River totally blocks Atlantic salmon access to the critical spawning and rearing habitat in the Sandy River area, located upstream from the four dams. Lusardi Decl. ¶¶ 9-10; Complaint, ECF No. 1, ¶ 55. The first dam that returning salmon encounter on passage up the Kennebec River from the Atlantic Ocean is the Lockwood Project, located in Waterville, Maine. Complaint, ECF No. 1, ¶ 63. Immediately upstream of Lockwood are the Hydro-Kennebec Project, the Shawmut Project, and finally the Weston Project in Skowhegan. *Id.* ¶ 3. These hydroelectric dams on the Kennebec "have eliminated or degraded vast, but to date unquantified, reaches of suitable rearing habitat in the Kennebec . . . watershed[]," and "[a] significant proportion of Atlantic salmon smolts and kelts are injured or killed while passing dams during their downstream migration." *Id.* ¶¶ 75 & 68 (quoting 2013 NMFS Interim Biological Opinion at 141 & 46).[4] *See* Lusardi Decl ¶¶ 8 &12; Pugh Decl. ¶¶ 8 & 11.

Without access to the Sandy River spawning and rearing habitat, survival and recovery goals for the GOM DPS of Atlantic salmon will never be met. In 2019, only 56 salmon returned to be trapped at the Lockwood dam. Complaint, ECF No. 1, ¶ 60. In the 2020 migration season, only 51 salmon were captured at the Lockwood fishlift. *Id.*

## C. Expiration of Defendants' Take Authorization

Up to December 31, 2019 – the date of expiration of all take permits – there had been in effect for the Defendants' hydropower projects interim, time-limited incidental take authorizations, including terms and conditions that were set forth in these incidental take statements of the respective interim biological opinions of July 19, 2013 and September 17, 2012. These take authorizations had been a previous result of NMFS's consultation under section 7 of the ESA (16 U.S.C. § 1536(a)(2) & (b)) with the Federal Energy Regulatory Commission, concerning the effects of proposed approval of applications to amend the licenses

[4] Interim Biological Opinion of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration's National Marine Fisheries Service ("NMFS") "Endangered Species Act Section 7 Formal Consultation for the Lockwood (2574), Shawmut (2322), Weston (2325), Brunswick (2284), and Lewiston Falls (2302) Projects," NOAA Fisheries Greater Atlantic Region Reference No. NER-2013-9613, at section 2.1.1 (July 19, 2013) (hereafter "2013 Interim BiOp) at 141. As explained further herein, Defendants allowed this 2013 Interim BiOp to expire on December 31, 2019, and have not secured a new one with any incidental take permits.

for the construction of new upstream fishways at each of the projects, as well as the incorporation of an Interim Species Protection Plan (ISPP) for the GOM DPS of Atlantic salmon at each of the projects, which would also govern downstream passage.[5]

Since the expiration of take authorizations at all four projects on December 31, 2019, Brookfield has continued to operate all four projects, and those operations of each project have violated section 9 of the ESA (16 U.S.C. § 1538) by causing the unauthorized "take" of individual GOM DPS of Atlantic salmon attempting to migrate upstream at the Lockwood Project, and by causing the unauthorized "take" of individual GOM DPS of Atlantic Salmon attempting to migrate downstream at the Weston Project and at all of the remaining three projects downstream from the Weston Project. Complaint, ECF No. 1, ¶ 82; Lusardi Decl ¶¶ 8 & 12; Pugh Decl. ¶¶ 8 & 11.

The ongoing incidental take of one or more individuals of the listed species of Atlantic salmon – take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" – violates the ESA without take authorization. 16 U.S.C. §§ 1538-1539. Defendants have not restored any lapse in take authorization or obtained incidental take permits under sections 1536(b)(4) or 1539 of the ESA.

**D. "Take" of Atlantic Salmon from the Operation of the Four Hydropower Projects**

Incidental "take" of Atlantic salmon caused by Defendants' operation of the four hydropower projects on the Kennebec River occurs at various areas of the riverine environment

[5] 2013 Interim BiOp. at sections 1 & 10; Biological Opinion of the U.S. Department of Commerce, National Oceanic and Atmospheric Administration's National Marine Fisheries Service ("NMFS") "Endangered Species Act Section 7 Formal Consultation for the Hydro-Kennebec Project (FERC No. 2611) (September 17, 2012); " NOAA Fisheries Greater Atlantic Region Reference No. NER-2012-01860 (September 17, 2012) at section 2.1 (hereafter "2012 Interim BiOp") at sections 1.0 and 10.0.

and in various ways. *See generally* Lusardi Decl ¶¶ 8 &12 (with Exhibit B); Pugh Decl. ¶¶ 8-9 & 11.

For purposes of this motion, *upstream* migration "take" currently occurs at the Lockwood Project only – but would occur at the remaining three upstream dams in the four-dam gauntlet which Atlantic salmon (and other coevolved fish species) would face on their upstream migration, even assuming passage at Lockwood. Complaint, ECF No. 1, ¶¶ 62-67; Lusardi Decl. ¶ 11.D; Pugh Decl. ¶ 10.D. The fish lift at this dam has never worked well since its installation in 2006,[6] and Defendants have failed to improve it. Complaint, ECF No. 1, ¶ 64. Salmon captured at the fish lift at Lockwood are currently transported by MDMR for release to the Sandy River spawning and rearing habitat area upriver from the fourth dam, Weston in Skowhegan. *Id.* at ¶ 58. The significance of the Lockwood fish lift in relation to the current motion is that the operations of the fish lift – with what few salmon return to encounter Lockwood in the upstream migration season from May 1 through November 10 – must be coordinated with the turbine shutdown for downstream migration in this same window of time, when there is movement both upstream and downstream. Lusardi Decl. ¶ 11.D.; Pugh Decl. ¶ 10.D.

*Downstream* outmigration of Atlantic salmon also suffers incidental "take." Lusardi Decl. ¶¶ 8 & 12 (and see Exhibit B attached thereto); Pugh Decl. ¶¶ 8-9, 11. A high percentage of outmigrating smolts die trying to return to the ocean due to Defendants' projects and the impoundments they create. *Id*.; Complaint, ECF No. 1, ¶¶ 61, 69-70. A significant percentage

[6] In a recent filing to the Federal Energy Regulatory Commission (FERC), the Maine Department of Marine Resources (MDMR) stated that, "[f]ish passage failures at the Lockwood Project provide a cautionary tale as unexpectedly poor performance has left hundreds of returning endangered Atlantic salmon to die or spawn in subpar habitats below the project." Complaint, ECF No. 1, ¶ 64 & n.18. Similarly, NMFS stated in a 2018 letter to Brookfield that: "1) The Lockwood facility demonstrates poor upstream passage efficiency for Atlantic salmon; 2) Atlantic salmon are highly attracted to the 'bypass' reach of the Lockwood facility; and 3) the Lockwood facility imposes a significant delay upon the upstream migration of Atlantic salmon. Although the study did not address the facility's upstream passage effect on other species, it is reasonable to assume that other diadromous species experience similar effects." *Id*. ¶ 65 & n.19.

of outmigrating *kelts* – which make up a biologically unique and significant part of the population as potential "repeat-spawners" – are also injured or die. Exhibit B, Lusardi Decl. ¶¶ 8 & 12; Pugh Decl. ¶¶ 9 & 11. And, "[i]n addition to direct mortality sustained by Atlantic salmon at hydroelectric projects, Atlantic salmon in the Kennebec [River] will also sustain delayed mortality as a result of repeated passage events at multiple hydroelectric projects."[7] Complaint, ECF No. 1, ¶¶ 69-71.[8]

There are other incidental "take" occurrences resulting from the Defendants' four hydroproject operations – beyond struggles or inability to pass the projects, and the death, delayed mortality, or direct injuries arising from those struggles or failures to pass. The known passage failures at the projects to pass other co-evolved species, like American shad, has a direct correlation to Atlantic salmon increased mortality in the critical habitat area. The depletion of "cover" species, which reduce predation on Atlantic salmon, is an adverse modification of critical habitat, and the projects' successive failures to pass these other species increases the percentage of takes during both in- and out-migrations.[9] Furthermore, the existing operations of the hydroprojects result in four impoundments – impounded waters created by the damming of the river at the four projects. In the aggregate, these impoundments cover a substantial percentage (85%) of the river from the Lockwood Project upstream to the upper end of the Weston Project impoundment, and it has long been recognized that these areas of the riverine

[7] 2013 Interim BiOp at 49.

[8] In addition to Brookfield's own salmon smolt mortality studies, yielding calculations that over 40% of the outmigrating smolts die trying to return to the ocean due to Brookfield's dams and the impoundments they create, in recent correspondence to FERC, NMFS explains that "[t]he total mortality associated with passage through a dam system can be represented by a conceptual equation: mortality in the impoundment + direct mortality + indirect mortality that occurs in the river + latent mortality in the estuary and marine environment = **total dam-related mortality**." NMFS letter to Kimberly D. Bose, Secretary, Federal Energy Regulatory Commission) (August 26, 2021) (bold emphasis added); FERC Accession No. 20210826-5106. Complaint, ECF No. 1, ¶ 69.

[9] 74 Fed. Reg. 29,344-01 at 29,374-75 (Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic Salmon) (June 19, 2009).

environment are deleterious to the recovery of cold water fish species. Complaint, ECF No. 1, ¶¶ 74-75.[10]

Outmigrating smolts and kelts may be delayed or hindered by the lack of free-flowing habitat, and alterations in water quality (temperature, lowered dissolved oxygen levels, etc.) hinder their outmigration to a degree that "creates the likelihood of injury . . . by annoying [them] to such an extent as to significantly disrupt normal behavioral patterns . . ." 50 C.F.R. § 17.3; *see* 16 U.S.C. § 1532(19). In short, dams are a man-made degradation of the natural riverine environment. *See American Rivers and Alabama Rivers Alliance v. Federal Energy Regulatory Commission*, 895 F.3d 32, 46-50 (D.C. Cir. 2018). The existence and operations of the Defendants projects and dams in issue are entirely within the designated critical habitat of the GOM DPS of Atlantic salmon, and adversely impact that critical habitat, resulting in unauthorized "takes" by "significantly disrupt[ing] normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." 50 C.F.R. § 17.3; 16 U.S.C. §§ 1538(a).

## ARGUMENT

### A. Standard for Preliminary Injunctive Relief in an ESA Case

When determining whether to grant a motion for preliminary injunctive relief, "a district court must find the following four elements satisfied: (1) a likelihood of success on the merits, (2) a likelihood of irreparable harm absent interim relief, (3) a balance of equities in the plaintiff's favor, and (4) service of the public interest." *Arborjet, Inc. v. Rainbow Treecare Scientific Advancements, Inc.*, 794 F.3d 168, 171 (1st Cir. 2015). Although each factor must be considered, "[t]he sine qua non of this four-part inquiry is likelihood of success on the merits: if the moving party cannot demonstrate that [it] is likely to succeed in [its] quest, the remaining

[10] *See* 2013 Interim BiOp at 46.

factors become matters of idle curiosity." *New Comm Wireless Services, Inc. v. SprintCom, Inc.*, 287 F.3d 1, 9 (1st Cir. 2002). In the context of the ESA, the First Circuit "has incorporated Congress's prioritization of listed species' interests into the third and fourth prongs of the analysis, modifying those factors where appropriate to 'tip heavily in favor of protected species.'" *Animal Welfare Institute v. Martin*, 623 F.3d 19, 27 (1st Cir. 2010) (quoting *Strahan v. Coxe*, 127 F.3d 155, 160 (1st Cir.1997) (alteration omitted))."

"Thus, where violations of the ESA are involved, only the first two prongs of the traditional preliminary injunction analysis are at issue." *American Whitewater v. Electron Hydro, LLC*, No. C16-0047-JCC, 2021 WL 2530384 at *2 (W.D. Wash. Jun. 18, 2021). Plaintiffs must "show either a likelihood of success on the merits, or alternatively, the existence of 'substantial questions' regarding the merits." *Id.* (quoting *Audubon Soc. of Portland v. Nat'l Marine Fisheries Serv.*, 849 F. Supp. 2d 1017, 1033 (D. Or. 2011)). Next, Plaintiffs must demonstrate that "irreparable injury is *likely* in the absence of an injunction." *Id.* (quoting *Native Ecosystems Council v. Krueger*, 40 F. Supp. 3d 1344, 1348 (D. Mont. 2014) (quoting *Winter v. Natural Resources Defense Council*, 555 U.S. 7, 20 (2008)) (emphasis in original)).

We meet both of these elements, as demonstrated further below.

**B. Plaintiffs Will Prevail on the Merits (or There Are Substantial Questions).**

The ESA was enacted, in part, to provide a "means whereby the ecosystems upon which endangered species and threatened species depend may be conserved ... [and] a program for the conservation of such endangered species and threatened species." 16 U.S.C. § 1531(b). Section 9 of the ESA makes it unlawful for "any person" to "take" a listed species, including take of "any such species within the United States or the territorial sea of the United States." *Id.* § 1538(a)(1)(B). As defined by the ESA, "take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." *Id.* §1532(19). The ESA's legislative history supports "the broadest possible" reading of "take." *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. 687, 704-05 (1995). "Take" includes direct as well as indirect harm and need not be purposeful. *Id*. at 704; *see also Nat'l Wildlife Fed'n v. Burlington No. R.R.*, 23 F.3d 1508, 1512 (9th Cir. 1994).

" 'Harm' in the definition of 'take' in the [ESA] means an act which actually kills or injures fish or wildlife. **Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering**." 50 C.F.R. § 222.102 (bold emphasis added); *see Babbitt v. Sweet Home Chapter, Communities for Great Oregon*, 515 U.S. 687, 708 (1995) (upholding interpretation of the term "take" to include significant habitat degradation). Significantly, "listed species need not be harmed to constitute a take, as 'harm' is identified as a separate category of take." *American Whitewater v. Electron Hydro, LLC*, No. C16-0047-JCC, 2021 WL 2530384 (W.D. Wash. Jun. 18, 2021) (granting preliminary injunction against dam operating without take permits) at n.7. (citing 16 U.S.C. § 1538(a)(1)(B); *see Babbitt v. Sweet Home Chapter, Communities for Greater Or.*, 515 U.S. 687, 699 n.11, 702 (1995) (each category of "take" has a distinct meaning); *see also Animal Welfare Inst. v. Martin*, 588 F. Supp. 2d 70, 98 (D. Me. 2008) (harmlessly trapping a listed species is a take)).

A "person" is defined, in relevant part, as "an individual, corporation, partnership, trust, association, or any other private entity." 16 U.S.C. § 1532(13). Clearly Defendants are subject to the ESA.

Section 10 of the ESA provides an exception to the take prohibition, allowing the take of a listed species where NMFS, which receives delegated authority from the Secretary of the Department of Commerce, issues a permit authorizing the take. 16 U.S.C. § 1539.[11] If the "taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity," such as take associated with construction, development, or operation of an industrial site, the person intending to cause the take must first apply to NMFS for an incidental take permit. *Id.* § 1539(a)(1)(B). To receive a permit, the applicant must submit a habitat conservation plan to NMFS that specifies the "impact which will likely result from such taking" and provides "steps the applicant will take to minimize and mitigate such impacts," "to the maximum extent practicable," to ensure the project will not "appreciably reduce the likelihood of the survival and recovery of the species in the wild." *Id.* § 1539(a)(2)(A)(i)–(iv), (B). In addition, an applicant must satisfy NMFS that there is adequate funding available to implement the proposed minimization and mitigation measures, alternatives to the planned activities that would minimize or avoid take and why they are not being utilized, *id.* § 1539(a)(1)(B)(2)(iii), and any other assurances deemed necessary to minimize and avoid take of salmon, *id.* § 1539(a)(1)(B)(2)(iv). Once an applicant receives an incidental take permit, the applicant is protected from take liability so long as it complies with the minimization and mitigation measures set forth in the habitat conservation plan. But the protection lapses when any incidental take permit expires.

The ESA authorizes private enforcement of unpermitted take in violation of the take prohibition through a broad citizen-suit provision. "[A]ny person may commence a civil suit on his own behalf to enjoin any person . . . who is alleged to be in violation of any provision of [the

[11] NMFS is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce. NMFS is the federal wildlife agency with the mandate for ensuring survival and recovery of this endangered species under the ESA. 16 U.S.C. §§ 1532(15) & 1533(a)(2); 50 C.F.R. § 402.01(b); 74 Fed. Reg. 29,344, 29,358 (June 19, 2009).

ESA] . . . ." *Id.* § 1540(g)(1)(A). Citizens may seek to enjoin both present activities that result in take as well as future activities that are reasonably likely to result in take. *National Wildlife Fed'n*, 23 F.3d at 1511.[12]

Here, Defendants' take authorization, covering both upstream and downstream fish passage, expired on December 31, 2019, for all four hydropower projects.[13] Thus, the hydropower operations being carried out by Defendants constitute a prohibited taking under Section 9 of the ESA. 16 U.S.C. § 1538. These two dispositive points are uncontested: 1) Defendants take salmon at each project, or "take" occurs by the project existence and operations;

---

[12] Each of the Plaintiffs in this action clearly satisfy "citizen suit" status under section 11 (16 U.S.C. § 1540(g)). We presume Defendants will not challenge this status, especially given that in previous cases between these same parties regarding these same projects, Atlantic Salmon Federation U.S. ("ASF"), Maine Rivers, and the Natural Resources Council of Maine ("NRCM"), met even the higher threshold showings of organizational standing for an administrative law challenge in previous litigation not brought pursuant to the section 11 ESA "citizen suit" provision. All Plaintiffs, including here the Conservation Law Foundation ("CLF"), have for decades advocated for, and have been intricately engaged in, river restoration and sea-run fish restoration in Maine, on the Kennebec specficially, on salmon restoration efforts in Maine and on the Kennebec specifically, and in relation to these four hyrdoprojects specifically. ASF and NRCM are members of the "Kennebec Coalition," a longstanding coalition of non-profit organizations and party to the public *1998 Lower Kennebec River Comprehensive Settlement Record (KHDG Agreement)* dated May 27, 1998, which covered these very hydroprojects upon order for removal of the Edwards Project in Augusta – the project which had been immediately downriver of Lockwood. *Edwards Manufacturing Co., Inc., and City of Augusta, Maine*, 84 FERC ¶ 61,227 (1998) (incorporating May 27, 1998 Lower Kennebec River Comprehensive Settlement Record (KHDG Agreement)). Kennebec Coalition members have long been involved with all aspects of the protection and restoration of the Kennebec River, including filings with the Federal Energy Regulatory Commission on matters involving the projects in issue. CLF was previously a plaintiff in this Court on the case that compelled expansion of the GOM DPS of Atlantic salmon to include, inter alia, the Kennebec River watershed, and the related designation of critical habitat. *Conservation Law Foundation of New England, et al. v. Kempthorne, et al.*, No. 2:06-cv-00226-DBH (D. Me.) (Complaint, ECF No. 1, December 15, 2006). All Plaintiffs have members who use the Kennebec River for recreational, educational, and aesthetic pursuits, and who reside in the communities that border the Kennebec River including Waterville, Skowhegan and Fairfield where these projects are located. There should be no question that these Plaintiff-organizations, even beyond most others, are uniquely qualified to enforce the ESA in this case by invoking the citizen suit provision, 16 U.S.C. § 1540(g)(1)(a).

[13] 2013 Interim BiOp. at sections 10.1, p.149-150 ("The exempted take includes only take incidental to the proposed action. The incidental take provided by this Opinion is valid until 2019. In 2020, this Opinion will no longer be valid for Atlantic salmon."); 2012 Interim BiOp at section 10.1 & 2017 Biological Opinion for the Proposed Extension of Time for the Interim Species Protection Plan of the Hydro-Kennebec Project (P-2611), at section 10 & 12 ("Because this Opinion only considers the effects of continued operation of the project pursuant to the proposed amended license, the accompanying ITS [incidental take statement] only exempts take until the end of 2019. After that time, this Opinion will no longer be valid."); NOAA Fisheries Greater Atlantic Region Reference No. NER-2012-01860 (May 27, 2017).

2) Defendants do not have the Secretary's (i.e., NMFS's) permission to take salmon, even incidental to "otherwise lawful activites." 16 U.S.C. § 1539(a)(1)(B).

In the seminal ESA case, *Tennessee Valley Authority v. Hill*, 437 U.S. 153 (1978), the Supreme Court affirmed enjoining the operation of a virtually completed federal hydropower dam. *Id*. at 156, 172. The questions posed to Court were the same as in this case: "(a) Would [the dam operator] be in violation of the Act [ESA] if it completed and operated the Tellico Dam as planned? (b) If [its] actions would offend the Act, is an injunction the appropriate remedy for the violation?" *Id*. at 172. The Court held that "both questions must be answered in the affirmative." *Id*. Hence, when operation of a hydropower dam violates the ESA, an injunction is the appropriate remedy. *Id*. The injunction issues, regardless of "the sacrifice of the anticipated benefits of the project and of many millions of dollars in public funds" – which in the *Tennessee Valley* case were results including "the loss of some $53 million in nonrecoverable obligations." *Id*. at 174 & n.19. With enactment of the ESA, Congress ushered in an era of "the most comprehensive legislation for the preservation of endangered species ever enacted by any nation." *Id.* at 180. The ESA "reveals a conscious decision by Congress to give endangered species priority over the 'primary missions' of federal agencies." *Id.* at 185. "The plain intent of Congress in enacting [the ESA] was to halt and reverse the trend toward species extinction, *whatever the cost*." *Id.* at 184 (emphasis added).

Ever since this seminal case, federal courts have not wavered in enforcing the ESA, at whatever the cost. Even any benefits of doubt go to the endangered species. *Sierra Club v. Marsh*, 816 F.2d 1376, 1386 (9th Cir. 1987). Recently, the court in *American Whitewater v. Electron Hydro, LLC*, No. C16-0047-JCC, 2021 WL 2530384 (W.D. Wash. Jun. 18, 2021), granted a preliminary injunction upon finding take of listed species by a dam owner operating without take permits. The Washington court ordered that intake to the flume be kept closed, at considerable hindrance to a hydroelectric dam's operations by barring the operator from diverting water to the power generation facility during project improvements, unless and until the required section 10 incidental take permits issued. *Id*. at **2 & 5.

In short, in this case Defendants' operation of the four hydropower projects on the Kennebec River unequivocally results in the take of Atlantic salmon, both through the operations of the projects themselves and through the alterations to the riverine environment. Given that Defendants are not currently operating these projects with any incidental take authorization, Defendants' take of Atlantic salmon is in direct violation of 16 U.S.C. § 1538(a)(1)(B), and mandates a preliminary injunction remedy. *See American Whitewater v. Electron Hydro, LLC*, No. C16-0047-JCC, 2021 WL 2530384 (W.D. Wash. Jun. 18, 2021) (finding take of listed species by dam owner operating without take permits and granting preliminary injunction).

**C. Irreparable Harm is Demonstrated**

"[I]rreparable harm can consist of a substantial injury that is not accurately measurable or adequately compensable by money damages." *Ross-Simons of Warwick, Inc. v. Baccarat, Inc.*, 217 F.3d 8, 13 (1st Cir. 2000) (quotation marks omitted). A "finding of irreparable harm must be grounded on something more than conjecture, surmise, or a party's unsubstantiated fears of what the future may have in store." *Charlesbank Equity Fund II v. Blinds To Go, Inc.*, 370 F.3d 151, 162 (1st Cir. 2004). In other words, the moving party must "demonstrate that irreparable injury is *likely* in the absence of an injunction." *Winter v. Nat. Res. Def. Council, Inc.*, 555 U.S. 7, 22 (2008) (emphasis in original).

As described above, the breadth of take occurring at Defendants' hydropower projects is extensive. Two aspects of this take, in particular, speak directly to the "irreparable harm" to the

GOM DPS of Atlantic salmon. First, female Atlantic salmon are repeat seasonal spawners who may create several redds before depositing all of their eggs and then, eventually, returning to sea. Lusardi Decl. ¶ 9. Second, Atlantic salmon migration to, and outmigration from, the Sandy River is critical to survival and recovery of this endangered species. "Take" that prevents or restricts access both to and from this critical spawning and rearing habitat is particularly detrimental to the survival and recovery of the GOM DPS of Atlantic salmon as a whole. In 2019, only 56 salmon returned to be captured in the Lockwood Project fish lift in Waterville.[14] In the 2020 migration season, only 51 salmon were captured at the Lockwood fish lift.[15] As of June 21, 2021, only 15 returning adults have been captured at the Lockwood Project.[16] An incident that occurred at the Lockwood Project in June of this year – over a month *after* Defendants had received the Plaintiffs' notices of intent to sue under the ESA – resulted in what can only be described as Defendants undertaking operations at the projects *knowing* that those operations would result in incidents of take.[17] Flashboard replacement/installation operations at Lockwood had resulted in "rescue" efforts for trapped and injured salmon in virtually every

[14] 2020. DMR. MDMR Response to the Ready for Environmental Analysis (REA) Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions for the Shawmut Project (P-2322-069). August 28, 2020. P.3.

[15] Brookfield Renewable, Diadromous Fish Passage Report for the Lower Kennebec River Watershed during the 2020 Migration Season, at section 2.2.1.3 (Table 2-5). February 19, 2021. P. 20.

[16] 2021. MDMR Comments on [Brookfield] Species Protection Plans at the [Lockwood, Hydro-Kennebec, and Weston] Hydroelectric Projects. August 25. Table 1 at P.8; FERC Accession No. 2021 0825-5159.

[17] Injuries to delayed salmon "rescued" at the Lockwood Project are fully and vividly documented in a Maine Department of Marine Resources field report. Maine Department of Marine Resources (Jennifer Noll). June 17, 2021. Field Summary of Atlantic Salmon Stranding Rescue at Lockwood Dam. (Attachment 1 to FERC Accession No. 20210701-5242.); *see* Complaint, ECF No. 1, ¶ 12.

previous year, and in June this year the operations injured three adult salmon and nearly two dozen smolts were stranded in the ledges at the Lockwood Project during flashboard repair.[18]

This is not an instance where the harm to Atlantic salmon is based on "conjecture, surmise, or a party's unsubstantiated fears of what the future may have in store." *Charlesbank*, 370 F.3d at 162. Rather, the take of Atlantic salmon, including repeat spawners and the projects' individual and cumulative impacts on migration to, and from, the Sandy River – especially where, as here, Defendants are operating without take authorization and hence without any determination that the impacts of any such taking will be "minimize[d] and mitigate[d]," 16 U.S.C. § 1539(a)(2)(A) – are likely to irreparably harm the GOM DPS of Atlantic salmon as a whole.

**D. Balancing of Harms and the Public Interest Supports the Injunction**

While in this case Plaintiffs are not required to make a showing under the balance of harms test and the public interest test, because the ESA policy itself answers those questions in Plaintiffs' interest, we address them here to emphasize two important points. The relief Plaintiffs are requesting by this motion is narrowly tailored to the circumstances that Defendants face – and it is both the fault and responsibility of the Defendants that they find themselves where they are today, without incidental take authorization. Last May of 2021, Defendants engaged in these very turbine shutdowns called for by the Plaintiffs – albeit for only a month – because of this lapse in incidental take permission. In this matter, given the unauthorized take occurring at the four hydropower projects, any balance of hardships and the effect on the public interest must "tip[] heavily in favor of" Atlantic salmon and against Defendants who have engaged in turbine shutdowns (albeit half-heartedly for only the month of May) because of this very issue of noncompliance. And to the extent that there is economic harm to Defendants' private financial

[18] Ibid.

interests by the granting of a preliminary injunction, or that there is an effect on the public, such harm is minimal compared to the species-wide harm to the GOM DPS of Atlantic Salmon. Indeed, prohibiting the operation of these four hydropower projects, for instance, would only affect less than 0.5% of the total annual electricity generation in Maine. The Maine Department of Marine Resources summed up the issue well, in its comments submitted to FERC relating to the Shawmut Project relicensing proceedings:

> The Shawmut project represents less than 0.1% of the production of electricity in the State of Maine yet, if relicensed with underperforming fishways, would hasten the extinction of an iconic Maine species, Atlantic salmon, and could result in millions of sea-run fish not reaching historic habitats over the term of the license...*MDMR believes the Shawmut project is particularly suited for decommissioning and removal.*[19]

In sum, the take of Atlantic salmon caused by Defendants' operation of the four hydropower projects demonstrates that, as Congress has concluded, "the 'balance of hardships and the public interest tips heavily in favor of protected species.'" *Water Keeper Alliance v. U.S. Dept. of Defense*, 271 F.3d 21, 34 (1st Cir. 2001) (quoting *Coxe*, *supra*, 127 F.3d at 171).

## CONCLUSION

For the foregoing reasons, Plaintiffs respectfully request that this Court grant this motion for preliminary injunction, and thereby enjoin Defendants' operations of the four hydropower projects on the Kennebec River without take permits, by enjoining operations that result in take and/or pose a likelihood of imminent take of Atlantic salmon without take permits. Specifically, Plaintiffs request relief in the form of a decree in accordance with the expert opinions of Don

[19] 2020. MDMR. MDMR Response to the Ready for Environmental Analysis (REA) Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions for the Shawmut Project (P-2322-069). August 28, 2020. P.2. (italics emphasis added); FERC Accession No. 20200828-5199 at 2.

Pugh and Rob Lusardi, as set forth in their Declarations, ¶¶10 and 11 respectively: the Defendants should be ordered to shut down the turbines at Lockwood, Hydro-Kennebec, and Shawmut from October 15 through December 31 and April 1 through June 30 (with sunset-to-sunrise alternate schedule at Lockwood from May 1 to June 30 and October 15 to November 10, to accommodate the complications involving simultaneous operation of upstream passage facilities at that project in those windows of time); run downstream passage facilities at maximum discharge at all the projects; and, at Weston, to use the fully open sluice bypass for downstream passage from October 15 to December 31 and from April 1 to June 30 as the first point of downstream passage for both kelts and smolts, with alternative points of passage in the order presented in the Pugh Declaration, ¶10.D.i, and Lusardi Declaration, ¶¶11.D.i.

Dated at Portland, Maine this 21st day of October, 2021.

/s/ Russell B. Pierce, Jr.
Russell B. Pierce, Jr., Esq.

NORMAN, HANSON & DeTROY, LLC
Two Canal Plaza
P.O. Box 4600
Portland, Maine 04112-4600
(207) 774-7000
rpierce@nhdlaw.com

*Attorney for Plaintiffs*
Atlantic Salmon Federation U.S.;
Maine Rivers; and
Natural Resources Council of Maine

/s/ Charles Owen Verrill, Jr.
Charles Owen Verrill, Jr., Esq.
Verrill Advocacy, LLC
Suite M-100
1055 Thomas Jefferson St. NW
Washington, D.C. 20007

(202) 390-8245
charlesverrill@gmail.com

*Attorney for Plaintiffs*
Atlantic Salmon Federation U.S.;
Maine Rivers; and
Natural Resources Council of Maine

/s/ Sean Mahoney
Sean Mahoney, Executive Vice President
Conservation Law Foundation
53 Exchange Street
Portland, ME 04101
(207) 210-6439
smahoney@clf.org

*Attorney for Plaintiff*
Conservation Law Foundation

## CERTIFICATE OF SERVICE

I hereby certify that on October 21, 2021, I electronically filed Plaintiffs' Motion for Preliminary Injunction with Incorporated Memorandum of Law with the Clerk of Court using the CM/ECF system which will send notification of such filing to all counsel of record.

/s/ Russell B. Pierce, Jr.
Russell B. Pierce, Jr., Esq.
Attorney for Plaintiffs

Norman, Hanson & DeTroy, LLC
Two Canal Plaza, P.O. Box 4600
Portland, ME 04112-4600
(207) 774-7000
rpierce@nhdlaw.com

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MAINE

| | |
|---|---|
| ATLANTIC SALMON FEDERATION U.S., CONSERVATION LAW FOUNDATION, MAINE RIVERS, and NATURAL RESOURCES COUNCIL OF MAINE,<br><br>Plaintiffs<br><br>v.<br><br>BROOKFIELD RENEWABLE PARTNERS, L.P., MERIMIL LIMITED PARTNERSHIP, HYDRO-KENNEBEC LLC, BROOKFIELD WHITE PINE HYDRO LLC, BROOKFIELD POWER US ASSET MANAGEMENT LLC, and BROOKFIELD POWER US HOLDING AMERICA CO.<br><br>Defendants | Civil Action No. 1:21-cv-00257-JDL |

**DECLARATION OF ROBERT A. LUSARDI**

1. My name is Robert Andrew Lusardi. I am an aquatic research ecologist and applied conservation biologist at the Center for Watershed Sciences, and Adjunct Faculty in the Department of Wildlife, Fish, and Conservation Biology at the University of California, Davis. I have more than 15 years of experience, study, and expertise in analyzing the adverse impacts of hydroelectric projects on diadromous fish species. I have worked on numerous fish passage projects or consultations, and my publication credits, presentations, and other professional credentials are set forth in the attached CV (Exhibit A), current as of September 2021.

2. I have been retained by the Atlantic Salmon Federation U.S., Maine Rivers, and the Natural Resources Council of Maine, who are part of the group of non-governmental organizations called the "Kennebec Coalition," and who are Plaintiffs in the above-captioned action. The Kennebec Coalition has been actively engaged in all the regulatory

proceedings involving the four hydroelectric projects in issue in this case on the Kennebec River – the Lockwood Project in Waterville/Winslow, the Hydro-Kennebec Project, the Shawmut Project, and the Weston Project in Skowhegan. I have offered opinions in some of those proceedings, including most recently opinions involving review and critique of the FERC staff draft Environmental Assessment prepared in connection with the Shawmut Project relicensing proceedings, and involving review and critique of Brookfield's Species Protection plans for the Lockwood, Hydro-Kennebec, and Weston project.

3. I have reviewed the Complaint in this case, and the "notice of intent to sue" letter referenced therein. I have reviewed the 2012 and 2013 temporary or "interim" Biological Opinions (which are now expired) that had been issued by the National Marine Fisheries Service ("NMFS") for Atlantic salmon in relation to the subject four hydroelectric projects. I have also reviewed Brookfield's proposed species protection plans and the draft Biological Assessment covering each project, including the Shawmut project in relation to its relicensing proceedings; and I have reviewed the FERC staff draft Environmental Assessment prepared in connection with the Shawmut Project relicensing proceedings. I have examined photographic and diagrammatic schemes of record for each of the four projects, including publicly available Google Maps satellite views, as well as descriptions of each project in the various licenses and in the Kleinschmidt "Brookfield White Pine Hydro, LLC Energy Enhancements and Lower Kennebec Fish Passage Improvements Study" of October 2018. I have reviewed other pertinent documents relevant to the present issue, including but not limited to:

- 4-29-2021 NMFS letter to Brookfield requesting interim measures to reduce smolt take;
- 5-6-2021 Brookfield letter addressing interim measures to reduce smolt take;
- 5-17-2021 letter from Maine Department of Marine Resources ("MDMR") to Brookfield relating to fish passage operations at the Lockwood Project;
- various additional filings on the FERC record, including MDMR's 8-13-2021 comments on the FERC staff draft Environmental Assessment in the Shawmut relicensing, and the 8-26-2021 NMFS letter to Brookfield relating to response to request for formal consultation under the Endangered Species Act.

4. I have also consulted numerous studies, publications, and literature on the topic of fish passage, fish passage efficiency including injuries, mortality, and delayed mortality, many of which have been previously cited by me or by the Kennebec Coalition in the course of our submission of comments on the FERC regulatory record, or cited by NMFS in its various comments or Biological Opinions.

5. I have reviewed the Complaint allegations at paragraphs 5-6 relating to "take" of fish, defining "take" to include killing, injury or "harm."

6. Based upon my review and analysis of the above documents, and my experience and expertise in analyzing fish passage issues at hydroelectric projects, and the impacts of hydroelectric project operations on fish migration, life cycles, and essential behavioral patterns, I have reached an opinion on the activities which the subject dam owner or operator ("Brookfield") must undergo at each of the four projects in order to minimize the risk of "take" of fish – i.e., death, injury, or harm.

7. I have also reviewed the opinions of Donald H. Pugh, Jr., who has also been retained by the Plaintiffs, and who is an experience fish passage expert, formerly of the S.O. Conte Anadromous Fish Research Laboratory. We are in concurrence in our opinions on this subject of this Declaration.

8. In my opinion, each hydroelectric project and all four of the projects as a group, will cause "take" even under the best possible scenario – whether that "take" is the result of impediment to passage, whether by death or injury upon fish encounters with whatever passage means or facilities are in place, whether by delayed mortality, or by harm resulting from adverse impact to the environment such as changes to the river associated with each dam impoundment, etc. There are no great options, but at a minimum, we can significantly reduce take by the following measures.

9. Atlantic salmon biology.

Atlantic salmon are anadromous fish, spending most of their adult life in the ocean but returning to freshwater to spawn.

Atlantic salmon have a complex life history that includes spawning and rearing in rivers and extensive feeding migrations during their marine phase. During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements.

Adult Atlantic salmon migrate from the ocean to return to their natal freshwater habitats to spawn; a small percentage (1-2%) of returning adults in Maine will stray to a new river. Adults ascend rivers within the GOM DPS beginning in spring. The ascent of adult salmon continues into fall. Although spawning does not occur until late fall, the majority of Atlantic salmon in Maine enter freshwater between May and mid-July. The full upstream migration season is May 1 through November 10.

Atlantic salmon are repeat seasonal spawners. In the fall, female Atlantic salmon select sites for spawning in rivers, and a single female may create several redds (nests) before depositing all of her eggs. After spawning, Atlantic salmon may either return to the sea immediately or remain in freshwater until the following spring before returning to the sea.

Embryos develop in redds, hatching in late March or April. Newly hatched salmon, referred to as larval fry, alevin, or sac fry, remain in the redd for approximately six weeks (depending on water temperature) after hatching and are nourished by their yolk sac. Survival from the egg to fry stage in Maine is estimated to range from 15 to 35%.

When salmon fry reach approximately 4 cm in length, young salmon – termed "parr" – remain in the river for 2 to 3 years before undergoing "smoltification," the process of physiological changes that parr undergo in order to transition from a freshwater environment to a saltwater marine environment. In Maine, the vast majority of naturally reared parr (90% or more) remain in freshwater for two years with the balance remaining for either one or three years.

Most smolts enter the sea during May to begin their first ocean migration. During this outmigration, smolts must contend with changes in salinity, water temperature, pH, dissolved oxygen, pollution levels, and various predator assemblages. The transition of smolts into seawater is usually gradual as they pass through a zone of fresh and saltwater mixing that typically occurs in a river's estuary.

The spring migration of post-smolts out of the coastal environment is generally rapid, within several tidal cycles, and follows a direct route.

The full downstream migration seasons are April 1 through June 30, and October 15 through December 31 (the latter period involving post-spawn adults returning to the ocean as potential repeat spawners or kelts).

Repeat spawners within the GOM DPS of Atlantic salmon hold a unique importance for the survival and recovery of the species, as they are critical for population resilience and therefore recovery.

The Kennebec was once the most productive river in Maine, with Atlantic salmon runs in the hundreds of thousands.[1] Today, Atlantic salmon in the United States are on the edge of extinction,[2] including Atlantic salmon in the Kennebec River.

[1] 2006. Saunders et al. Maine's Diadromous Fish Community: Past, Present, and Implications for Atlantic Salmon Recovery. Fisheries 31(11):537-547. Table 2 (cited in ESA Atlantic salmon listing, 74 Fed. Reg. 29344, 29374-75); Fay *et al.*, 2006. Status review for anadromous Atlantic salmon (*Salmo salar*) in the United States. Report to the National Marine Fisheries Service and U.S.. Fish and Wildlife Service. P. 23. In the Kennebec alone, historic evidence puts the Atlantic salmon run at well over 216,000 fish, based on an 1867 Maine Agriculture report of a fish harvest on the Kennebec. Maine Agriculture, 1867 Report of Commissioners Nathan Foster and Charles Atkins at p. 114 (Jan. 16, 1868).

[2] 65 Fed. Reg. 69459 (November 17, 2000); 74 Fed. Reg. 29344 (June 19, 2009).

The lower Kennebec River watershed is completely within designated critical habitat for the migrating GOM DPS of Atlantic salmon. The vast majority of salmon spawning and rearing habitat in the Kennebec River Watershed is located above Brookfield's four hydropower projects, in the critical habitat recovery units within the Sandy River spawning and rearing area.[3]

10. The operations of each hydroproject "take" salmon.

The combination of the four hydropower projects of Lockwood, Hydro-Kennebec, Shawmut, and Weston on the Kennebec River totally blocks Atlantic salmon access to and from the critical spawning and rearing habitat in the Sandy River area, located upstream from the four dams.

In previous comments I filed on the FERC regulatory record last month, I set forth my analysis of the array of conditions arising from hydroproject operations, including harm resulting from significant habitat modification or degradation posed by the hydroprojects, including their significant impoundments. A copy of my comments and analysis is attached hereto as Exhibit B.

11. My opinions of the measures to undergo at each project to *reduce* take (take will never be *eliminated* under any scenario, so long as the project operations continue) are as follows, and in accordance with the opinions developed by Donald H. Pugh, Jr., and in accordance with the migration seasons described in more detail in paragraph 9, above. In the order of fish encounters moving downstream:

> A. Weston Project. Unlike Pacific salmon, Atlantic salmon are iteroparous which simply means that they can spawn successfully, return to the ocean, and spawn again in freshwater at a future date. Such returning fish or kelts are key to the overall population dynamics of Atlantic salmon because they often return to spawn at larger sizes and exhibit higher fecundity. This suggests that Atlantic salmon kelts play an intergral role in the population dynamics of the GOM DPS and may be critically important to the long-term recovery and population persistence of this DPS and others.

[3] The critical habitat for the GOM DPS of Atlantic salmon is divided into "salmon habitat recovery units" or SHRU's. Areas designated as critical habitat under the ESA within each SHRU are termed "habitat units," with one unit representing 100 square meters of spawning or rearing habitat. With more than 43,000 units of habitat, the Sandy River HUC 10 watershed has more Atlantic salmon habitat than any of the other 27 HUC 10 watersheds that were historically accessible to Atlantic salmon within the Merrymeeting Bay SHRU. (HUC stands for Hydrologic Unit Code, and is the national classification system for watershed by size.)

The Weston dam presents several challenges for migrating salmon. Most notably, passage routes are extremely limited and those that exist do not exhibit significant plunge pool depth for the downstream passage of salmon kelts and smolts during fall and spring. Specifically, the necessary depths to minimize take and encourage safe passage of downstream migrating fish do not exist due to bedrock outcroppings associated with both the north and south channels of the Weston Project (see project description). While there are truly no good options to totally limit take at the Weston Project, the most feasible option would be to fully open the sluice bypass (or log sluice bypass) associated with the south channel to encourage downstream migration of kelts and smolts. As such, I recommend opening this bypass channel to the fullest extent possible (maximum discharge) during critical migration periods for Atlantic salmon including from October 15 through December 31st (kelt migration) and from April 1 to June 30th during the spring outmigration period.

B. Shawmut Project. In order to reduce take at the Shawmut Project, I recommend completely shutting down the dam turbines during fall migration (October 15th-December 31st) and again during spring migration (April 1st-June 30th). In order to reduce take to the fullest extent possible, I also recommend operating spill and tainter gates at maximum discharge to encourage the entrainment and movement of fish downstream during the period.

C. Hydro-Kennebec Project. Similarly, in order to reduce take at the Hydro-Kennebec Project, I recommended completely shutting down the dam turbines during fall migration (October 15th-December 31st) and again during spring migration (April 1st-June 30th). In order to reduce take to the fullest extent possible, I suggest operating downstream passage facilities at the fullest extent possible to encourage fish passage and minimize mortality associated with dam passage.

D. Lockwood Project. The Lockwood project contains a fish lift for the upstream passage of adult salmon, unlike the other dams previously noted. Empirical observations suggest that previous shutdowns of the dam turbines to encourage safe downstream passage (e.g., May 2021) may have encouraged upstream movement of adult salmon past the fish lift and, instead, towards high magnitude flow releases associated with the bypass channel (i.e., where adult passage is *not* feasible). Therefore, during the period when upstream *and* downstream passage is occurring, I recommend completely shutting down the turbines between sunset and sunrise to minimize downstream passage mortality between May 1st through June 30th, and October 15th through November 10th, the periods when there is both upstream and downstream migration at Lockwood. Outside of this important timing window, I recommend shutting down the turbine units 24 hours/day to minimize the take of kelts and outmigrating smolts from April 1st to May 1st and again from November 10th through December 31st. During these periods, downstream fish passage facilities should continue to be run at maximum operation 24 hours/day.

12. I reiterate that even with these measures, under current conditions, some percentage of downstream "take" will occur by the operations of each hydroelectric project, in both the fall and spring migration seasons.

13. The measures above involving use of the sluice bypass facility at Weston; turbine shutdowns at Shawmut, Hydro-Kennebec, and Lockwood; and continuing operations at maximum flows of each bypass facility at Shawmut, Hydro-Kennebec, and Lockwood, will reduce the percentage of takes caused by project operations and project's habitat degradation, under current conditions and status of project operations.

**Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.**

DATED: October 19, 2021

/s/ Robert A. Lusardi
Robert A. Lusardi

EXHIBIT A

# Robert Andrew Lusardi
*Curriculum Vitae*

Dept. of Wildlife, Fish, & Conservation Biology
University of California, Davis
One Shields Ave., Davis, CA 95616
Website: https://sites.google.com/view/lusardi-lab

Phone: (510) 847-2713
Email: ralusardi@ucdavis.edu

## EDUCATION

**University of California, Davis**
**PhD**, Ecology, January 2015
Dissertation: *Volcanic Spring-fed Rivers: Ecosystem Productivity and Importance for Pacific Salmonids*
Advising professor: Peter Moyle

**University of California, Davis**
**M.A.**, Biogeography, May 2010
Advising professors: Peter Moyle and Jeffery Mount

**Hamilton College, Clinton, NY**
**B.A.** Biology with an economics minor, May 1998

## RESEARCH AND PROFESSIONAL EXPERIENCE

1. *Assistant Adjunct Professor* (step 4.5), University of California, Davis, Wildlife, Fish, & Conservation Biology, November 2019-present.
2. *Assistant Professional Researcher* (step 4), University of California, Davis, John Muir Institute for the Environment, Center for Watershed Sciences, October 2017-Present.
3. *California Trout-U.C. Davis Wild and Coldwater Fish Scientist*, University of California Davis, Center for Watershed Sciences, January 2015-Present.
4. *Postdoctoral Research Fellow*, University of California, Davis, John Muir Institute for the Environment, Center for Watershed Sciences, January 2015-October 2017.
5. *Graduate Student Researcher*, University of California, Davis, Center for Watershed Sciences, September 2007-October 2014.
6. *Recovery Biologist*, U.S. Fish and Wildlife Service, Sacramento, CA, April 2010-October 2014.
7. *Staff Research Associate,* University of California, Santa Barbara, Sierra Nevada Aquatic Research Laboratory, Mammoth Lakes, CA, September 2006-September 2007.
8. *Eastern Sierra Regional Conservation Director*, California Trout, Mammoth Lakes, CA, April 2004-September 2007.
9. *Staff Ecologist*, Tetra Tech EMI, San Francisco, CA, October 2000-April 2004.
10. *Assistant Field Biologist*, Oregon Department of Fish and Wildlife, Clackamas Field Station, Oregon, March 1999-June 2000.
11. *Research Assistant,* Elkington Laboratory, University of Massachusetts Amherst, June 1997-August 1998 (summers).

## PEER REVIEWED PUBLICATIONS

1. Grantham, T., Carlisle, D.M., Howard, J., Lane, B., **Lusardi**, R. Obester, A., Sandoval-Solis, S., Stanford, B., Stein, E. Taniguchi-Quan, K.T., Yarnell, S.M., and J.K. Zimmerman. Modeling functional flows in California's rivers. In review at Frontiers in Environmental Science.

2. Yarnell, S.M., Will, A., Obester, A., Peek, R.A., **Lusardi**, R.A., Zimmerman, J., Grantham, T., and E. Stein. Functional flows in groundwater influenced streams: application of the California environmental flows framework to determine ecological flow needs. In review at Frontiers in Environmental Science.
3. Corline, N., Vasquez-Housley, P., Yokel, E., Gilmore, C., Stapleton, B., and **R.A. Lusardi**. When humans work like beavers: riparian restoration enhances macroinvertebrate gamma diversity and habitat resiliency. In revision at *Restoration Ecology*.
4. Obester, A., **Lusardi, R.A.**, Santos, N., Peek, R.A., and S.M Yarnell. 2021. Conservation management over large geographic areas using suites of umbrella species. Accepted at *Aquatic Conservation: Marine and Freshwater Ecosystems*.
5. **Lusardi, R.A.**, Nichols, A.L., Willis, A.D., Jeffres, C.A., Kiers, A.H., Van Nieuwenhuyse, E.E., and R.A. Dahlgren. 2021. Not all rivers are created equal: the importance of spring-fed rivers under a changing climate. *Water* 13 (12): xxx-xxx.
6. Bellido-Leiva, F.J., **Lusardi, R.A.**, and J.R. Lund. 2021 Modeling the effect of habitat availability and quality on endangered winter-run Chinook salmon (*Oncorhynchus tshawystscha*) production in the Sacramento Valley. Ecological Modeling 47: xxx-xxx. https://doi.org/10.1016/j.ecolmodel.2021.109511
7. Zillig, K.W., **Lusardi, R.A**, and N.A. Fangue. 2021. One size does not fit all: variation in eco-physiology among Pacific salmonids. *Reviews in Fish Biology and Fisheries* 31: 95-114.
8. **Lusardi, R.A.**, B.G. Hammock, C.A. Jeffres, R.A. Dahlgren, and J.D. Kiernan. 2020. Oversummer Growth and Survival of Juvenile Coho Salmon (*Oncorhynchus kisutch*) Across a Natural Gradient in Stream Water Temperature and Prey Availability: an In Situ Enclosure Experiment. *Canadian Journal of Fisheries and Aquatic Sciences* 77: 413-424.
9. Nichols, A.L., **Lusardi, R.A.**, and Willis, A.D. 2020. Seasonal Macrophyte Growth Constrains Extent, but Improves Quality of Cold-Water Habitat in a Spring-fed River. *Hydrological Processes* 34(7): 1587-1597. DOI: 10.1002/hyp.13684
10. Durand, J.D., Manfree, A., Medellin-Azuara, J., Bombardelli, F., Fleenor, W., Henneberry, Y., Herman, J., Jeffres, C., Leinfelder-Miles, M., **Lusardi, R.A.**, Milligan, B., Moyle, P.B., and T. Young. 2020. Drought and the Sacramento-San Joaquin Delta, 2012-2016: Synthesis Review and Lessons. *San Francisco Estuary and Watershed Science* 18(2): 1-26.
11. Yarnell, S.M., Stein, E.D., Webb, J.A., Grantham, T., **Lusardi, R.A.**, Zimmerman, J., Peek, R.A., Grantham, T., Lane, B.A., Howard, J., and S.S. Sandoval-Solis. 2020. A Functional Flows Approach to Selecting Ecologically Relevant Flow Metrics for Environmental Flow Applications. *River Research and Applications* 36: 318-324.
12. **Lusardi, R.A.**, C.A. Jeffres, and P.B. Moyle. 2018. Stream Macrophytes Increase Invertebrate Production and Fish Habitat Utilization in a California Stream. *River Research and Applications* 34: 1003-1012.
13. Moyle, P.B., **R.A. Lusardi**, P.J. Samuel, and J.V.E. Katz. 2017. State of the Salmonids: Status of California's Emblematic Fishes 2017. Center for Watershed Sciences, University of California, Davis and California Trout, San Francisco, CA. 579 pp.
14. Steel, A.E, R.A. Peek, **R.A. Lusardi,** and S.M. Yarnell. 2017. Associating Metrics of Hydrologic Variability with Benthic Macroinvertebrate Communities in Regulated and Unregulated Snowmelt-dominated Rivers. *Freshwater Biology* 63: 844-858.
15. **Lusardi, R.A.**, and P.B. Moyle. 2017. Two-way Trap and Haul as a Conservation Strategy for Anadromous Salmonids. *Fisheries* 42(9): 478-487.

16. **Lusardi, R.A.**, M.T. Bogan, R.A. Dahlgren, and P.B. Moyle. 2016. Environment Shapes Invertebrate Assemblage Structure Differences between Volcanic Spring-fed and Runoff Rivers in Northern California. *Freshwater Science* 35(3): 1010-1032.
17. **Lusardi, R.A.**, M.R. Stephens, C. McGuire, P.B Moyle, and J. Hull. 2015. Threat Evolution: Negative Feedbacks Between Management Action and Species Recovery in Threatened Trout. *Reviews in Fish Biology and Fisheries* 25: 521-535.
18. Durand, J.R., **R.A. Lusardi**, D.M. Nover, R.J. Suddeth, G.C. Carmona-Catot, C.R. Connell-Buck, S.E. Gatzke, J.V. Katz, J.F. Mount, and J.H. Viers. 2011. Environmental Heterogeneity and Community Structure of the Kobuk River, Alaska, in Response to Climate Change. *Ecosphere* 2(4):1-19.
19. Herbst, D.B., M.T. Bogan, and **R.A. Lusardi**. 2008. Low Specific Conductivity Limits Growth and Survival of the New Zealand Mudsnail from the Upper Owens River, CA. *Western North American Naturalist* 68(3): 324-333.

<u>MANUSCRIPTS IN PREPARATION</u>

1. Jeffres, C. A., A.L. Nichols, **R.A. Lusardi**, M.L. Deas, J.F. Mount, P.B. Moyle, and R.A. Dahlgren. From Subduction to Salmon: Geologic Subsidies Drive High Productivity of a Spring-fed River. For submission to *American Naturalist.*
2. **R.A. Lusardi**, E. Van Niewenhuyse, R. Johnson, and R. Dahlgren. For submission to Ecology. The Matthew effect: does geology promote differences in growth trajectories and life history diversity of riverine predators? For submission to *Ecology*
3. Huber, E.R., Ryan, R., Johnson, R.C., Sturrock, A.M., **Lusardi, R.A.**, and S.M. Carlson. Seventy years of diminishing biocomplexity of California Central Valley hatchery Steelhead, Oncorhynchus mykiss. For submission to the *Canadian Journal of Fisheries and Aquatic Sciences.*

<u>EDITED CHAPTERS OR TECHNICAL REPORTS</u>

1. Lukk, A., Vasquez-Housely, P., **Lusardi, R.A.**, and Willis, A.D. 2019. Little Shasta River 2017-2019: Pre Project Assessment of the Proposition 1 Ecosystem Restoration Grant Activites. 46 pp.
2. Zillig, K. W., **R.A. Lusardi**, and Fangue, N. A. 2018. Variation in Thermal Eco-Physiology among California Salmonids: Implications for Management. Sacramento, California: California State Water Resources Control Board. 39 pp.
3. Yarnell, S., R. Peek, and **R. Lusardi**. 2018. Development of Tier 1 Environmental Flows for California. Final Report to The Nature Conservancy.
4. Nichols, A., **R.A. Lusardi**, and A. Willis. 2017. Little Shasta Habitat Assessments 2016. Final Report to The Nature Conservancy.
5. Jeffres, C., R. Dahlgren, J. Kiernan, A. King, **R. Lusardi**, A. Nichols, S. Null, S. Tanaka, and A. Willis. 2009. Baseline Assessment of Physical and Biological Conditions within the Waterways on Big Springs Ranch, Siskiyou County, California. Final Report to the California State Water Resources Control Board.
6. Durand, J.D., **Lusardi, R.A.**, Suddeth, R., Caromona-Catot, G., Connell, C.R., Gatzke, S.E., Katz, J., Nover, D., Mount, J.F., Moyle, P.B., and Viers, J.H. 2009. Conceptual ecosystem model of subarctic river response to climate change: Kobuk River, Alaska. Final report to the National Park Service and Alaska Department of Fish and Game.

7. **Lusardi, R.A.** 2009. Chapter 5: Aquatic Food Webs of the Tuolumne River. In J. Mount and S. Purdy (Eds.), Confluence: A Natural and Human History of the Tuolumne River Watershed (in publication with the Tuolumne River Trust).
8. Jeffres, C., A. Nichols, A. Willis, N. Corline, A. King, **R. Lusardi**, and R. Dahlgren. Longitudinal baseline assessment of salmonid habitat characteristics of the Shasta River, March through September, 2008. Final Report to the United States Bureau of Reclamation.

PEDAGOGICAL TRAINING

*Course: Evidence-Based Undergraduate STEM Teaching*, with distinction. September 2019. Center for Integration of Research, Teaching and Training.

TEACHING EXPERIENCE

1. Instructor of Record, Freshwater Ecology (Wildlife, Fish, and Conservation Biology [WFC] 198: Spring 2021; 30 students. Lectured on freshwater ecology, fluvial geomorphology, hydrology, food web ecology, and current theory and practice. Writing Intensive Course.
2. Instructor of Record, *Biology and Conservation of Fishes* (WFC120/WFC 120L): Fall 2016 (94 students). Lecture on fish taxonomy, conservation, aquatic ecology, and community ecology. Maintained two fish taxonomy laboratory sections.
3. Instructor of Record, Principles and Applications in Freshwater Ecology (ECL 290). Graduate student seminar. Fall 2020. Discussion of seminal freshwater biology papers with instruction.
4. Instructor of Record, Topics in Freshwater Ecology (WFC 198): Spring 2020. Undergraduate students only. Lectured on freshwater ecology and applied conservation science.
5. Co-Instructor of Record, *Ecogeomorphology of the Tuolumne River, CA* (WFC 102): Spring 2015. Lectured on stream ecology and trophic dynamics of aquatic ecosystems.
6. Guest Lecturer, *Natural History of California's Wild Vertebrates* (WFC 50): Winter 2021. Lectured on fish distributions in California, ecosystem ecology, and conservation biology.
7. Guest Lecturer, *Wildlife Ecology and Conservation* (WFC 10): Spring 2021. Lectured on aquatic ecology of the Central Valley, native fish evolution, and reconciliation ecology
8. Guest Lecturer, *Wildlife Ecology and Conservation* (WFC 10): Fall 2020. Lectured on aquatic ecology of the Central Valley, native fish evolution, and reconciliation ecology.
9. Guest Lecturer, *Wildlife Ecology and Conservation* (WFC 10): Spring 2020. Lectured on aquatic ecology of the Central Valley, native fish evolution, and reconciliation ecology.
10. Guest Lecturer, *Natural History of California's Wild Vertebrates* (WFC 50): Winter 2020. Lectured on fish distributions in California, ecosystem ecology, and conservation biology.
11. Guest Lecturer, *Rivers of California* (GEL 35): Spring 2019. Lectured on stream food webs, adaptations to the natural flow regime, and aquatic ecology.
12. Guest Lecturer, *Wildlife Ecology and Conservation* (WFC 10): Fall 2019. Lectured on the human-environment interface and management of aquatic species in highly altered environments.
13. Guest Lecturer, *Nature Rx: Exploring the Power of the Natural World*: Fall 2019. Lectured on reconciliation ecology and aquatic field methods for capturing fish.
14. Guest Lecturer, *Wildlife Ecology and Conservation* (WFC 10): Spring 2019. Lectured on aquatic ecology of the Central Valley, native fish evolution, and reconciliation ecology.
15. Guest Lecturer, *Wildlife Ecology and Conservation* (WFC 10): Fall 2018. Lectured on reconciliation ecology and conservation of native riverine biota.
16. Guest Lecturer, *Nature Rx: Exploring the Power of the Natural World*: Fall 2018. Lectured on historical ecology and field methods in aquatic ecology.

17. Guest Lecturer, *UC Water Security and Sustainability Research Initiative*: Summer 2018. Lectured on water policy and science in the west with an emphasis on the Mono Lake decision. UC Merced.
18. Guest Lecturer, *Nature Rx: Exploring the Power of the Natural World*: Fall 2017. Lectured on historical ecology and field methods in aquatic ecology.
19. Guest Lecturer, *Wildlife Ecology and Conservation* (WFC 10): Spring 2015. Lectured on California fishes, threats and potential solutions.
20. Guest Lecturer, *Field methods in Wildlife, Fish and Conservation Biology* (WFC 100): Spring 2015. Lectured on fish sampling methods.
21. Guest Lecturer, *Management of Regulated Rivers* (Environmental Science and Policy [ESP] 130): Spring 2011. Lectured on aquatic ecology, ecological theory, and ecological conceptual models.
22. Laboratory Instructor. *Biology and Conservation of Fishes* (WFC 120L): Fall 2013. Laboratory methods, fish identification and taxonomy.
23. Teaching Assistant, *Ecology and Management of Sierra Nevada Rivers* (ESP 190): Spring 2013. Field methods, fish and invertebrate identification, supervision of students and course evaluation.
24. Teaching Assistant, *Ecogeomorphology* (Geology 136): Spring 2010, 2011, 2012. Field methods, fish and invertebrate identification, supervision of students and course evaluation.
25. Teaching Assistant, *Vertebrates of California* (WFC 50): Winter 2010, 2011, 2012. Vertebrate taxonomy, preparation of lab materials and lecture on taxonomic relatedness of CA vertebrates.
26. Teaching Assistant, Wildlife Ecology and Conservation (WFC 10): Spring 2009. Supervised review sessions and discussed current topics in wildlife conservation.

<u>FUNDING</u>

*Total Independent Research Funding Acquired to date: $4,587,569 USD*

1. S. Yarnell and **R.A. Lusardi**. California Department of Fish and Wildlife. Resiliency of California fishes: assessing native fish sensitivity to changes in wet and dry season baseflows. 2021-2024. $799,999.
2. A.D. Willis and **R.A. Lusardi**. Wildlife Conservation Board Stream Flow Enhancement Program, California Department of Fish and Wildlife. Flow enhancement and restoration of freshwater spawning and rearing habitat on Parks Creek, Cardoza Ranch, CA. 2021-2023. $483,240.
3. **R.A. Lusardi**. United States Bureau of Reclamation. Food-Temperature Optimization Model for Central Valley Project Reservoirs. 2020-2023. $951,285
4. A.D. Willis and **R.A. Lusardi**. California Trout. Parks Creek-Cardoza Diversion: pre-construction monitoring and assessment. 2020. $12,675.
5. Sarah Yarnell and **R.A. Lusardi**. Wildlife Conservation Board Stream Flow Enhancement Program, California Department of Fish and Wildlife. Developing a tiered framework for environmental flow recommendations for California. 2019-2022. $499,995.
6. **R.A. Lusardi** and A.D. Willis. Resource Legacy Fund. Klamath Dam Removal Baseline Science. 2020-2021. $79,974
7. **R.A Lusardi** and A.D. Willis. Scott River Watershed Council. Sugar Creek Beaver Dam Analog and Aquatic Community Response. 2019-2021. $17,000
8. **R.A. Lusardi**, and A.D Willis. California Trout. Walker Creek Initial Aquatic Habitat Assessment. 2019-2021. $47,563.
9. A.D. Willis and **R.A. Lusardi**. California Trout. Evans Springs Management Alternative Analysis. 2018-2021. $29,884.

10. Willis, A.D., and **R.A. Lusardi**. California Trout. South Fork Scott River and Shackelford Creek Monitoring for Adaptive Management Conservation Actions. 2017-2021. $92,750.
11. Jeffres, C.A., and **R.A. Lusardi**. California Trout. Habitat dependent life state model for salmon. 2017-2019. $200,000.
12. **Lusardi, R.A.**, and A.D. Willis. Scott River Watershed Council. Scott River watershed restoration and aquatic community response, Scott River. 2017-2021. $43,000
13. Fangue, N.A. and **R.A. Lusardi**. State Water Resource Control Board (SWRCB): Evaluating thermal criteria for salmonids in the Central Valley, CA. 2017-2018. $184,032
14. Willis, A.D., and **R. A. Lusardi**. Wildlife Conservation Board Stream Flow Enhancement Program, California Department of Fish and Wildlife: Hart Ranch instream flow enhancement and biotic response, Little Shasta River. 2018-2021. $482,660
15. **Lusardi, R.A.** California Trout: Coldwater and Wild Fish Research Cooperative Lead. 2014-2022. $146,250
16. **Lusardi, R.A.** University of California, Davis, Center for Watershed Sciences Continuing Post-Doctoral Research Grant: Juvenile coho salmon exhibit compensatory mechanisms in a large spring-fed creek, Shasta River, CA. 2014-2016. $61,250.
17. **Lusardi, R.A.** and R.A. Dahlgren. United States Bureau of Reclamation. Baseline assessment of salmonid rearing habitat and growth in the upper Sacramento River watershed above Shasta Reservoir. 2016-2020. $456,012.

<u>ACADEMIC FELLOWSHIPS AND AWARDS</u>

1. University of California, Davis, Graduate Group in Ecology Block Grant (2013).
2. University of California, Davis, Graduate Group in Ecology Hillyer Fellowship (2013).
3. University of California, Davis, Jastro-Shields Research Fellowship (2012).
4. Marin Rod and Gun Club Fellowship (2012).
5. Marin Rod and Gun Club Fellowship (2010).
6. Stockton Sportsmen Fellowship (2010).
7. James P. Michelleti Research Fellowship (2010).
8. University of California, Davis, Jastro-Shields Research Fellowship (2009).
9. University of California, Davis, Jastro-Shields Research Fellowship (2008).
10. California Trout Graduate Research Fellowship (2008).
11. California Trout Graduate Research Fellowship (2007).

<u>SELECTED PRESENTATIONS, PANEL DISCUSSIONS[PD], AND SYMPOSIUMS</u>

1. Salmonid Restoration Federation Annual Meeting (2021). Abundant Prey Availability Improves Juvenile Coho Growth Under Warming Stream Temperatures (Authors: **R.A. Lusardi** and J.D. Kiernan). Virtual Conference due to Covid-19. <u>Invited Talk</u>.
2. Salmonid Restoration Federation Annual Meeting (2021). The influence of food webs on salmonid growth and performance: a forgotten link to species resilience (Authors: **R.A. Lusardi**). Session coordinator. Santa Cruz, CA. Virtual Conference due to Covid-19.
3. United States Bureau of Reclamation (2021). Defining the spatial and temporal extent of reservoir subsidies to regulated rivers and their role in riverine food webs: implications for managed ecosystems and water management flexibility (Authors: **R.A. Lusardi**). Sacramento, California. <u>Invited Talk</u>.
4. Department of Fish, Wildlife, and Conservation Biology, University of California, Davis (2021). Growth of juvenile coho salmon across a gradient in stream water temperature and prey availability (Authors: **R.A. Lusardi**). Davis, CA. <u>Invited Talk</u>.
5. American Fisheries Society, California/Nevada Chapter, Annual Meeting (2021). Contrasting histological, genetic, and otolith indicators of growth and condition in an

endangered estuarine fish (Authors: R.A. Fichman, W. Xieu, F. Zhao, M. Willmes, J.A. Hobbs, T.C. Hung, A. Schultz, B. Hammock, S. Teh, **R.A. Lusardi**, and L.S. Lewis. Virtual conference due to Covid-19.

6. Klamath River Renewal Corporation and California Trout (2020). Klamath Dam Removal Panel Discussion [PD]. Webinar. <u>Invited Talk</u>.
7. Public Policy Institute of California and California Trout (2020). Making the most of water for the environment: a functional flows approach for California's rivers (Authors: **R.A Lusardi** and T. Grantham). Online seminar. <u>Invited Talk</u>
8. Sierra Streams Institute. Stream macroinvertebrates: vital tools to assess environmental change, instream flows, and prey availability for foraging fishes (Authors: **R.A. Lusardi**). Nevada City, CA. <u>Invited Talk.</u> *Cancelled due to Covid-19*
9. Department of Ecology and Evolution, University of California Santa Cruz (2020). Eating your way out of climate change? Metabolic compensation of juvenile coho salmon in the wild (Authors: **R.A. Lusardi** and J.D. Kiernan). Santa Cruz, CA. <u>Invited Talk</u>.
10. 38th Annual Salmonid Restoration Conference (2020). Abundant prey availability improves juvenile coho growth under warming stream temperatures (Authors: **R.A. Lusardi**, B.G. Hammock, C.A. Jeffres, R.A. Dahlgren, and J.D. Kiernan). Santa Cruz, CA. *Cancelled due to Covid-19*
11. 38th Annual Salmonid Restoration Conference (2020). The influence of food webs on salmonid growth and performance: a forgotten link to species resilience (Authors: **R.A. Lusardi**). Session coordinator. Santa Cruz, CA. *Cancelled due to Covid-19*
12. CalTrans Annual Fish Passage Partnership Meeting (2020). State of the Salmonids: Fish in Hot Water (Authors: **R.A. Lusardi** and P. Samuel). Symposium. <u>Invited Talk</u>.
13. Ecological Society of America (2020). Intraspecific variation in thermal physiology of West-Coast Chinook salmon (Authors: Zillig, K.W., **R.A. Lusardi**, Cocherell, D.E., and Fangue, N.A.). Virtual Conference due to Covid-19.
14. International Congress on the Biology of Fishes (2020). Patterns and variations in thermal performance of Chinook salmon, *Oncorhynchus tshawytscha*, from eight hatchery populations (Authors: Zillig, K.W., **R.A. Lusardi**, Cocherell, D.E., and Fangue, N.A.). Montpellier, France. *Cancelled due to Covid-19*
15. California Senate Joint Committee on Fisheries and Aquaculture; California Legislature (2019) -expert testimony. Fish passage concerns in California (Authors: **R.A. Lusardi**). State Capitol Building, Sacramento, CA. <u>Invited Talk</u>.
16. International Society for River Science (2019). Developing ecological flow recommendations for native fishes when quantifiable relationships are lacking (Authors: **R.A. Lusardi**, A. Obester, N. Santos, R. Peek, E. Stein, and S. Yarnell). Vienna, Austria.
17. International Society for River Science (2019). The environmental flow and water management nexus: implementation challenges, strategies, and outcomes of environmental flow programs. Session coordinator. Vienna, Austria.
18. American Fisheries Society (2019). Eco-physiological patterns in thermal performance among populations of Chinook salmon, *Oncorhynchus tshawytscha* (Authors: Zillig, K.W., **R.A. Lusardi**, Cocherell, D.E., and Fangue, N.A.). Reno, Nevada.
19. Society for Freshwater Science Annual Conference (2019). A California environmental flows framework (Authors: T. Grantham, B. Lane, **R.A. Lusardi**, J. Howard, E. Stein, S. Sandoval, S. Yarnell, and J. Zimmerman). Salt Lake City, Utah.
20. Society for Freshwater Science Annual Conference (2019). An Ecosystem approach for selecting flow metrics for environmental flow applications (Authors: S. Yarnell, E. Stein, **R.A. Lusardi**, J. Zimmerman, R. Peek, T. Grantham, B. Lane, J. Howard, and S. Sandoval). Salt Lake City, Utah.

21. American Geophysical Union Conference (2019). Optimization of restoration for non-natal rearing habitats using a population dynamic model (HaBPWM) for winter-run Chinook Salmon along the Sacramento River (Authors: F.J. Bellido-Leiva, **R.A. Lusardi**, and J.R. Lund). Washington, D.C.
22. Sacramento River Science Workshop (2019). Biogeochemistry and food webs in the Upper Sacramento River (Authors: **R.A. Lusardi**). Library Galleria, Sacramento, CA. Invited Talk.
23. Sacramento River Science Workshop (2019) [PD]. Habitat restorations efforts in the Sacramento River, CA. Library Galleria, Sacramento, CA. Invited Talk.
24. One Health Institute Symposium (2019). California epidemic: the rise and fall (and rise again?) of salmonids (Authors: **R.A. Lusardi**). University of California, Davis. Symposium. Invited Talk.
25. Scott River Watershed Forum (2019). Food Web Analysis and Coho Salmon Response at Scott River Beaver Dam Analogue Sites (Authors: **R.A. Lusardi** and E. Yokel). Fort Jones, CA. Invited Talk.
26. International Symposium on Ecohydraulics (2018). Establishing environmental flow targets in complex environments (Authors: E. Stein, S. Yarnell, S. Sandoval-Solis, **R.A. Lusardi**, B. Lane, J. Zimmerman, J. Howard, and T. Grantham. Tokyo, Japan
27. International Symposium on Ecohydraulics (2018). An ecologically based approach for selecting flow metrics for environmental flow applications (Authors: S. Yarnell, E. Stein, **R.A. Lusardi**, J. Zimmerman, R. Peek, T. Grantham, B. Lane, J. Howard, and S. Sandoval). Tokyo, Japan.
28. Bay-Delta Science Conference (2018). Differences in thermal performance between populations of Chinook salmon, Oncorhynchus tshawytscha (Authors: K.W. Zillig, **R.A. Lusardi**, D.E. Cocherell, and N.A. Fangue). Sacramento, CA.
29. Shasta Fish Passage Steering Committee (2018). Assessment of Stream Food Webs and Salmonid Growth Rates in the Upper Sacramento River Watershed (Authors: **R.A. Lusardi**). EPA Building, Sacramento, CA. Invited Talk.
30. International Congress on the Biology of Fishes (2018). Interpopulation variation in the thermal performance of Chinook salmon, *Oncorhynchus tshawytscha* (Authors: Zillig, K.W., **R.A. Lusardi**, Cocherell, D.E., and Fangue, N.A.). Calgary, AB
31. California Senate Joint Committee on Fisheries and Aquaculture; California Legislature (2018) -expert testimony. The Status and Future of California Salmonids (Authors: **R.A. Lusardi**). State Capitol Building, Sacramento, CA. Invited Talk.
32. North Coast Regional Water Quality Control Board (2018). State of the Salmonids (Authors: **R.A. Lusardi**, Peter Moyle, and Patrick Samuel). Special session board meeting, Santa Rosa, CA. Invited Talk.
33. Biennial Symposium of the International Society for River Science (2017). Developing Tiered Environmental Flow Targets using Functional Flows (Authors: **R.A. Lusardi**, Sarah Yarnell, Sam Sandoval, Belize Lane, Eric Stein, Julie Zimmerman, Ted Grantham, Jeanette Howard, and Jay Lund). Hamilton, New Zealand.
34. California Aquatic Bioassessment Workgroup (2017). Migratory Assistance? Two-way Trap and Haul for Anadromous Salmonids in California (Author: **R.A. Lusardi**). Davis, CA. Invited Talk.
35. Salmonid Restoration Conference (2017). Two-way Trap and Haul as a Conservation Strategy for Anadromous Salmonids (Author: **R.A Lusardi**). Davis, CA. Invited Talk.
36. Salmonid Restoration Federation (2017). Reintroduction of Salmon to Historical Habitats (**R.A. Lusardi**). Session coordinator. Davis, CA.
37. International Trout Congress (2016) [PD]. The Climate Dilemma: Preparing for an Uncertain Future for Trout. Bozeman, MT.

38. Society for Freshwater Science Annual Meeting (2016). Invertebrate Community Composition and Drivers of Assemblage Dissimilarity between Spring-fed and Runoff rivers (Authors: **R.A Lusardi**, M.T. Bogan, P.B. Moyle, and R.A. Dahlgren). Sacramento, CA.
39. American Fisheries Society Annual Meeting (2015). Juvenile Coho Salmon Exhibit Compensatory Mechanisms in a Large Volcanic Spring-fed River (Author: **R.A Lusardi**). Portland, OR.
40. The Nature Conservancy (2015). Prey Availability and Water Temperature Interact to Influence Coho Salmon Growth on the Shasta River (Author: **R.A Lusardi**). Sacramento, CA. Invited Talk.
41. Coho Coalition Semi-Annual Meeting (2015). Maximizing Reach Specific Growth Potential of Coho Using Interdisciplinary Methods (Author: **R.A Lusardi** and P.B. Moyle). Sacramento, CA. Invited Talk.
42. California Trout Science Meeting (2015). Juvenile Coho Exhibit Compensatory Mechanisms in a Large Volcanic Spring-Fed River (Author: **R.A. Lusardi**). Yreka, CA.
43. Salmonid Restoration Federation (2015). Coho Growth and Compensatory Mechanisms. (Authors: **R.A. Lusardi** and J.D. Kiernan). Santa Rosa, CA.
44. Salmonid Restoration Federation (2015)[PD]. Innovative Trans-Boundary Approaches to Coho Salmon Recovery. Santa Rosa, CA.
45. Bureau of Reclamation-Fish Passage Technical Group (2015). Volcanic Spring-Fed Rivers: Ecosystem Productivity and Importance for Pacific Salmonids. (Authors: **R.A. Lusardi** and R.A. Dahlgren). Sacramento, CA.
46. Shasta River Coho Safe Harbor (2014). Coho Growth and Compensatory Mechanisms. (Author: **R.A. Lusardi**). Yreka, CA. Invited Talk.
47. The Nature Conservancy (2014). Volcanic Spring-fed Rivers: Novel Ecosystems Provide Hope for Pacific salmonids. (Author: **R.A. Lusardi**). San Francisco, CA.
48. California Trout Water Talk (2013). Why Spring-fed Systems Offer a Glimmer of Hope in the Face of a Changing Climate. (Authors: **R.A. Lusardi** and C.A. Jeffres). Mt. Shasta, California. Invited Talk.
49. Center for Watershed Sciences (2013). Coho Growth and Compensatory Mechanisms (Author: **R.A. Lusardi**). University of California at Davis.
50. Geological Society of America (2009). Restoration Potential of the Groundwater-fed Big Springs Creek, Siskiyou County, California *(*Authors: A.L. Nichols, J.F. Mount, M.L. Deas, C.A. Jeffres, J.D Kiernan, **R.A. Lusardi**, and A.D. Willis). Portland, Oregon.
51. Bureau of Reclamation, Klamath Basin Office (2009). Big Springs Creek Baseline Assessment Study (Authors: M.L. Deas, C.A. Jeffres, A.L. Nichols, **R.A. Lusardi**, and A.D. Willis). Klamath Falls, CA.
52. American Fisheries Society (2008). Investigating Trophic Relationships on the Shasta River, CA Using Stable Isotope Analysis (Authors: **R.A. Lusardi** and J.D Kiernan). Portland, Oregon.
53. California Aquatic Bioassessment Workgroup (2006). Gradients in Channel Morphology Along the Upper Owens River in Relation to the New Zealand Mudsnail and Native Benthic Community (Authors: D.B. Herbst and **R.A. Lusardi**). University of California. Davis, CA.
54. Eastern Sierra Environmental Roundtable Group (2006). Surface and Groundwater Production in Mammoth Lakes: Sustainable Abstraction? (Author: **R.A. Lusardi**). Crowley Lake, CA.
55. California Trout Southern California Presentation Series (2006). Water in the Mammoth Basin: Competition for Water Resources (Author: **R.A. Lusardi**). The Olympic, Los Angeles, CA.
56. Hamilton College Senior Thesis Presentation (1998). The Growth of the Gypsy Moth, with Relation to Nitrogen Allocation and Defensive Chemistries of Host Plants (Author: **R.A Lusardi**). Clinton, NY.

SELECTED RESEARCH IN THE MEDIA AND RADIO INTERVIEWS[RI]

1. Maven's Notebook: California Water, Verbatim. Feature: The State of the Salmonids in California. May 2020.
2. Jefferson Public Radio (NPR). *Can more food offset climate effects on salmon?* January 2020.[RI]
3. Capital Public Radio (NPR). Young salmon defend themselves against climate change by eating more – but there's a catch. December 2019.[RI]
4. Whale Scout Podcast interview with Dr. Robert Lusardi: *Dams and the State of Klamath River Salmon*. August 2019.[RI]
5. The Revelator, *Drones, algae, and fish ears: what we're learning before the world's largest dam-removal project—and what we could miss*. November 2019.
6. The New York Times, *How Protecting Water Helps Industry and Nature*. September 2017.
7. San Francisco Chronicle (Front Page with cover photo and inset photos), *Nearly Half of California Salmon Species on Track for Extinction*. May 2017*.*
8. Earth Island Journal, *The Long Run Home: a Vanishing Tribe, a Critically Endangered Fish, and the Race to Pull Them Back from the Brink*. March 2018.
9. Jefferson Public Radio (NPR), *Report Urges Caution in Fish Trap and Haul Programs*. October 2017.[RI]
10. Yes Magazine, *The Shasta Dam Killed off This Tribe's Salmon — Or So They Thought*. October 2017.
11. The Siskiyou Daily News, *Guest Opinion: Removing dams is key to fish recovery*. September 2019
12. Field and Stream, *The Seven American Trout Species at Greatest Risk*. July 2017.
13. Jefferson Public Radio (NPR), *California Fish in Serious Hot Water*. June 2017.[RI]
14. Scientific American*, Popular Sport Fish May Be Headed for Broad Extinction in California.* May 2017*.*
15. San Francisco Chronicle, *Volcanic Springs Offer Hope for Threatened Fish*. August 2016.
16. Davis Enterprise, *Troubled Waters: Report Spotlights Fish in Peril*. May 2017.
17. California Water Blog, *Functional Flows Can Improve Environmental Water Management in California*, November 2020.
18. California Water Blog, *Drought and the Sacramento-San Joaquin Delta, 2012-2016: Environmental Reviews and Lessons*, August 2020.
19. California Water Blog, *Functional Flows for Developing Ecological Flow Recommendations*, December 2018.
20. California Water Blog, *The Little Shasta River, A Model for Sustaining Our National Heritage*. September 2017
21. California Water Blog, *Conservation of Inland Trout Populations in California*. April 2016.
22. California Water Blog, *Aquatic Macrophytes*: *Unsung but Prime Salmon Habitat*. January 2015.

THESIS COMMITEES

1. Mollie Ogaz, University of California-Davis, Masters Committee Signatory. Completed 2020.
2. Brandi Goss, University of California-Davis, Master Committee Chair. Expected 2022.
3. Rachel Fichman, University of California-Davis, Masters Committee Chair. Expected 2022.

STUDENTS AND POSTDOCTORAL FELLOWS MENTORED

1. Francisco Bellido-Leiva, University of California, Davis, postdoctoral fellow (2021-present)
2. Ethan Baruch, University of California, Davis, postdoctoral fellow (2021-present)
3. Eric Holmes, University of California, Davis graduate student (2020 Ecology cohort)

4. Brandi Goss, University of California, Davis, graduate student (2020-present).
5. Rachel Fichman, University of California, Davis, graduate student (2020-present)
6. Rachelle Tallaman, University of California, Davis, graduate student (2019-present)
7. Francisco Bellido-Leiva, University of California, Davis, graduate student (2019-present)
8. Kenneth Zillig, University of California, Davis, graduate student (2016-present)
9. Adriana Alarcon, University of California, Davis, undergraduate student (2018-2020). Current lab manager.
10. Madeline Frey, University of California, Davis, undergraduate student (2019-present)
11. Misa Terrell, University of California, Davis, undergraduate student (2020-present)
12. Neil Singh, University of California, Davis, undergraduate student (2018-present).
13. Celina Chang, University of California, Davis, undergraduate student (2017-present).
14. Priscilla Vasquez-Housely, University of California, Davis, undergraduate student (2016-2020).
15. Gabriel Saron, University of California, Davis, undergraduate student (2015-2016).
16. Kyle Phillips, University of California, Davis, undergraduate student (2011-2014).
17. Nicholas Corline, University of California, Davis, undergraduate student (2010-2013).

DOCTORAL STUDENT QUALIFYING EXAMS

1. Christine Parisek. Area of Emphasis: Aquatic Community Ecology.

RESEARCH METHODS

- **Field:** Surface water, groundwater and soil sampling, river transect surveys and quantification of physical habitat parameters, discharge measurements, substrate characterization, riparian cover characterization, water quality sampling, algae and particulate organic matter sampling and processing, aquatic invertebrate sampling and identification, stable isotope data collection and processing, electro-fishing surveys, snorkel surveys, pit tagging, seining and otter trawling sampling methods, fish taxonomy and identification.
- **Laboratory Analysis:** Macroinvertebrate taxonomy, macrophyte/particulate matter/algae biomass processing, otolith dissection and preparation, stable isotope preparation and analysis, otolith methods, and spectrophotometric analytical methods.
- **Software:** R, SAS, SigmaPlot, JMP, ArcGis 9.0, AutoCAD, Microsoft Office.

PROFESSIONAL AND PUBLIC SERVICE

- Salmonid Bioenergetics Symposium (2018). Examined the history and current use and application of bioenergetics modeling in salmonid conservation, gaps in knowledge, and opportunities. National Oceanic and Atmospheric Administration, Fresno State University, University of California (Davis and Santa Barbara), Oregon State University, Humboldt State University, National Marine Fisheries Service, University of Nevada (Reno), USGS, University of Alaska (Fairbanks)
- California Environmental Flows Framework (CEFF), Technical Workgroup. Establish environmental flow targets for all streams in California and make scientifically based recommendations on appropriate methods. University of California, Davis, University of California, Berkeley, USGS, The Nature Conservancy, and California Trout. January 2017-present.
- Climate change effects on environmental flows, Technical Advisory Committee. Review flow ecology models and relationships and comment as appropriate. Advise on the use of models to assess anticipated climate change effects on stream ecosystems in southern California. Southern California Coastal Watershed Research Project, National Park Service, California

Department of Fish and Wildlife, California State Water Resources, Control Board, University of California. March 2018-present.

- Scientific adviser: California Trout (Shasta River Program, Limiting Factors Analysis). January 2015-present.
- Session coordinator, Salmonid Restoration Federation. Reintroduction of salmonids to historical habitat. Davis, California: April 1, 2017.
- Session coordinator, International Society for River Science. The environmental flow and water management nexus: implementation challenges, strategies, and outcomes of environmental flow program. Vienna, Austria: September 2019
- Session coordinator, Salmonid Restoration Federation. Davis, California: Spring, 2020. The influence of food webs on salmonid growth and performance: a forgotten link to species resilience (R.A. Lusardi). Session coordinator. Santa Cruz, CA. *Cancelled due to Covid-19*
- Center for Watershed Sciences Principal Investigator Partnership. Chair. University of California Davis. March 2020-June 2020.
- Department of Wildlife, Fish, and Conservation Biology (WFCB) Justice, Equity, Diversity, and Inclusion (JEDI) Committee Member. August 2020-present.
- Graduate Group in Ecology, Conservation Ecology Area of Emphasis (AOE) Advisor, University of California, Davis.

<u>SERVICE TO DISCIPLINE</u>

*Ad hoc* manuscript reviewer for the following peer reviewed journals: *Global Change Biology*, *BioScience*, *Conservation Biology, Journal of Applied Ecology, Transactions of the American Fisheries Society*, *Fisheries*, *Reviews in Fish Biology and Fisheries*, *River Research and Applications*, *Ecosphere*, *Water*, *Northwest Naturalist*, and *Marine and Freshwater Research*.

<u>PROFESSIONAL SOCIETIES</u>

Society for Freshwater Science, American Fisheries Society.

<u>REFERENCES</u>

Professor Emeritus Peter B. Moyle
Center for Watershed Sciences
University of California, Davis
One Shields Ave.,
Davis, CA 95616
Office: (530) 574-6695
Email: pbmoyle@ucdavis.edu

Professor Randy A. Dahlgren
Department of Land, Air, and Water Resources
University of California, Davis
One Shield Ave.,
Davis, CA 95616
Office: (530) 752-3073
Email: radahlgren@ucdavis.edu

Professor Michael T. Bogan
School of Natural Resources and the Environment

University of Arizona
1064 East Lowell St.
Tuscon, AZ 85721
Office: (520) 621-1086
Email: mbogan@email.arizona.edu

Professor Emeritus Jeffery F. Mount
Department of Geology
Center for Watershed Sciences
University of California, Davis
One Shields Ave.,
Davis, CA 95616
Office: (415) 291-4478
Email: mount.jeffrey@gmail.com

EXHIBIT B

August 16, 2021

UNITED STATES OF AMERICA

BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Brookfield White Pine Hydro LLC Project No. 2322-069

**KENNEBEC COALITION'S ADDITIONAL COMMENTS IN OPPOSITION TO THE "DRAFT ENVIRONMENTAL ASSESSMENT FOR HYDROPOWER LICENSE" FOR THE SHAWMUT PROJECT NUMBER 2322-069, MAINE**

Pursuant to the Notice of Availability of Draft Environmental Assessment and Revised Procedural Schedule (July 1, 2021), the Kennebec Coalition hereby submits the attached learned opinions and comments of Dr. Robert A. Lusardi,[1] as additional critical Comments in opposition to the Draft Environmental Assessment for Hydropower License in the above matter.[2]

Respectfully submitted, this 16th day of August, 2021,

The Kennebec Coalition by:

/s/ Russell B. Pierce, Jr., Esq.
Norman Hanson & DeTroy, LLC
Two Canal Plaza
P.O. Box. 4600
Portland, ME 04112
207.774.7000
rpierce@nhdlaw.com

/s/ Charles Owen Verrill, Jr., Esq.
Verrill Advocacy, LLC
Suite M-100
1055 Thomas Jefferson St. NW
Washington, D.C. 20007
202.390.8245
charlesverrill@gmail.com

[1] Dr. Lusardi is an aquatic research ecologist and applied conservation biologist at the Center for Watershed Sciences and is Adjunct Faculty in the Department of Wildlife, Fish, and Conservation Biology at the University of California, Davis.

[2] Commission staff also indicated that the Draft EA would serve simultaneously as the Commission's Biological Assessment for purposes of initiation of formal section 7 consultation with NMFS under the Endangered Species Act (the "ESA"), 16 U.S.C. § 1536, for the relicensing of the Shawmut Project. FERC Accession No. 20210709-3034 (Turner to Petony correspondence requesting formal consultation on the relicensing of the Shawmut Project, July 9, 2021). Hence this supplemental Comment will also serve as Dr. Lusardi's comments on the Biological Assessment under the ESA, and on the EFH assessment, for the Shawmut relicensing application.

CERTIFICATE OF SERVICE

I, Russell B. Pierce, Jr., Esq., hereby certify that a copy of these comments was transmitted by electronic means to each of the persons on the Service list maintained by the Secretary of the Commission.

/s/ Russell B. Pierce, Jr.

Russell B. Pierce, Jr., Esq.
Attorney for Kennebec Coalition

Norman, Hanson & DeTroy, LLC
Two Canal Plaza, P.O. Box 4600
Portland, ME 04112-4600
(207) 774-7000
rpierce@nhdlaw.com

Comments on the Draft EA for the Shawmut Hydroelectric Project

From: Dr. Robert A. Lusardi

To: Secretary Bose, FERC

Re. Comments on the Draft Environmental Assessment for the Shawmut Project (P-2322)

August 12, 2021

<u>*Comments*</u>

1. *Delayed Mortality. The EA neglects to examine the impact of delayed morality on Atlantic salmon as individuals move downstream through the Shawmut Project.* Delayed mortality has been found to have a profound effect on juvenile salmon survival when smolts must migrate downstream through dams and has been tied to the hydrosystem experience (Budy et al. 2002). Typically, mortality occurs after passage through, over, or around a dam, but does not become evident until those individuals reach the estuary or ocean (Budy 2002). The draft EA neglects to examine the potential for delayed mortality to play a significant role in survival estimates of juvenile salmon through the Shawmut project. Budy et al. (2002) demonstrated that as a fish passes through a dam, they experience acute or chronic stress. While some individuals may fully recover, others do not and experience physical limitations making them more susceptible to mortality at a later point in time (e.g., more susceptible to predators, disease, or energetic and/or physiological impairment). For instance, Ferguson et al. (2006) found that while initial survival estimates of juvenile Pacific salmon passage through McNary Dam in the Pacific Northwest ranged from approximately 86-95%, delayed mortality ultimately accounted for 46-70% of total estimated mortality. The authors concluded that the primary mechanism of delayed mortality was sensory impairment and subsequent predation in and around the dam tailrace. *FERC's failure to analyze or acknowledge delayed mortality as a mechanism affecting endangered Atlantic salmon is a significant oversight.*

2. *Shawmut Project Impoundment. The EA does not consider the effects of the Shawmut Project impoundment on juvenile salmon in numerous aspects.* Dams strongly alter hydrology and water quality (Ward and Stanford 1983, Stanford and Ward 2001) often leading to a loss of habitat for lotic species. Ponding of water behind a dam can significantly alter abiotic and biotic processes. Numerous studies have shown that such changes in physical habitat are conducive to the colonization of introduced species, promotion of lentic species, and/or changes in food web dynamics. The EA describes the resident fish community in the impoundment at Shawmut which include: yellow perch, largemouth bass, and black crappie at significant percentages of the total fish community (51%, 12% and 5%, respectively). Smallmouth bass (14% of the total fish community) were also found at relatively high percentages in the tailwater immediately downstream of the Shawmut Project. Despite acknowledging the presence of these species, no information was provided on the predation effects of these species on juvenile salmon,

which would be relatively easy to accomplish using gut content analysis or stable isotope analysis. Additionally, downstream fish passage studies conducted by Brookfield (except 2012—these survival estimates are detailed further in comment #8 ) did not release fish upstream of the Shawmut impoundment, which is a critical design flaw, considering that wild salmon must pass through the Shawmut Project impoundment during outmigration.

Raymond (1979) found that dams on the Snake River were responsible for record low returns of Pacific salmon in the early 1970s and, among other factors, attributed such declines to predation associated with dam impoundments. Warner et al. (1968) found that yellow perch were predators of juvenile stocked Atlantic salmon in lakes in Maine, while Vigg et al. (1991) found that smallmouth bass were significant predators of juvenile salmon where they had been introduced into John Day Reservoir in the Columbia River system and Tabor et al. (2007) found that up to 50% of smallmouth bass diet consisted of juvenile salmon where they were found sympatrically with smallmouth bass in the Pacific Northwest. Changes in physical habitat associated with dams and impoundments can encourage population growth of predatory, introduced species, with dire consequences for native fishes (Moyle et al. 2002). Further, predatory species can have large effects on juvenile salmon populations, particular during their downstream migration. Rieman et al. (1991) found that predators associated with dams and associated impoundments in the Columbia River system accounted for the loss of 2.7 million juvenile salmon over a four year period. Largemouth bass are also voracious predators and have been shown to preferentially select juvenile salmonids as prey (Tabor et al. 2007). The Shawmut Project has enabled numerous predatory species to become resident species of the Kennebec River, yet the EA does not address the influence of the project on the proliferation of these species nor their effect on juvenile Atlantic salmon.

3. *Shawmut Project Impoundment effects. The EA neglects to consider the effects of the Shawmut Project impoundment on travel time delays during juvenile salmon outmigration.* Dams have been shown to delay outmigration of juvenile salmon due to upstream impoundments through changes in water velocity and flow paths (Clarke et al. 2007). For instance, Norrgard et al. (2013) found that juvenile Atlantic salmon experienced an 83% reduction in migration speed when traversing rivers with hydroelectric dams compared with congeners that outmigrated through unimpaired rivers. Creation of impoundments can affect juvenile salmon in two primary ways: (i) by reducing overall energy expenditures making it more difficult to energetically complete downstream migrations to the estuary or ocean and (ii) causing migration delays that lead to a mismatch between outmigration timing and critical phenological events (e.g., the timing of environmental conditions that are key to an organism's life history) (Marschall et al. 2011). Marschall et al. (2011) found that impoundment delays in outmigration caused a mismatch between movement timing and environmental conditions such as elevated water temperature downstream of dams. In another study, Satterthwaite et al. (2014) found that timing of ocean entry was a critical determinant of within year survival rates of juvenile Pacific salmon, suggesting that delays could have important

consequences for salmon stock resilience. *The EA must consider the effects of the Shawmut Project impoundment on travel time delays during juvenile salmon outmigration.*

4. *The EA neglects to discuss changes in habitats above (e.g., Shawmut Project impoundment) and below the project that may be critical to spawning, rearing and the growth of outmigrating salmon and their success as returning adults.* Numerous studies have shown that dams can drastically alter downstream habitats with consequences for native and resident fishes due to changes in environmental conditions and elimination of key habitats (Katz et al. 2017, Opperman et al. 2017, Ward and Stanford 1983). Such changes may negatively affect body condition and size at time of ocean or estuary entry. Much of the literature has focused on the effects of dams and their ability to change flow and temperature regimes, fluvial processes, sedimentation (or lack thereof), channelization, and the loss of critical habitats that negatively affect salmon growth prior to ocean entry (e.g., NRC 2004). Changes in habitat or reductions in productive habitats, in particular, can negatively affect growth during outmigration or lead to migratory delays, ultimately reducing survival in the marine environment. For instance, Claiborne et al. (2011) found that size of juvenile salmon at ocean entry was a strong predictor of adult returns and that smaller salmon at ocean entry may be selected as prey by marine predators while others have demonstrated that the loss of key or critical habitats during outmigration have contributed to salmon population declines (NRC 2004, Katz et al. 2017). *The EA should clearly quantify the relative contribution of the Shawmut Project to changes in river habitat for Atlantic salmon and other diadromous species (both upstream and downstream of the Shawmut Project) that may negatively affect the growth and fitness of juvenile salmon.*

5. *Macroinvertebrates and food webs. The EA discusses the food web community immediately below the Shawmut Project but does not describe nor provide any information on changes to the Kennebec River immediately above Shawmut Dam (specific to the Shawmut Project impoundment).*

    a. *With respect to macroinvertebrate sampling above the Shawmut Project and specific to the impoundment area.* The EA does not describe any macroinvertebrate sampling that occurred in the Shawmut Project impoundment area despite significant changes in habitat associated with the Project (e.g., changes from lotic to lentic habitat). Macroinvertebrate prey is an important resource for juvenile salmon during rearing and prior to outmigration (Lusardi et al. 2020). Potential changes in food web structure in the impoundment area of the Shawmut Project must be quantified to determine changes in the quality and quantity of prey for Atlantic salmon during their rearing phase.

    b. *With respect to macroinvertebrate sampling below the Shawmut Project (and specific to the tailrace area).* Macroinvertebrate density, diversity, and assemblage dynamics are known to vary greatly through space and time, particularly below dams (Steel et al. 2017, Lusardi et al. 2016, Ward and Stanford 1983) and depend on numerous factors including water quality, hydrological conditions, and biotic interactions. The EA implies that a discrete collection of macroinvertebrates at one point in time (at two locations) during 2016 suggests that water quality and food web dynamics are sufficient for Atlantic salmon and water quality analysis. *FERC should require Brookfield to improve spatiotemporal sampling of macroinvertebrates below the Shawmut Project to better capture seasonal and inter-annual variability of macroinvertebrates during the spring outmigration period and over different water type years (dry, moderate, and wet years) to better understand fluctuations in water quality and food webs that support Atlantic salmon.*

6. *Other diadromous species. The EA does not consider the role that the Shawmut Project has played in the decline of other diadromous species, which historically were important (and will be important for species recovery) to the life history of Atlantic salmon. The EA must consider the full suite of species and impacts of those species from dam relicensing and the relative effects on Atlantic salmon.* Currently, the EA does not contain any passage standards for co-evolved diadromous species such as American shad, Blueback herring, alewife, sea lamprey, and the American Eel. Consideration of the role of other diadromous species is consistent with Maine's multi-species restoration goals for the Kennebec River. Further, Saunders et al. (2006) demonstrated that several co-evolved diadromous species in Maine played an important role in the life history of Atlantic salmon. FERC must require Brookfield to define passage standards or other co-occurring species and specific to the Shawmut Project.

7. *Run-of-River hydrology*. Despite the EA suggesting that the Kennebec River at the Shawmut Project is operated as "run of river", frequent flow fluctuations have been observed below the dam. For instance, between May 27 and June 2, 2014 daily fluctuations in release flows ranged from 8,000-11,000 cfs, while high flows ranged from 15,000-16,000 cfs as measured as the North Sidney, Maine, USGS gage. While deviations in flow are noted in the EA, there is no description of those deviations (or their frequency) and specifically, changes in the magnitude, timing, duration, frequency, or rate of change of flow releases through time at the Shawmut Project. Such fluctuations, as those noted here, can have a strong effect on aquatic biota below dams and on fish passage. Dams and changes to the natural flow regime are known to strongly interfere with evolved life history, behavioral, and morphological adaptations of numerous native species, including riparian plants, macroinvertebrates, and native fishes (Lytle and Poff 2004, Kiernan et al. 2012). Kennedy et al. (2016) demonstrated that sudden fluctuations in flow, downstream of a dam, may extirpate certain macroinvertebrate taxa which are key to the food webs of higher trophic consumers. Steel et al. (2017) found strong differences between macroinvertebrate communities between regulated (dam controlled)

and unregulated rivers in California and found that the rate of the spring recession flow and water temperature (or changes in these variables due to dam releases) were strong predictors of changes in macroinvertebrate assemblage dynamics. With respect to fish, Korman and Campana (2009) found that daily flow fluctuations below a dam displaced juvenile salmonids from habitats known to improve growth and sequestered them to less bioenergetically favorable habitat. *The EA must address changes in the magnitude, timing, duration, frequency, and rate of change of flow releases at the Shawmut Project as compared to inflow hydrology.*

8. *The EA conflates fish passage studies with the success of Atlantic salmon outmigration through the entire Shawmut Project.* The fish passage studies conducted between 2013-2015 (Normandeau 2014-2016) simply examined fish passage at specific river reaches, but do not examine additive survival or mortalities associated with the Shawmut Project. Paired releases are a way to isolate survival estimates to a specific reach of river and can help account for post release handling effects. Ultimately, however, a paired release design can only estimate immediate survival (e.g., does not include delayed mortality, or mortality associated with other reaches affected by a dam or additive mortalities; see comment #1) and is most often used to assess the survival of fish when they pass a project. The virtual paired release method, among other issues, was intended to be used to overcome issues associated with dead fish passing through a dam, which would positively bias dam survival estimates. Such mortalities are common in systems such as the Columbia River, where thousands of fish have been tagged and released to study movement through large dams.

   However, prior to using the paired release methodology *to estimate reach specific survival*, Brookfield consultants examined *the effects of the Shawmut Project* (including passage through the Shawmut Impoundment and downstream of Shawmut Dam) through the release of hatchery Atlantic salmon smolts upstream of the Weston Project, tracking them to a downstream location below Lockwood. We calculated survival of those smolts from the array located 5.5. miles downstream of Weston (e.g., within the Shawmut Project) to 1.1 miles below the Shawmut Project to estimate survival through the entire Shawmut Project during 2012. Survival of those release groups through the Shawmut project were 50%, 69%, 81%, 88%, and 60% or an average survival of 69.5% through the entire Shawmut Project during that year.

9. *Whole system passage and survival*. FERC's estimates on downstream passage survival neglect to consider other dams and impoundments that Atlantic salmon must navigate in the Kennebec watershed. The aforementioned survival data from 2012 (Normandeau 2013), prior to the use of paired releases and a virtual release group to study reach specific survival), can also be examined to look at survival throughout the hydroelectric system (e.g., above Weston smolt releases through the Lockwood Project). The following survival numbers, calculated during the 2012 dry year, are likely conservative as hatchery Atlantic salmon smolts were released immediately above Weston Dam,

whereas wild smolts must also navigate through the Weston Project impoundment. We calculated total survival of smolts through the Kennebec system based on the 2012 telemetry data. Salmon were released immediately (0.5 miles) upstream of the Weston Project and tracked to 1.7 miles downstream of the Lockwood Project. Five groups were released on separate days during May 2012. Total smolt survival through the Kennebec hydrosystem was calculated for each release: 15%, 25%, 30%, 37%, and 30%. FERC neglects to consider watershed-wide processes and the effects of hydroelectric infrastructure associated with the Shawmut Project that have changed habitat conditions and inherently affect survival of salmon smolts during outmigration.

10. *Downstream passage. FERC did not review the paired release studies conducted by Brookfield to examine reach specific survival at the Shawmut Project nor did they review the methods and models associated with the paired release.* With respect to the paired release survival studies at the Shawmut Project, several assumptions appear to have been violated and the results are likely positively biased, inflating survival. First, fish used in a virtual paired release study should be representative of the general population (Skalski et al. 2010, Harnish et al. 2020). Brookfield used hatchery reared Atlantic salmon, which have been shown to exhibit differences in behavior, physiology, and predator avoidance among other factors when compared with wild congeners (Jonsson et al. 1991, Chittenden et al. 2010). Hatchery fish are not representative of wild Atlantic salmon smolts. Second, the downstream antennae responsible for tracking $R_2$ fish (to measure survival associated with the tailrace) should be placed downstream far enough so that false positives of dead fish are not mistaken for live fish once they pass through the dam. The downstream antenna for all years of studies at the Shawmut Project was only 1.1 miles downstream. Havn et al. (2017) identified dead salmon smolts drifting as far as 2.4 km (1.5 miles). There is a strong possibility that the fish passage data contain false positives downstream of the Shawmut Project. Typically, dead fish are tagged before a movement study to pinpoint exactly how far downstream dead fish are able to travel so that false positives do not occur and skew survival results (Skalski et al. 2010). Third, and most importantly, the paired release method used here produces positively biased estimates of survival because dam passage survival was estimated using only the virtual release group ($V_1$) with a tailwater release ($R_2$) of newly tagged fish. To avoid such positive biases, a third release group should have been used ($R_3$) to better estimate survival throughout the tailwater portion of the Shawmut Project (Skalski et al. 2010). Finally, and as mentioned earlier, the paired release method can only account for direct mortality and does not account for delayed mortality associated with dam passage (see comment #1).

Literature Cited

Budy, P., G. P. Thiede, N. Bouwes, C. Petrosky, and H. Schaller. 2002. Evidence linking delayed mortality of Snake River salmon to their earlier hydrosystem experience. North American Journal of Fisheries Management **22**:35-51.

Chittenden, C. M., C. A. Biagi, J. G. Davidsen, A. G. Davidsen, H. Kondo, A. McKnight, O.-P. Pedersen, P. A. Raven, A. H. Rikardsen, and J. M. Shrimpton. 2010. Genetic versus rearing-environment effects on phenotype: hatchery and natural rearing effects on hatchery-and wild-born coho salmon. Plos One **5**:e12261.

Claiborne, A. M., J. P. Fisher, S. A. Hayes, and R. L. Emmett. 2011. Size at release, size-selective mortality, and age of maturity of Willamette River hatchery yearling Chinook salmon. Transactions of the American Fisheries Society **140**:1135-1144.

Clarke, A. D., K. H. Telmer, and J. M. Shrimpton. 2007. Habitat use and movement patterns for a fluvial species, the Arctic grayling, in a watershed impacted by a large reservoir: evidence from otolith microchemistry. Journal of Applied Ecology **44**:1156-1165.

Ferguson, J. W., R. F. Absolon, T. J. Carlson, and B. P. Sandford. 2006. Evidence of delayed mortality on juvenile Pacific salmon passing through turbines at Columbia River dams. Transactions of the American Fisheries Society **135**:139-150.

Harnish, R., J. Skalski, R. Townsend, and K. Ham. 2020. In search of a cost-effective approach for estimating dam passage survival. North America Journal of Fisheries Management **40**:865-882.

Havn, T. B., F. Økland, M. A. K. Teichert, L. Heermann J. Borcherding , S. A. Sæther, M. Tambets, O. H. Diserud and E. B. Thorstad. Movements of dead fish in rivers. Animal Biotelemetry (2017) 5:7.

Jonsson, B., N. Jonsson, and L. P. Hansen. 1991. Differences in life history and migratory behaviour between wild and hatchery-reared Atlantic salmon in nature. Aquaculture **98**:69-78.

Katz, J. V. E., C. Jeffres, J. L. Conrad, T. R. Sommer, J. Martinez, S. Brumbaugh, N. Corline, and P. B. Moyle. 2017. Floodplain farm fields provide novel rearing habitat for Chinook salmon. Plos One **12**:e0177409.

Kennedy, T. A., J. D. Muehlbauer, C. B. Yackulic, D. A. Lytle, S. W. Miller, K. L. Dibble, E. W. Kortenhoeven, A. N. Metcalfe, and C. V. Baxter. 2016. Flow management for hydropower extirpates aquatic insects, undermining river food webs. Bioscience **66**:561-575.

Kiernan, J. D., P. B. Moyle, and P. K. Crain. 2012. Restoring native fish assemblages to a regulated California stream using the natural flow regime concept. Ecological Applications **22**:1472-1482.

Korman, J., and S. E. Campana. 2009. Effects of hydropeaking on nearshore habitat use and growth of age-0 rainbow trout in a large regulated river. Transactions of the American Fisheries Society **138**:76-87.

Lusardi, R. A., M. T. Bogan, P. B. Moyle, and R. A. Dahlgren. 2016. Environment shapes invertebrate assemblage structure differences between volcanic spring-fed and runoff rivers in northern California. Freshwater Science **35**:1010-1022.

Lusardi, R. A., B. G. Hammock, C. A. Jeffres, R. A. Dahlgren, and J. D. Kiernan. 2020. Oversummer growth and survival of juvenile coho salmon (Oncorhynchus kisutch) across a natural gradient of stream water temperature and prey availability: an in situ enclosure experiment. Canadian Journal of Fisheries and Aquatic Sciences **77**:413-424.

Lytle, D. A., and N. L. Poff. 2004. Adaptation to natural flow regimes. Trends in Ecology & Evolution **19**:94-100.
Marschall, E. A., M. E. Mather, D. L. Parrish, G. W. Allison, and J. R. McMenemy. 2011. Migration delays caused by anthropogenic barriers: modeling dams, temperature, and success of migrating salmon smolts. Ecological Applications **21**:3014-3031.
Moyle, P. B. 2002. Inland fishes of California. University of California Press, Berkeley, CA.
Normandeau (Normandeau Associates, Inc.). 2013. Downstream passage effectiveness for the passage of Atlantic salmon smolts at the Weston, Shawmut and Lockwood projects, KennebecRiver, Maine. Prepared for FPL Energy Maine Hydro LLC and The Merimil Limited Partnership.
Normandeau (Normandeau Associates, Inc.). 2014. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, Hydro Kennebec, and Lockwood Projects, Kennebec River and Brunswick Project, Androscoggin River, Maine, Spring 2013. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.
Normandeau (Normandeau Associates, Inc.). 2015. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, Hydro Kennebec, and Lockwood Projects, Kennebec River and Brunswick Project, Androscoggin River, Maine, Spring 2014. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.
Normandeau (Normandeau Associates, Inc.). 2016. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, and Lockwood Projects, Kennebec River and Pejepscot and Brunswick Projects, Androscoggin River, Maine, Spring 2015. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.
Norrgård, J. R., L. A. Greenberg, J. J. Piccolo, M. Schmitz, and E. Bergman. 2013. Multiplicative loss of landlocked Atlantic salmon Salmo salar L. smolts during downstream migration trough multiple dams. River Research and Applications **29**:1306-1317.
NRC. 2004. Endangered and threatened fishes in the Klamath River Basin. National Academies Press, Washington, DC.
Opperman, J. J., P. B. Moyle, E. W. Larsen, J. L. Florsheim, and A. D. Manfree. 2017. Floodplains: Processes and management for ecosystem services. Univ of California Press.
Raymond, H. L. 1979. Effects of dams and impoundments on migrations of juvenile chinook salmon and steelhead from the Snake River, 1966 to 1975. Transactions of the American Fisheries Society **108**:505-529.
Rieman, B. E., R. C. Beamesderfer, S. Vigg, and T. P. Poe. 1991. Estimate loss of juvenile salmonids to predation by northern squawfish, walleyes, and smallmouth bass in the John Day Reservoir, Columbia River. Transactions of the American Fisheries Society **120**:448-458.
Satterthwaite, W. H., S. M. Carlson, S. D. Allen-Moran, S. Vincenzi, S. J. Bograd, and B. K. Wells. 2014. Match-mismatch dynamics and the relationship between ocean-entry timing and relative ocean recoveries of Central Valley fall run Chinook salmon. Marine Ecology Progress Series **511**:237-248.
Saunders, R., M. A. Hachey, and C. W. Fay. 2006. Maine's diadromous fish community: past, present, and implications for Atlantic salmon recovery. Fisheries **31**:537-547.
Skalski, J. R., R. L. Townsend, T. W. Steig, and S. Hemstrom. 2010. Comparison of two alternative approaches for estimating dam passage survival of salmon smolts. North American Journal of Fisheries Management **30**:831-839.

Stanford, J. A., and J. V. Ward. 2001. Revisiting the serial discontinuity concept. Regulated Rivers-Research & Management **17**:303-310.

Steel, A. E., R. A. Peek, R. A. Lusardi, and S. M. Yarnell. 2018. Associating metrics of hydrologic variability with benthic macroinvertebrate communities in regulated and unregulated snowmelt-dominated rivers. Freshwater Biology 63(8): 844-858.

Tabor, R. A., B. A. Footen, K. L. Fresh, M. T. Celedonia, F. Mejia, D. L. Low, and L. Park. 2007. Smallmouth bass and largemouth bass predation on juvenile Chinook salmon and other salmonids in the Lake Washington basin. North American Journal of Fisheries Management **27**:1174-1188.

Vigg, S., T. P. Poe, L. A. Prendergast, and H. C. Hansel. 1991. Rates of consumption of juvenile salmonids and alternative prey fish by northern squawfish, walleyes, smallmouth bass, and channel catfish in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society **120**:421-438.

Ward, J. V. a. J. A. S. 1983. The Serial Discontinuity Concept of Lotic Ecosystems. Pages 29-42 *in* F. T. D. a. B. S.M., editor. Dynamics of Lotic Ecosystems. Ann Arbor Scientific Publishers, Ann Arbor.

Warner, K., R. AuClair, S. DeRoche, K. Havey, and C. Ritzi. 1968. Fish predation on newly stocked landlocked salmon. The Journal of Wildlife Management:712-717.

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MAINE

| | |
|---|---|
| ATLANTIC SALMON FEDERATION U.S., CONSERVATION LAW FOUNDATION, MAINE RIVERS, and NATURAL RESOURCES COUNCIL OF MAINE,<br><br>Plaintiffs<br><br>v.<br><br>BROOKFIELD RENEWABLE PARTNERS, L.P., MERIMIL LIMITED PARTNERSHIP, HYDRO-KENNEBEC LLC, BROOKFIELD WHITE PINE HYDRO LLC, BROOKFIELD POWER US ASSET MANAGEMENT LLC, and BROOKFIELD POWER US HOLDING AMERICA CO.<br><br>Defendants | Civil Action No. 1:21-cv-00257-JDL |

**DECLARATION OF DONALD PUGH**

1. My name is Donald H. Pugh, Jr. I have more than 20 years of experience, study, and expertise in analyzing fish passage at hydroelectric projects. I formerly worked on both up- and downstream passage at the S.O. Conte Anadromous Fish Research Laboratory. I have been engaged in numerous fish passage projects or consultations. These projects, my publication credits, and presentations are set forth in the attached CV, current as of January 2021.

2. I have been retained by the Atlantic Salmon Federation U.S., Maine Rivers, and the Natural Resources Council of Maine, who are part of the group of non-governmental organizations called the "Kennebec Coalition," and who are Plaintiffs in the above-captioned action. The Kennebec Coalition has been actively engaged in all the regulatory proceedings involving the four hydroelectric projects in issue in this case on the Kennebec River – the Lockwood Project in Waterville/Winslow, the Hydro-Kennebec Project, the Shawmut Project, and the Weston Project in Skowhegan. I have offered opinions in some of those proceedings, including most recently opinions involving review and data analysis

of downstream smolt radio telemetry studies and upstream fish passage plans at the Shawmut project on the Kennebec River, and review and analysis of downstream and upstream fish passage plans involving the other three dams.

3. I have reviewed the Complaint in this case, and the "notice of intent to sue" letter referenced therein. I have reviewed the 2012 and 2013 temporary or "interim" Biological Opinions (which are now expired) that had been issued by the National Marine Fisheries Service ("NMFS") for Atlantic salmon in relation to the subject four hydroelectric projects. I have also reviewed Brookfield's proposed species protection plans and the draft Biological Assessment covering each project, including the Shawmut project in relation to its relicensing proceedings; and I have reviewed the FERC staff draft Environmental Assessment prepared in connection with the Shawmut Project relicensing proceedings. I have reviewed the Brookfield-generated downstream smolt radio telemetry studies in relation to the four projects. I have examined photographic and diagrammatic schemes of record for each of the four projects, including publicly available Google Maps satellite views, as well as descriptions of each project in the various licenses and in the Kleinschmidt "Brookfield White Pine Hydro, LLC Energy Enhancements and Lower Kennebec Fish Passage Improvements Study" of October 2018. I have reviewed other pertinent documents relevant to the present issue, including but not limited to:

- 4-29-2021 NMFS letter to Brookfield requesting interim measures to reduce smolt take;
- 5-6-2021 Brookfield letter addressing interim measures to reduce smolt take;
- 5-17-2021 letter from Maine Department of Marine Resources ("MDMR") to Brookfield relating to fish passage operations at the Lockwood Project;
- Species Protection Plan for Atlantic Salmon, Atlantic Sturgeon, and Shortnose Sturgeon at the Lockwood, Hydro-Kennebec, and Weston Projects on the Kennebec River, Maine, May 2021.
- Interim Species Protection Plan, Biological Assessment for Atlantic Salmon for the Shawmut Project on the Kennebec River, Maine, May 2021.
- various additional filings on the FERC record, including MDMR's 8-13-2021 comments on the FERC staff draft Environmental Assessment in the Shawmut relicensing, and the 8-26-2021 NMFS letter to Brookfield relating to response to request for formal consultation under the Endangered Species Act.

4. I have also consulted numerous studies, publications, and literature on the topic of fish passage, fish passage efficiency including injuries, mortality, and delayed mortality, many of which have been previously cited by me or by the Kennebec Coalition in the course of our submission of comments on the FERC regulatory record, or cited by NMFS in its various comments or Biological Opinions.

5. I have reviewed the Complaint allegations at paragraphs 5-6 relating to "take" of fish, defining "take" to include killing, injury or "harm."

6. Based upon my review and analysis of the above documents, and my experience and expertise in analyzing fish passage issues at hydroelectric projects, I have reached an opinion on the activities which the subject dam owner or operator ("Brookfield") must undergo at each of the four projects in order to minimize the risk of "take" of fish – i.e., death, injury, or harm.

7. I have also reviewed the opinions of Robert Andrew Lusardi, who has also been retained by the Plaintiffs, and who is an aquatic research ecologist and applied conservation biologist at the Center for Watershed Sciences, and Adjunct Faculty in the Department of Wildlife, Fish, and Conservation Biology at the University of California, Davis, and we are in concurrence in our opinions on the subject of this Declaration.

8. If the following measures are not undertaken, "take" of one or more – and likely much more than a few – individual fish at each project is certain to occur in downstream migrations, during both the fall and spring migration seasons. The take will occur at, or because of, each project – meaning that some level of "take" will occur upon passage at each project, or will be caused by delay in passage, or will occur as a result of each project's significant habitat modification/degradation, including the project impoundments.

9. For example, at Weston alone – the first hydro project fish would encounter on their downstream migration from the Sandy River critical spawning and rearing habitat – there is a turbine survival range of 81% to 64% for smolts and a 21% to 34% range for kelts depending upon which of the two units fish pass through. As another example, Brookfield's own downstream radio telemetry studies of smolts reflects a range of 9% to 11% whole station mortality of fish detected downstream of the dam after passage. When adjusted to consider fish not passing within twenty-four hours of arrival, as mortalities, mortality ranges from 14% to 34%.

10. My opinions of the measures to undergo at each project to *reduce* takes (takes will never be *eliminated* under any scenario, so long as the project operations continue) are as follows, in the order of fish encounters moving downstream:

A. Weston Project. The Weston project consists of dams at the north and south channels, thirty-eight and fifty-one feet high respectively, with stanchion, Obermeyer and Tainter gates at the north channel dam, and at the south channel dam a powerhouse with four vertical Francis turbines, a downstream sluice-bypass, stanchion gates and a concrete spillway. A fuller description of the project, based on descriptions used on the record in the interim Biological Opinion, along with aerial Google Maps satellite photos is attached as Exhibit 1.

i. Weston poses unique problems with downstream passage for kelts and for smolts, primarily because of ledges and likely inadequate depth of plunge-pool areas below the dams. Also, kelts with an average total length of 31”, passing through units would be expected to experience very low survival (21% to 34%).[1]

Opening the Obermeyer, stanchion and/or Taintor gates at the north channel will not provide the safe passage conventionally expected from ‘spill’. Fish passing over the spillway gates do not have an adequate depth in the receiving pool to prevent fish from striking the bottom of the river. Fish passing through the Tainter gates also have the potential to hit the bottom or ledges, more so with the Tainter closest to the island (right Tainter).

Passage mortality at Weston for smolts ranges from 9%, without adjusting for delay, to 34% in 2015 when delay is included. Therefore the options at Weston are, in essence, choosing between two bad options. My opinion to reduce takes under current conditions would be to use the fully open sluice bypass for downstream passage from October 15 to December 31 and for spring downstream migration from April 1 to June 30 as the first point of downstream passage for both kelts and smolts.

For smolts, after the sluice:

- Units 1 to 4 in that order
- Left Taintor
- North dam stanchion boards closest to the Tainter gates (green line photo 2 in Exhibit 1)
- Right Obermeyer (yellow line)
- Right Tainter
- South channel stanchions.

For kelts, after the sluice:

- Left Taintor
- Right stanchions (green line)
- Right Tainter
- Right Obermeyer (yellow line)
- Remaining spill gates
- Units.

[1] USFWS. Turbine Blade Strike Analysis. Fish length 31”, SD 2.5”.

B. Shawmut Project. The Shawmut Project consists of a dam with hinged flashboards and inflatable bladders, a headgate structure, a powerhouse with six Francis turbines and one with two three-blade horizontal propeller units, and a deep Tainter gate and two surface gates used as downstream bypasses. A fuller description of the project, based on descriptions used on the record in the interim Biological Opinion, along with an aerial Google Maps satellite photo is attached as Exhibit 1.

i. My opinion to reduce takes under current conditions at Shawmut would be to shut down the turbine units for downstream passage from October 15 to December 31 and for spring downstream migration from April 1 to June 30, and operate the surface spill and the Tainter gates at maximum discharge, followed by spill and finally the units.

C. Hydro-Kennebec Project. The Hydro-Kennebec Project consists of a dam with an un-gated concrete spillway, a gated spillway, a downstream bypass gate with a boom to guide fish, and a powerhouse with two four blade horizontal pit-type Kaplan turbines. The project has a fish lift for upstream passage. A fuller description of the project, based on descriptions used on the record in the interim Biological Opinion, along with an aerial Google Maps satellite photo is attached as Exhibit 1.

i. My opinion to reduce takes under current conditions at Hydro-Kennebec would be to shut down the turbine units for downstream passage from October 15 to December 31 and for spring downstream migration from April 1 to June 30, and continue to operate the downstream passage facilities at maximum, followed by the gated spillway and the units.

D. Lockwood Project. The Lockwood Project consists of a two section dam with wooden flashboards, a headworks section, a forebay canal, and two powerhouses one with six vertical Francis units and one with a single horizontal Kaplan unit, a guide boom and downstream bypass sluice located upriver of the powerhouse and a fish lift. The project has a fish lift for upstream passage. A fuller description of the project, based on descriptions used on the record in the interim Biological Opinion, along with an aerial Google Maps satellite photo is attached as Exhibit 1.

i. My opinion to reduce takes under current conditions at Lockwood would be to shut down the turbine units from sunset to sunrise for downstream passage from May $1^{st}$ through June $30^{th}$, and October $15^{th}$ through November $10^{th}$, the periods when there is both upstream and downstream migration at Lockwood. The reason for turbine shutdown at night only during this period is because successful upstream passage of adult salmon requires attraction of migrating fish to the fish lift. The experience, from shutdowns of last May 2021, shows that turbine shutdowns, in order to facilitate downstream passage, directs spill into the bypass resulting in adult salmon passing the lift entrance as the dominant flow is at the dam. This reduces upstream encounters with the fishlift. Outside of these dates (i.e., April 1 to May 1 and November 10 to December 31) the turbine units should be shut down 24-hours a day.

Operations of the downstream passage facilities should continue at maximum discharge for 24 hours a day, from October 15 to December 31 and for spring downstream migration from April 1 to June 30.

11. I reiterate that even with these measures, under current conditions, some percentage of downstream "take" will occur by the presence and operations of each hydroelectric project, in both the fall and spring migration seasons.

12. The measures above involving use of the sluice bypass facility at Weston and opening gates or operating units as described above; turbine shutdowns at Shawmut, Hydro-Kennebec, and Lockwood; and continuing operations at maximum flows of each bypass facility at Shawmut, Hydro-Kennebec, and Lockwood, will reduce the percentage of takes caused by project operations and project's habitat degradation, under current conditions and status of project operations.

**Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.**

DATED: October 19, 2021

/s/ Donald Pugh
Donald Pugh

Donald H. Pugh, Jr.
10 Old Stage Road
Wendell, MA 01379
Telephone 978 544 7438 Office
413 387 9439 Cell

**Work History**:

Self Employed

Current projects:

Maryland Power Plant Research Project – relicensing of Conowingo Project (FERC # 405) on the Susquehanna River and post-license studies at Holtwood (FERC # 1881) and York Haven (FERC # 1888) upstream of Conowingo. Principle areas of responsibility include: up- and downstream fish passage, telemetry data analysis, fish biology, habitat-flow analysis, and American eel passage.

Connecticut River Conservancy – relicensing of First light hydroelectric projects on the Connecticut River at Turners Falls (FERC # 1889) and the Northfield Mountain Pumped Storage Station (FERC #2485). Scoping began in 2012. First Light has filed its final license application. Reviewed study plans, study reports, IFIM review, shortnose sturgeon spawning flow needs analysis, and shad telemetry analysis. Participated in settlement talks with company, state and federal agencies, and NGOs.

SWCA, Inc. – Shortnose and Atlantic sturgeon habitat and protection plans for sewer line crossing construction on the Connecticut River, Springfield, Massachusetts.

Geosyntec consultants - Shortnose and Atlantic sturgeon habitat and protection plans for river bank stabilization on the Merrimack River, Haverhill, Massachusetts

Maine Rivers – relicensing of three projects on the Mousam River (FERC # 14856).

Kennebec Coalition – review and data analysis of downstream smolt radio telemetry studies (2012 – 2015) and the upstream fish passage plan at the Shawmut project on the Kennebec River (FERC # 2322).

Member of the Holyoke Cooperative Consultation Team for the Holyoke Hydroelectric Project (FERC #2004). Post-licensing downstream fish passage planning including configuration of the downstream passage protection structure, review of CFD analysis, analysis of telemetry data of American shad, shortnose sturgeon, and American eel during post licensing studies.

Santo Antônio , January 2010 to June 2011

TIRIS PIT tag installation, data analysis, and fish passage consultation for an experimental fish passage flume on the Rio Maderia, Brazil.

American Rivers, April 2010 to November 2011

Represented American Rivers for the relicensing of three projects on the Susquehanna River – Conowingo Dam, Muddy Run Pumped Storage Project and York Haven Dam. Participated in study plan development, reviewed study reports and prepared comment letters, attended meetings with the project owners, the FERC, state and federal agencies, and NGO's. Developed and independent analysis of American shad telemetry data at York Haven and Conowingo.

University of Massachusetts, Amherst MA January 1997 to January 2009

Research Assistant in the Department of Natural Resource Conservation working at the

Silvio Conte Anadromous Research Center – areas of research included the behavior and movement of adult Atlantic salmon in the Westfield River in Massachusetts using radio telemetry, upstream passage of sturgeons and riverine fishes in a spiral fishway, spawning behavior of shortnose sturgeon in an artificial 'stream, and downstream passage of sturgeons at a bar rack and louver system with a low level bypass entrance.

Massachusetts Cooperative Fisheries and Wildlife Research Unit, University of Massachusetts, Amherst MA
March 1991 to January 1997

Project Leader for Anadromous Fish Investigations project. Duties include: hire and supervise technicians staffing the Holyoke, Turners Falls, and Westfield River fish passage facilities; conduct recreational angler creel surveys, Atlantic salmon habitat assessment, and juvenile growth and survival estimates; supervise stocking of Atlantic salmon fry for the Connecticut River basin in Massachusetts; coordinate Unit operations with utility companies and state and federal agencies; and prepare budgets and reports.

**Education:**

Undergraduate

Trinity College
Hartford, CT 1967-71, B.A.
Major: History
Specialty: American History

Continuing Ed.

Greenfield Community College
- Photography I, II & III, Fall 1980-81
- Engineering Drawing, Fall 1978
- Drafting for Engineers, Spring 1979
- Programming Principles and Concepts, Fall 2002
- Advanced Basic for Programmers, Spring 2002
- Database Programming and Procedures, Spring 2005
- Advanced Database Programming, Spring 2006

University of Massachusetts, Amherst
- Principles of Management, Fall 1981
- Microeconomics, Fall 1980
- Macroeconomics, Spring 1981
- Social Conflicts and Natural Resources, Spring 1991
- Biological Limnology, Fall 1991
- Anadromous Fish, Fall 1991
- Biostatistics, Fall 1991
- Intermediate Biostatistics, Spring 1992
- GIS, Spring 1992
- Population Dynamics, Fall 1992
- Animal Movement and Migration, Fall 1992
- Coastal Zone Management, Spring 1993
- Ichthyology, Fall 1993
- Principles of Fisheries Stock Assessment, Spring 1994
- Aquatic Invertebrates, Fall 1994
- Freshwater Fisheries Management, 1997
- Inland Fisheries Management, Spring 1999
- Imaging in Fisheries Science, Fall 2000
- Natural Resource Modeling, Spring 2001

American Fisheries Society Workshops
- Fish Ageing, 1995
- Stream Habitat Assessment, 1996

USFWS - National Education and Training Center
Principles and Techniques of Electrofishing, 1996

DOI-USGS – Motorboat Operator Certification Course, 2000

Certified S.O. Conte Anadromous Research Center dive team member

**S.O. Conte Fish Research Projects**:

Atlantic salmon behavior and movements in the Westfield River, Massachusetts 1996 to 1998 – wild adult Atlantic salmon returning to the Westfield River were internally radio tagged and released into the upper Westfield River. Fish were tracked with fixed stations and with manual tracking. Movement, habitat choice, spawning, and post-spawning behavior were evaluated. Domestic broodstock Atlantic salmon were also radio tagged and released to assess their spawning potential to contribute to the salmon restoration effort in the Connecticut River basin.

Spiral fishway 2001 to 2007 – evaluation of a spiral, side baffle fishway designed for upstream sturgeon fish passage. Sturgeon, a benthic fish, need a fishway that allows upstream movement while maintaining close proximity to the bottom of the fishway. The spiral uses side baffles to reduce velocity and provide depth allowing fish to move in a sinusoidal curve along the bottom of the channel. Sturgeon movement was evaluated with a PIT tag system detecting fish at the entrance and exit of the fishway and at four points along each of two loops. Riverine fish were also evaluated in the spiral fishway.

Shortnose sturgeon spawning behavior 2002 to 2008 – the spawning behavior of wild Connecticut River shortnose sturgeon was evaluated in an artificial stream. Mating behavior, mate choice, velocity preference, egg to larvae survival, and embryo and larval dispersal timing were evaluated.

Downstream passage and behavior studies of shortnose sturgeon 2004 and 2005 – yearling, juvenile and adult shortnose sturgeon were evaluated for swimming depth, behavior at and movement along a bar rack, entrainment and impingement, and willingness to enter an opening in the bar rack at three different approach velocities. Pressure sensitive (depth) and radio tags were used to assess swimming depth for both upstream and downstream movement in a 20’ by 120’ flume with a velocity of 1 ft/sec. PIT tags and video were used to assess individual fish movement and behavior at a bar rack oriented 90º to flow at velocities of 1, 2 and 3 ft/sec.

Downstream movement of yearling shortnose sturgeon 2004 and 2006 – yearling shortnose sturgeon (Connecticut River stock in 2004 and Savannah River stock in 2006) were evaluated in a large outdoor oval channel with a river stone substrate to determine the timing, frequency and duration of upstream and downstream movements. Fish were tested for 48 hours on a monthly basis from June through November. PIT tags and five antennas were used to determine movement.

Low level orifice use of sturgeon at an angled bar rack and louver 2006 to 2008 – green, lake, Savannah and Connecticut River shortnose sturgeon of different year classes were tested in a 10’ by 120’ flume at two bar rack angles (45º and 30º) and one louver angle (26º) with two velocities at the orifice. Approach velocity (2 ft/sec) and water depth (7.5’) remained constant for all trials. Fish were tested both day and night. Video and PIT tags were used to determine individual fish movement, behavior at the bar rack and passage through the orifice and pipe which transported fish downstream to a holding area.

**Past Relicensing Projects:**

Bear Swamp Hydroelectric Project – FERC # 2669
Relicensing of project through the ILP.
Deerfield River Project – FERC # 2323, License issued 1997
Deerfield River Compact – precursor to relicensing, all stakeholders in relicensing, including New England Power Co., met on a regular basis to discuss issues. Final report issued.
Deerfield River Settlement – followed the conclusion of the Deerfield River Compact with similar discussions as to the issues involved in relicensing with the goal of reaching agreement on environmental mitigation prior to issuing or license. Represented Trout Unlimited in

meetings with state and federal agencies, New England Power Co. and other NGO's which reached an agreement that was incorporated into and was the basis of relicensing by the FERC.

Holyoke – FERC # 2004, Connecticut River

Relicensing of project – bypass minimum flows, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, clupeids, and riverine fish), upstream passage (adult Atlantic salmon, clupeids, American eels, and riverine fish) freshwater mussel protection, flow priorities ( bypass reach, canal, up- and downstream fish passage, hydrogenation, run of river protection of federally threatened tiger beetle), and disabled angler fishing access.

Comments to both company and the FERC concerning above listed issues.

Participant in CCT meetings representing Trout Unlimited concerning above listed issues. CCT consists of Holyoke Gas & Electric (project owners), state and federal agencies, and NGO's (Trout Unlimited and Connecticut River Watershed Council).

Indian River – FERC # 12462, Westfield River

Licensing of project – bypass minimum flows, freshwater mussel protection, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, riverine fish), upstream passage for American eels.

Participation in ongoing fish passage discussions regarding both up- and downstream passage issues.

L.S. Starrett Co. – FERC # UL09-01, Millers River

Installation of new turbine initiated local Conservation Commission and Massachusetts Department of Environmental Protection actions presently on hold due to a FERC order of jurisdiction dated October 21, 2009.

Intervened in Massachusetts Department of Environmental Protection appeal by Starrett of a Superseding Order of Conditions.

Commented to the FERC concerning Starrett Motion for Stay of Order of Jurisdiction regarding downstream fish passage.

Muddy Run Pumped Storage Project – FERC # 2355, Susquehanna River. Contracted by Maryland Power Plant Project to provide biological and fish passage assistance during relicensing and post licensing. Principle issues are entrainment and the impact of the project on river flows.

New Home Dam Project – FERC # 6096, Millers River

Post licensing flow issues - run of river requirement.

Northfield Mountain Pumped Storage Project – FERC # 2485, Connecticut River

License amendment allowing more storage in upper pond. River bank erosion concerns. Amendment application withdrawn.

Woronoco – FERC # 2631, Westfield River

Relicensing of project and 401 certification – bypass minimum flows, freshwater mussel protection, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, riverine fish), upstream passage for American eels, and recreation issues.

Analyzed telemetry data from downstream smolt test to provide independent review of results.

York Haven – FERC # 1888, Susquehanna River

Contracted by Maryland Power Plant Project to provide biological and fish passage assistance during relicensing. Relicensing is currently involved in settlement discussions with project owner, Olympus Power. Principle issues are up- and downstream fish passage for American shad and American eel and bypass flows.

**Publications**:

Kynard, B., D. Pugh, and T. Parker. 2003. Development of a fish ladder to pass lake sturgeon. Great Lakes Foundation, Final Report, Lansing Michigan.

Kynard, B., M. Horgan, D. Pugh, E. Henyey and T. Parker. 2008. Using juvenile sturgeon as a substitute for adults: a new way to develop fish passage for large fish. American Fisheries Society Symposium 61: 1-21.

Kynard, B., M. Kieffer, E. Parker, D. Pugh and T. Parker. 2012. Lifetime movements by Connecticut River sturgeon. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Kynard, B., D. Pugh, and T. Parker, M. Kieffer. 2012. Spawning of shortnose sturgeon in an artificial stream: adult behavior and early life history. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Kynard, B., D. Pugh, and T. Parker. 2012. Passage and behavior of Connecticut River shortnose sturgeon in a prototype spiral fish ladder with a note on passage of other fish species. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Kynard, B., E. Parker, D. Pugh, and T. Parker. 2012. Downstream and Diel Movements of Cultured Yearling Pallid, Green, Lake, and Shortnose Sturgeons: An Artificial Stream Study. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

Kynard, B., D. Pugh, and T. Parker. 2004. Experimental Studies to Develop Guidance and a Bypass for Shortnose Sturgeon at Holyoke Dam. Final Report to City of Holyoke, Holyoke Gas & Electric Company, Holyoke, Massachusetts.

Kynard, B., D. Pugh, and T. Parker. 2005. Experimental Studies to Develop Guidance and a Bypass for Shortnose Sturgeon at Holyoke Dam. Final Report to City of Holyoke, Holyoke Gas & Electric Company, Holyoke, Massachusetts.

Kynard, B., E. Parker, D. Pugh, and T. Parker. 2007. Use of laboratory studies to develop a dispersal model for Missouri River pallid sturgeon early life intervals. J. Appl. Ichthyol. 23: 365–374.

Kynard, B., D. Pugh, and T. Parker. 2011. Passage and behavior of cultured lake sturgeon in a prototype side-baffle ladder: I. ladder hydraulics and fish ascent. J. Appl. Ichthyol. 47 (Suppl. 1): 1-12.

Pugh, D., B. Kynard. 2001. Westfield River adult salmon report Westfield River, Massachusetts, 1966 – 1968. Final report to United States Forest Service and United States Fish and Wildlife Service.

Pugh, D. 1997. Millers and Chicopee River Basins Mussel Survey. Report to Massachusetts Natural Heritage and Endangered Species Program.

Pugh, D. 1998. French and Westfield River Basins Mussel Survey. Report to Massachusetts Natural Heritage and Endangered Species Program.

Pugh, D. 1999. Blackstone, Quinebaug, and Quabog River Basins Mussel Survey. Report to Massachusetts Natural Heritage and Endangered Species Program.

Pugh, D and A. Haro. 2000. Passage of Atlantic salmon at Turners Falls fishways: PIT tag evaluation 1999. Conte Anadromous Fish Research Center Internal Report No 00-02.

Pugh, D. 2000. Merrimack, Ipswich, Charles, and Neponsett/Weymouth/Weir Basins Mussel Survey. Report to Massachusetts Natural Heritage and Endangered Species Program.

Pugh, D. 2001. 2001 Fort River dwarf wedge mussel (*Alasmidonta heterodon*) survey. Massachusetts Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program.

Pugh, D. 2002. 2002 Fort River dwarf wedge mussel (*Alasmidonta heterodon*) survey. Massachusetts Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program.

**Presentations**:

Movement and Habitat of Atlantic Salmon in the Westfield River. D. Pugh. Connecticut River Atlantic Salmon Commission Conference, 1999.

Zebra Mussels: Can We Stop The Eastward Invasion? M. Babione and D. Pugh. Northeast Fish and Wildlife Conference, 2003.

Passage of Sturgeons and Riverine Fishes in a Prototype Spiral Fish Ladder. B. Kynard, D. Pugh, T. Parker. American Fisheries Society Meeting, 2006

Behavior of Lake, Pallid, and Shovelnose Sturgeons at Passage Structures: Toward a New Paradigm in Developing Fish Passage. B. Kynard, M. Horgan, D. Pugh, E. Henyey, and T. Parker. American Fisheries Society Meeting, 2006.

Performance of Lake Sturgeons and Riverine Fishes in a Spiral Side-Baffle Fish Ladder. B. Kynard, D. Pugh, T. Parker. Connecticut River Atlantic Salmon Commission Conference, 2009.

Review of Using a Semi-natural Stream to Produce Young Sturgeons for Conservation Stocking. B. Kynard, D. Pugh, T. Parker, M. Kieffer. International Sturgeon Society Conference, 2009.

Up- and Downstream Passage and Behavior of Lake and other Sturgeons. D. Pugh B. Kynard and T. Parker. Keeyask Fish Passage Workshop, 2011.

Eel Passage Westfield & Millers Rivers, Massachusetts. D. Pugh. ASMFC Eel Passage Workshop, 2011.

Passage and Behavior of Cultured Lake Sturgeon in a Side-Baffled Fish Ladder: II. Fish Ascent and Descent Behavior. NAC. 2011.

Behavior, impingement, and entrainment of shortnose sturgeon at a vertical bar rack: with and without a bypass orifice. B. Kynard and D. Pugh. Fish Passage Conference, Amherst, MA. 2012.

Research on Up-and Downstream Passage of Lake Sturgeons at S. O. Conte Anadromous Fish Research Center. B. Kynard, D. Pugh, E Henyey, T. Parker and M. Horgan. *Scaphirhynchus* Conference: Alabama, Pallid, and Shovelnose Sturgeon Symposium, St. Louis, Missouri, January 2005

Shortnose Sturgeon Life History Requirements and the Holyoke Dam. B. Kynard, M. Kieffer, D. Pugh. Connecticut River Atlantic Salmon Commission Conference, March 2013

EXHIBIT 1

**Weston**

The Weston Project is located at river mile 83 in the town of Skowhegan and is the fourth dam on the mainstem of the Kennebec River. The Weston Project includes a 930 acre impoundment, two dams, and one powerhouse. The two dams are constructed on the north and south channels of the Kennebec River where the river is divided by Weston Island. The impoundment extends 12.5 miles upstream with a normal pond elevation of 156.0 feet at mean sea level.

The North Channel dam is a concrete gravity and buttress dam with a maximum height of 38- ft. The dam extends 530 feet from the north bank of the Kennebec River to Weston Island, in a broad V- shape, along a ledge of a natural falls. From north to south, the dam consists of a 22.5 foot concrete non-overflow section (with a top elevation of 167.2 ft.), a 244' stanchion section (with five 10.5 foot high bays), a 161 foot pneumatic gate section (in two parts 81.7' and 78.8') with 7.5 ft high steel panels, and a 93' gate section adjacent to the island with two steel Tainter gates (28' wide by 16' high).

The South Channel dam is a 51 foot high concrete gravity and buttress dam that is approximately 392-ft long, extending between abutment walls at the island to the south river bank. The South Channel dam includes five sections: a 125 foot powerhouse section, a 33 foot concrete non-overflow section, a 24-ft long sluice section with a 18 foot wide by 14 foot deep Tainter gate with a 69.5 foot long sluice for downstream fish passage, a 188 foot long stanchion section with five stanchion bays, and a 22 foot long concrete spillway. A 300-ft long forebay boom and a 10-ft deep floating guidance barrier extend upstream from the north side of the bypass sluice to the south shore of Weston Island.

The powerhouse and intake section of the dam, located adjacent to the north abutment and integral to the Project dam, includes the headworks and four intake bays, one for each of four vertical Francis turbine generator units. Four inch clear space racks are located in front of each of the bays. The units have a total combined hydraulic capacity at 34 ft of head of approximately 6,000 cfs and a total installed capacity of 14.2 MW. The downstream bypass sluice can pass 2,600 cfs.

The Weston Project operates in a run-of-river mode, maintaining the impoundment water surface elevation within 1 ft of the normal full pond elevation during normal operations. A minimum flow requirement in the existing FERC license requires the Licensee to provide a minimum flow of 1,947 cfs or inflow, whichever is less.

Photo 1. Weston Project showing the North Dam, Weston Island and the South Dam.


Photo 2. Weston North Dam stanchions, Obermeyer and Tainter gates. Right stanchions indicated with green line, right Obermeyers with green line.

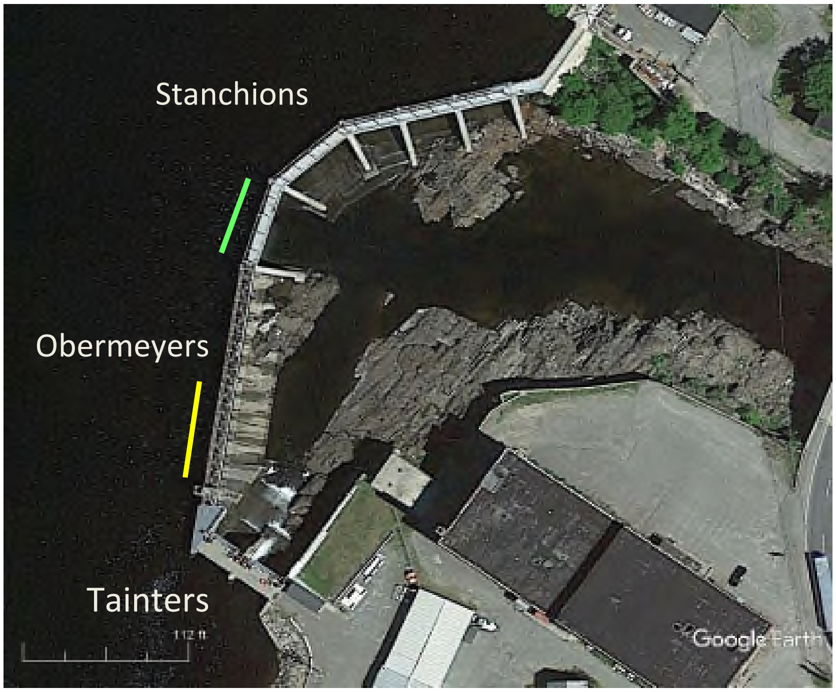


Photo 3. South Dam, powerhouse, downstream sluice and stanchions.


**Shawmut**

The Shawmut Project is located at RM 70 and is the third dam on the main stem of the Kennebec River. The Project includes a 1,310 acre impoundment, a 1,135 foot long dam with an average height of about 24 feet, a headworks structure, an enclosed forebay, and two powerhouses with intake structures. The crest of the dam has 380 ft. of hinged flashboards 4-ft high, a 730-ft. long inflatable bladder composed of three sections, each 4.5 feet high when inflated, and a 25 foot wide by 8 foot deep sluice equipped with a timber and steel gate.

The headworks and intake structures are integral to the dam and the powerhouses, respectively. The forebay intake section contains eleven headgates and two filler gates. A non-overflow concrete gravity section of dam connects the west end of the concrete filled forebay gate openings with a concrete cut-off wall which serves as a core wall for an earth dike.

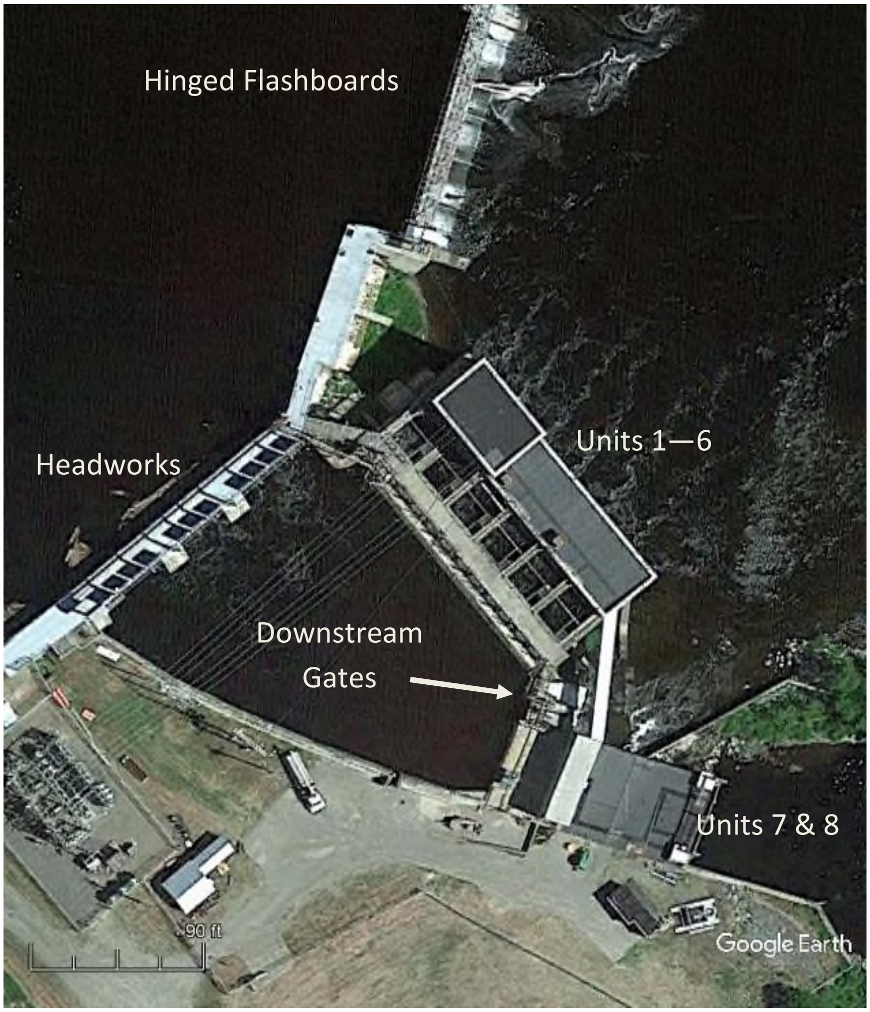
The forebay is located immediately downstream of the headgate structure and is enclosed by two powerhouse structures, the 1924 powerhouse located to the east and the 1982 powerhouse located to the south. An approximately 240-ft. long concrete retaining wall is located on the west side of the forebay. Located at the south end of the forebay between the powerhouses is a 10 foot by 7 foot Tainter gate. In addition, a 6 foot by 6 foot deep gate and a surface sluice (4 foot wide by 22 inches deep, passing 35 cfs) which discharges into a 3-ft. deep plunge pool are located at the south end of the forebay. Trash racks screen the intakes in front of Units 1-6 are 1.5 inch clear spacing and have 3.5 inch clear spacing in front of Units 7 and 8.

The original powerhouse contains six horizontal Francis-design units and the newer powerhouse contains two three blade horizontal propeller units, having a total combined authorized capacity of 8.74 MW and combined station flow of approximately 6,700 cfs. The Project is typically operated in a run-of-river mode maintaining the impoundment water surface within six inches of normal full pond, normally passing a minimum flow of 2,110 cfs, with a normal full pond elevation of about 112.0 ft msl.

Photo 4. Shawmut project.

.

Photo 5. Shawmut powerhouses, downstream bypass gates, headworks, and hinged flashboards.




**Hydro-Kennebec**

The Hydro-Kennebec Project is located at river mile 64 on the Kennebec River in the cities of Waterville and Winslow, Maine. Hydro-Kennebec is the second dam upstream on the Kennebec River. The Hydro-Kennebec Project has a total authorized capacity of 15.4 MW. The Project includes a 2.9 mile 250 acre pond. The principal project facilities include a concrete gravity dam with flashboards, forebay, impoundment, and a powerhouse containing two horizontal pit-type Kaplan turbines. A downstream bypass gate is located at the powerhouse with a boom to guide fish.

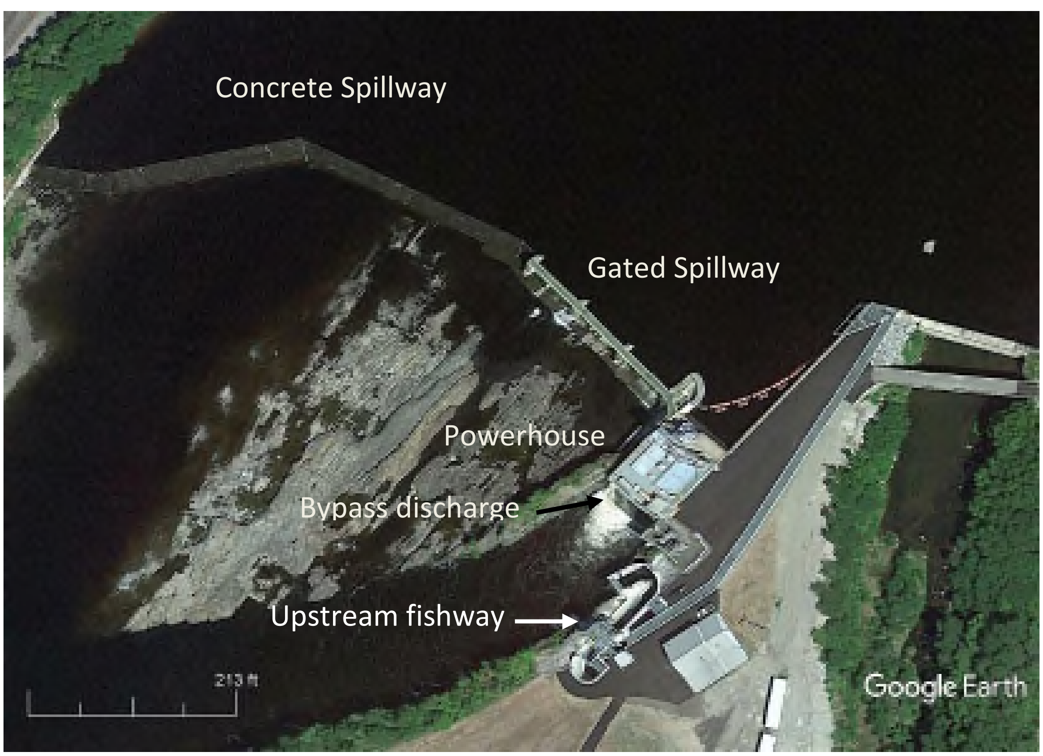
The Project consists of a 555-foot long un-gated concrete gravity spillway and a 200-foot long gated spillway. The dam also includes an 18-foot long east abutment adjacent to the powerhouse.

The un-gated spillway structure is 35 feet high at its maximum section with 6-foot high wooden flashboards, bringing the normal full headpond elevation to 81 feet. The gated spillway section has a permanent crest elevation of 68 feet and is equipped with three hydraulically controlled gates (each 15 feet high by 60 feet wide) to maintain the normal full pond elevation of 81 feet. The impoundment is approximately 250 acres in area.

The powerhouse is located between the middle retaining wall and the left bank and is 131.5 feet long and 62.2 feet wide at its base. The intake has steel trash racks with 3.5 inch clear spacing. Each of the two four blade pit-type Kaplan turbine units are capable of operating over a flow range of 1,550 cfs to 3,961 cfs. Unit 2 is located on the bank side of the powerhouse and Unit 1 is located on the river side of the powerhouse. The turbines are approximately 13 feet in diameter and have an operating speed of 115 rpm. Flow from the turbines is directly discharged to the tailrace and into the Kennebec River. The tailrace is separated from the Kennebec River by a narrow section of bedrock stabilized by rock anchors.

The Project has fish lift for upstream passage which consists of a tailrace entrance located immediately downstream of the Project powerhouse, a hopper elevator system, exit flume, and upstream exit located adjacent to the Project's abandoned gatehouse.

Photo 6. Hydro-Kennebec Project, concrete spillway, gated spillway, powerhouse, downstream bypass discharge, and upstream fishway.



**Lockwood**

The Lockwood Project is located at river mile 63, and is the first dam on the mainstem of the Kennebec River. The Lockwood Project includes a 1.2 mile 81.5-acre impoundment, an 875 foot long and 17 foot high dam with two spillway sections and a 160 foot long forebay headworks section, a 450 foot long forebay canal, and two powerhouses. The spillway sections impound the river on either side of a small island; the east spillway section begins at the east abutment of the dam and extends about 225 ft in a westerly direction to the small island. The west spillway extends about 650 ft from the small island in a southwesterly direction to the forebay canal headworks, which extend to the west bank of the river. Each spillway is equipped with 15 inch wooden flashboards.

The headworks and intake structures are integral to the dam and the powerhouses. The forebay intake section contains eleven headgates measuring 8.5 ft wide by 12 ft high. From the headworks, the forebay canal directs water to two powerhouses located on the west bank of the Kennebec River: the original 1919 powerhouse contains six vertical Francis units (660 cfs) and the 1989 powerhouse contains one horizontal Kaplan unit (1,700 cfs) having a total installed capacity of 6.8 MW and a combined flow of approximately 5,600 cfs. The trash racks have 2.0 inch clear spacing in front of Units 1-6 and 3.5 inch clear spacing in front of Unit 7. The project's tailrace returns the flow to the Kennebec River about 1,300 ft downstream from the east spillway section.

The Project includes an existing ice and debris surface sluice located between Units 6 and 7. This sluice is 6 ft wide by 30 inches deep, and it passes flows in the range of 60 to 70 cfs. Flows from this sluice discharge directly into the Project tailrace, which is approximately 15 ft deep. The Lockwood Project also has another existing debris surface sluice located above the head works structure and is 7.5 ft wide by 16 inches deep. Flows through this sluice range from 35 to 40 cfs and discharge over the face of the dam into a shallow pool connected to the river.

The surface sluice is located on the downstream end and on the eastern side of the forebay canal, adjacent to Unit 1. The sluice gate is seven feet wide and nine feet deep with a maximum flow capacity of 336 cfs (6% of the station capacity of 5,600 cfs). Water is discharged through the gate and drops approximately 18 ft to a river plunge pool with an approximate depth of 8 ft. There are also two deep canal drain gates located underneath the new surface sluice gate.

The Project has an fish lift for upstream passage located on the west side of the original powerhouse and adjacent to the Unit 7 powerhouse. The fish lift is required to be operated annually from May 1 to October 31, dependent on river conditions. During the river herring, shad and Atlantic salmon peak migration season (lasting from approximately May through mid-July), the fish lift is operated seven days per week to meet resource agency trap and truck requirements. During that migration season, the fish lift is generally operated from early morning to evening.

The Lockwood Project is operated in a run-of-river mode. The normal minimum head pond elevation is approximately 51.66 ft msl (six inches below the top of the spillway flashboards) when the flashboards are in place, and approximately 49.91 ft msl (1 foot below the spillway crest) when flashboards are being replaced.

Photo 7. Lockwood Project, east spillway, west spillway, headworks, powerhouse, and downstream bypass.