

Predation and predators in the Columbia River Basin

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Avian

Adkins, J. Y., D. E. Lyons, P. J. Loschl, D. D. Roby, K. Collis, A. F. Evans, and N. J. Hostetter. 2014. Demographics of piscivorous colonial waterbirds and management implications for ESA-listed salmonids on the Columbia Plateau. *Northwest Science* 88(4):344-359.
<https://doi.org/10.3955/046.088.0408>

Investigates colony size, productivity, and limiting factors for five piscivorous waterbird species nesting at 18 locations on the Columbia Plateau during 2004–2010 with emphasis on species with a history of salmonid depredation.

Adrean, L. 2013. Oregon Department of Fish and Wildlife Avian Predation Program 2012 final report. Oregon Department of Fish and Wildlife, Tillamook, Oregon.
<https://www.dfw.state.or.us/conservationstrategy/docs/2012AvianPredationReport.pdf>

Report on the Oregon Department of Fish and Wildlife’s Avian Predation Program work, which includes population monitoring, foraging surveys, hazing projects, diet studies, and band resighting.

Anchor QEA, LGL Limited, and Turnstone Environmental Consultants. 2017. Double-crested cormorant (DCCO) monitoring report: avian predation program monitoring. Report to U.S. Army Corps of Engineers, Portland, Oregon.
<https://usace.contentdm.oclc.org/utis/getfile/collection/p16021coll3/id/788>

Evaluates the status of the double-crested cormorant’s impacts on juvenile salmonids in the Lower Columbia River Estuary, outlines the plan to reduce the colony on East Sand Island.

Anderson, C. D., D. D. Roby, and K. Collis. 2004. Foraging patterns of male and female double-crested cormorants nesting in the Columbia River Estuary. *Canadian Journal of Zoology* 82(4):541–554. <https://doi.org/10.1139/z04-019>

Uses radiotelemetry to investigate the spatial and temporal foraging patterns of nesting cormorants to better understand how this colony meets its resource needs.

Anderson, S. K. 2003. Foraging ecology, colony attendance, and chick provisioning of Caspian tern (*Sterna caspia*) in the Columbia River estuary. Master's thesis. Oregon State University, Corvallis, Oregon. https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/mk61rk766

Examines factors influencing foraging distribution, diet composition, and overall reproductive success of Caspian terns nesting on East Sand Island in the Columbia River estuary.

Anderson, S. K., D. D. Roby, D. E. Lyons, and K. Collis. 2005. Factors affecting chick provisioning by Caspian terns nesting in the Columbia River estuary. *Waterbirds* 28(1):95-105. [https://doi.org/10.1675/1524-4695\(2005\)028\[0095:FACPBC\]2.0.CO;2](https://doi.org/10.1675/1524-4695(2005)028[0095:FACPBC]2.0.CO;2)

Investigates factors influencing foraging success, diet composition, and overall reproductive success of Caspian terns on a large colony on East Sand Island in the Columbia River estuary during 2001.

Anderson, S. K., D. D. Roby, D. E. Lyons, and K. Collis. 2007. Relationship of Caspian tern foraging ecology to nesting success in the Columbia River estuary, Oregon, USA. *Estuarine, Coastal and Shelf Science* 73(3-4):447-456. <https://doi.org/10.1016/j.ecss.2007.02.006>

Aims to add context to the prevalence of juvenile salmonids and marine forage fish in the diet of Caspian terns by examining the relationship between diet composition, foraging distribution, and productivity.

Antolos, M. 2002. Breeding and foraging ecology of Caspian terns (*Sterna caspia*) in the mid-Columbia River: predation on juvenile salmonids and management implications. Master's thesis. Oregon State University, Corvallis, Oregon. https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/cz30pw05t

Investigates the breeding and foraging ecology of Caspian terns nesting at colonies along the Columbia Plateau, with emphasis on terns nesting at colonies in the mid-Columbia River where terns foraged for juvenile salmonids.

Antolos, M., D. D. Roby, D. E. Lyons, K. Collis, A. F. Evans, M. Hawbecker, and B. A. Ryan. 2005. Caspian tern predation on juvenile salmonids in the mid-Columbia River. *Transactions of the American Fisheries Society* 134(2):466-480. <https://doi.org/10.1577/T04-043.1>

Utilizes a bioenergetics approach to determine the magnitude of predation by Caspian terns on juvenile salmonids in the mid-Columbia River during 2000 and 2001.

Bayer, R. D. 2003. Review: Bird predation of juvenile salmonids and management of birds near 14 Columbia Basin dams. Gahmken Press, Newport, Oregon.
<https://ir.library.oregonstate.edu/concern/defaults/jh343t74g>

Reviews bird predation of juvenile salmonids and/or bird predation control are reviewed for 14 of the 18 mainstem dams on the Columbia and Snake Rivers. Notes a gap in information on these dams.

Bird Research Northwest. 2013. Implementation and effects of double-crested cormorant dissuasion research at East Sand Island, Columbia River estuary, 2008-2012. Technical memorandum to U.S. Army Corps of Engineers, Portland, Oregon.
<http://www.birdresearchnw.org/Dissausion%202008-2012.pdf>

Reviews the feasibility of several techniques for dissuading double-crested cormorants from nesting on parts of their breeding colony on East Sand Island.

Bird Research Northwest. 2014. East Sand Island biological assessment, 2010-2012. Final technical memorandum to U.S. Army Corps of Engineers, Portland, Oregon.
<http://www.birdresearchnw.org/Final%20Biological%20Assessment.v4.pdf>

Outlines the suitability of habitats for waterbirds on East Sand Island with particular attention given to the areas used by double-crested cormorants, Brandt's cormorants, western gulls, ring-billed gulls, California brown pelicans, and horned larks.

Bonneville Power Administration. 2001. Avian predation on juvenile salmonids in the lower Columbia River Research Project : final environmental assessment. Bonneville Power Administration, Portland, Oregon. <https://www.energy.gov/nepa/articles/ea-1374-final-environmental-assessment>

Environmental assessment reviewing completed work and proposed activities related to controlling and mitigating avian predation of juvenile salmonids in the Lower Columbia River.

Clemens, B. J., S. P. Clements, M. D. Karnowski, D. B. Jepsen, A. I. Gitelman, and C. B. Schreck. 2009. Effects of transportation and other factors on survival estimates of juvenile salmonids in the unimpounded lower Columbia River. *Transactions of the American Fisheries Society* 138(1):169-188. <https://doi.org/10.1577/T07-090.1>

Estimates the survival of juvenile salmonids out-migrating through the lower Columbia River to the Pacific Ocean. Data suggest that barging reduces mortality between dams and also the post release mortality by avian predators in the Columbia River estuary.

Collis, K., A. Evans, J. Tennyson, A. Turecek, Q. Payton, and R. Bhatt. 2020. Avian predation in the Columbia Plateau Region: management, monitoring, and evaluation: 2019 final annual report. Report to Grant County Public Utility District and the Priest Rapids Coordinating Committee. <http://www.birdresearchnw.org/2019%20GPUD%20Final%20Report.pdf>

Report on the Inland Avian Predation Management Plan, which sought to reduce avian predation on juvenile salmonids by Caspian terns in the Columbia Plateau region, namely through dissuasion techniques.

Collis, K. M. Hawbecker, D. Roby, C. Couch, J. Wolf, and C. Anderson. 2001. Pelican, cormorant, and pinniped use of pile dikes and jetties at the mouth of the Columbia River estuary, 2000: 2000 final data report. http://www.birdresearchnw.org/2000_Pile_Dike_Report.pdf

Report on observations of brown pelicans, cormorants, and pinniped use of pile dikes and jetties at the mouth of the Columbia River.

Collis, K., M. Hawbecker, D. D. Roby, M. Thompson, C. Faustino, C. Cardoni, C. D. Anderson, and D. E. Lyons. 2002. Cormorant and brown pelican use of excluder-fitted pile dikes in the Columbia River estuary, 2001: 2001 final report. http://www.birdresearchnw.org/2001_Pile_Dike_Report.pdf

Study on the efficacy of excluders, such as wire spike strips, in discouraging cormorants from perching, roosting, or foraging from pile dikes in the mouth of the Columbia River.

Collis, K., D. D. Roby, C. Couch, G. Dorsey, K. Fischer, D. E. Lyons, A. M. Myers, S. K. Nelson, J. Y. Adkins, A. Evans, and M. Hawbecker. 2006. Piscivorous waterbird research on the Columbia River: final 2004 season summary. Report to Bonneville Power Administration and U.S. Army Corps of Engineers, Portland, Oregon. http://www.birdresearchnw.org/04_Season_Summary.pdf

Examines the dietary habits of a variety of waterbirds along the Lower Columbia River, from the mouth of the river to the impoundment created by McNary Dam. Finds terns, cormorants and

pelicans were strictly piscivorous, while gulls were more varied in their diet and sometimes primarily ate anthropogenic food items.

Collis, K., Roby, D. D., D. P. Craig, S. Adamany, J. Y. Adkins, and D. E. Lyons. 2002. Colony size and diet composition of piscivorous waterbirds on the lower Columbia River: implications for losses of juvenile salmonids to avian predation. *Transactions of the American Fisheries Society* 131(3):537-550. [https://doi.org/10.1577/1548-8659\(2002\)131<0537:CSADCO>2.0.CO;2](https://doi.org/10.1577/1548-8659(2002)131<0537:CSADCO>2.0.CO;2)

Reports on the colony size and diet composition of piscivorous waterbirds along the Lower Columbia River, from the mouth of the river to the impoundment created by McNary Dam.

Collis, K., D. D. Roby, D. P. Craig, B. A. Ryan, and R. D. Ledgerwood. 2001. Colonial waterbird predation on juvenile salmonids tagged with passive integrated transponders in the Columbia River estuary: vulnerability of different salmonid species, stocks, and rearing types. *Transactions of the American Fisheries Society* 130(3):385-396. [https://doi.org/10.1577/1548-8659\(2001\)130<0385:CWPOJS>2.0.CO;2](https://doi.org/10.1577/1548-8659(2001)130<0385:CWPOJS>2.0.CO;2)

Examines recovered passive integrated transponder tags collected from Caspian tern and double-crested cormorants on Rice Island in the Columbia River Estuary in order to assess the relative vulnerability of salmonid species to avian predation.

Collis, K., D. D. Roby, A. F. Evans, T. J. Lawes, and D. E. Lyons. 2023. Caspian tern management to increase survival of juvenile salmonids in the Columbia River Basin: Progress and adaptive management considerations. *Fisheries* 49(2):71–84. <https://doi.org/10.1002/fsh.11012>

Reviews the success of two management plans for Caspian terns within the Columbia River Basin, one in the estuary and one in the plateau. Finds that both programs were successful in lowering smolt loss from avian predation, but that adaptive management is needed to keep up with changes in tern behavior.

Collis, K., D. D. Roby, N. J. Hostetter, A. F. Evans, D. E. Lyons, J. Y. Adkins, Y. Suzuki, P. Loschl, and T. Lawes. 2012. Caspian tern colony site assessment: management opportunities in western North America. Report to U.S. Army Corps of Engineers, Walla Walla, Washington. http://www.birdresearchnw.org/IAPMP_site_assessment_report%20v18.pdf

Reviews Caspian tern nesting behavior in North America in order to predict potential nest sites for Caspian terns in the Columbia Plateau region of Washington. These potential nest sites were identified to anticipate future management issues after the relocation of the terns from Goose Island and Crescent Island.

Couch, S. L. L., and M. M. Lance. 2004. Diet composition and breeding success of Brandt's cormorants in the Columbia River estuary. *Northwestern Naturalist* 85(2):62-66. [https://doi.org/10.1898/1051-1733\(2004\)085<0062:DCABSO>2.0.CO;2](https://doi.org/10.1898/1051-1733(2004)085<0062:DCABSO>2.0.CO;2)

Investigates the diet composition and breeding success of Brandt's cormorants at colonies along the Columbia River Estuary.

David C. Smith and Associates, Statewide Land Surveying, and Harris Environmental Group. 2016. Enumeration and monitoring surveys of double-crested cormorants in the lower Columbia River estuary for the 2015 nesting season. Report to U.S. Army Corps of Engineers, Portland, Oregon. <https://usace.contentdm.oclc.org/utis/getfile/collection/p16021coll3/id/789>

Enumeration and monitoring report on double-crested cormorants in the lower Columbia river in 2015, the primary study area is East Sand Island, but the rest of the estuary was also monitored for double-crested cormorant colonies.

Dare, M. R., C. S. McCutcheon, and R. J. Richmond. 2002. Manual PIT tag collection at the Caspian tern colony on Crescent Island, Washington. Report to U.S. Army Corps of Engineers, Walla Walla, Washington. <https://catalog.cbowl.org/cgi-bin/koha/opac-detail.pl?biblionumber=3925>

Report on collected passive integrated transponder tags from a Caspian tern colony on Crescent Island, Washington. Over the course of three days in October 2001, more than 11,000 passive integrated transponder tags were detected and removed.

Double-Crested Cormorant Subcommittee and Pacific Flyway Nongame Migratory Bird Technical Committee. 2012. A framework for the management of double-crested cormorant depredation on fish resources in the Pacific flyway. Report to Pacific Flyway Council, Portland, Oregon. http://pacificflyway.gov/Documents/Dcc_plan.pdf

Plan for the management of double-crested cormorant in the Pacific flyway which includes much of Western North America. Plan was developed to address regional concerns over double-crested cormorant predation and also address management of populations at the flyway scale.

Evans, A. F., N. J. Hostetter, D. D. Roby, K. Collis, D. E. Lyons, B. P. Sandford, R. D. Ledgerwood, and S. Sebring. 2012. Systemwide evaluation of avian predation on juvenile salmonids from the Columbia River based on recoveries of passive integrated transponder tags. *Transactions of the American Fisheries Society* 141(4):975-989. <https://doi.org/10.1080/00028487.2012.676809>

Utilizes passive integrated transponder tags recovered at nine piscivorous waterbird colonies along the Columbia River to assess the impact of avian predation on salmonids. Finds that

impacts were greater for Snake River and upper Columbia River salmonids than for salmonids originating closer to the estuary.

Evans, A. F., N. J. Hostetter, and K. Collis. 2013. Caspian tern predation on upper Columbia River steelhead in the Priest Rapids Project: a retrospective analysis of data from 2008-2010. Report to Public Utility District No. 2 of Grant County, Ellensburg, Washington and Blue Leaf Environmental.
http://www.birdresearchnw.org/Evans%20et%20al%202013_GPUD%20Final%20Avian%20Predation%202008%20to%202010.pdf

Evaluates avian predation of juvenile steelhead in the upper Columbia River, finding that Caspian tern predation was a substantial source of mortality, terns nesting on Goose Island in Potholes Reservoir annually consuming 12.8% of steelhead released into the tailrace of Rock Island Dam during 2008, 2009, and 2010.

Evans, A. F., Q. Payton, A. Turecek, B. Cramer, K. Collis, D. Roby, P. Loschl, J. Skalski, R. Townsend, L. Sullivan, and M. Weiland. 2015. Avian predation on juvenile salmonids in the Columbia River: a spatial and temporal analysis of impacts in relation to fish survival. Report to Public Utility District No. 2 of Grant County, Ephrata, Washington.
http://www.birdresearchnw.org/Evans%20et%20al%202015_Avian%20Predation%20on%20AT%20smolts%20_Final%20Report.pdf

Survival study using the Juvenile Salmonid Acoustic Telemetry System to assess the impact of avian predation from 11 colonies of various piscivorous waterbirds along the Snake River and Columbia River.

Evans, A. F., Q. Payton, B. Cramer, K. Collis, D. Lyons, and P. Loschl. 2016. Predation impacts on juvenile salmonids by double-crested cormorants and Caspian terns nesting on East Sand Island in the Columbia River Estuary. Report to U.S. Army Corps of Engineers, Portland, Oregon.
<http://www.birdresearchnw.org/2015%20ESI%20PIT%20Recovery%20FINAL%20Report.pdf>

Estimates predation rates of salmonids by double-crested cormorants and Caspian terns nesting on East Sand Island in the Columbia River Estuary based on recoveries of passive integrated transponder tags.

Evans, A. F., Q. Payton, B. M. Cramer, K. Collis, N. J. Hostetter, D. D. Roby, and C. Dotson. 2019. Cumulative effects of avian predation on upper Columbia River steelhead. Transactions of the American Fisheries Society 148(5):896-913. <https://doi.org/10.1002/tafs.10197>

A mark–recapture–recovery study with upper Columbia River steelhead implanted with passive integrated transponder tags. Utilizes state–space Bayesian model that incorporated live

detections and dead recoveries of tagged fish to jointly estimate predation and survival probabilities during smolt out-migration.

Evans, A. F., Q. Payton, N. J. Hostetter, K. Collis, B. M. Cramer, and D. D. Roby. 2022. Cumulative effects of piscivorous colonial waterbirds on juvenile salmonids: a multi predator-prey species evaluation. *PLoS One* 17(8):e0272875. <https://doi.org/10.1371/journal.pone.0272875>.

Aims to determine the proportion of all sources of fish mortality attributable to avian predation in the Columbia River Basin. Results indicate that probabilities of avian consumption varied greatly across salmonid populations, bird species, colony location, river reach, and year.

Evans, A. F., Q. Payton, A. Turecek, B. Cramer, K. Collis, D. D. Roby, P. J. Loschl, L. Sullivan, J. Skalski, M. Weiland, and C. Dotson. 2016. Avian predation on juvenile salmonids: spatial and temporal analysis based on acoustic and passive integrated transponder tags. *Transactions of the American Fisheries Society* 145(4):860-877. <https://doi.org/10.1080/00028487.2016.1150881>

Evaluates the impact of predation on juvenile steelhead *Oncorhynchus mykiss* and yearling and subyearling Chinook salmon *O. tshawytscha* by piscivorous waterbirds from 11 different breeding colonies in the Columbia River basin during 2012 and 2014

Good, T. P., M. McClure, B. Sandford, K. Barnas, D. Marsh, B. Ryan, and E. Casillas. 2007. Quantifying the effect of Caspian tern predation on threatened and endangered Pacific salmon in the Columbia River Estuary. *Endangered Species Research* 3:11–21. <https://doi.org/10.3354/esr003011>

Analyzes recoveries of salmonid passive integrated transponder tags from the East Sand Island tern colony to calculate predation rates on Columbia and Snake River steelhead.

Good, T. P., L. A. Weitkamp, D. E. Lyons, D. D. Roby, K. S. Andrews, and P. J. Bentley. 2022. Availability of alternative prey influences avian predation on salmonids. *Estuaries and Coasts* 45:2204-2218. <https://doi.org/10.1007/s12237-022-01076-8>

Compares the diet of two piscivorous bird species nesting in the lower Columbia River with purse seine samples of the fish community to explore the influence of alternative prey availability on the consumption of juvenile salmonids in the Columbia River Estuary.

Gravenhof, D. A., M. R. Wuellner, E. A. Renner, and M. J. Fincel. 2024. Estimating predation rates of stocked juvenile Chinook salmon using novel acoustic predation transmitters. *North American Journal of Fisheries Management* 44(2): 438-448. <https://doi.org/10.1002/nafm.10992>

Assesses the impact of avian predation from 11 colonies of various piscivorous waterbirds along the Snake and Columbia rivers on steelhead and Chinook salmon. Results indicated that avian predation was a substantial source of steelhead mortality.

Haeseke, S. L., G. Scheer, and J. McCann. 2020. Avian predation on steelhead is consistent with compensatory mortality. *Journal of Wildlife Management* 84(6):1164–1178.
<https://doi.org/10.1002/jwmg.21880>

Applies a random effects model to a long-term, mark-recapture-recovery data set on anadromous steelhead in the Snake River Basin to assess whether avian predation mortality constitutes an additive or compensatory source of mortality.

Harper, J. and K. Collis. 2018. 2018 hazing and dissuasion of Caspian terns in the lower Columbia estuary: season end summary report. Report to U.S. Army Corps of Engineers, Portland, Oregon.
<http://www.birdresearchnw.org/FinalAvianPredationSummaryReport2018.pdf>

Report on efforts to prevent Caspian terns from nesting on three dredge material disposal islands in the upper Columbia River Estuary after the program to reduce numbers on East Sand Island.

Hostetter, N. J. 2009. Susceptibility of juvenile salmonids to avian predation: Are Caspian terns and double-crested cormorants only taking the sick and injured? Master's thesis. Oregon State University, Corvallis, Oregon.
https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/3197xr26d

Investigates the use of a quick, non-lethal, external examination technique to assess general health status of run-of-the-river juvenile steelhead migrating from the Snake River basin to determine if avian predation mainly impacts sick and injured steelhead.

Hostetter, N. J., A. F. Evans, B. M. Cramer, K. Collis, D. E. Lyons, and D. D. Roby. 2015. Quantifying avian predation on fish populations: integrating predator-specific deposition probabilities in tag recovery studies. *Transactions of the American Fisheries Society* 144(2):410-422.
<https://doi.org/10.1080/00028487.2014.988882>

Applies an integrated tag recovery modeling approach in a Bayesian context to estimate predation probabilities that accounted for predator-specific tag detection and deposition probabilities in a multiple-predator system to assess the impact of specific piscivorous waterbirds.

Hostetter, N. J., A. F. Evans, Q. Payton, D. D. Roby, D. E. Lyons, and K. Collis. 2023. A review of factors affecting the susceptibility of juvenile salmonids to avian predation. *North American Journal of Fisheries Management* 43(1):244-256. <https://doi.org/10.1002/nafm.10862>

Reviews peer-reviewed academic and government published reports and studies of piscivorous colonial waterbird predation on juvenile salmonids to synthesize current knowledge of factors affecting fish susceptibility to avian predators.

Hostetter, N. J., A. F. Evans, D. D. Roby, and K. Collis. 2012. Susceptibility of juvenile steelhead to avian predation: the influence of individual fish characteristics and river conditions. *Transactions of the American Fisheries Society* 141(6):1586-1599. <https://doi.org/10.1080/00028487.2012.716011>

Investigated factors influencing salmonid susceptibility to predation by using juvenile steelhead from the Snake River to examine the influence of prey condition, prey size, and environmental conditions.

Hostetter, N. J., Q. Payton, D. D. Roby, K. Collis, A. F. Evans. 2022. Predation probabilities and functional responses: how piscivorous waterbirds respond to pulses in fish abundance. *Ecosphere* 13(9):e4220. <https://doi.org/10.1002/ecs2.4220>

Evaluates how piscivorous waterbirds respond to changes in prey abundance utilizing a 13-year dataset to quantify weekly predation probabilities and functional responses across waterbird species, colonies, and years.

Johnson, B. L., J. L. Kaiser, C. J. Henny, and R. A. Grove. 2008. Prey of nesting ospreys on the Willamette and Columbia Rivers, Oregon and Washington. *Northwest Science* 82(3):229-236. <https://doi.org/10.3955/0029-344X-82.3.229>

Assesses the diet of ospreys along the lower Columbia and upper mainstem Willamette rivers by evaluating prey remains collected from wire baskets constructed under artificial feeding perches installed near nest sites and from the ground beneath natural feeding perches and nests from 1997 –2004.

Jones, S. T., G. M. Starke, and R. J. Stansell. 1995-1999. Predation by gulls and effectiveness of predation control measures at Bonneville, The Dalles, and John Day Dams. Report to U.S. Army Corps of Engineers, Cascade Locks, Oregon. <https://catalog.cbfiwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=31775>

Multiple reports on levels of predation by gulls and the effectiveness of avian predation control efforts at the Dalles, John Day, and Bonneville dams. Finds complete stainless steel avian line arrays were 100% effective at preventing gull predation.

Kennedy, B. M., W. L. Gale, and K. G. Ostrand. 2007. Relationship between smolt gill Na⁺, K⁺ ATPase activity and migration timing to avian predation risk of steelhead trout (*Oncorhynchus mykiss*) in a large estuary. *Canadian Journal of Fisheries and Aquatic Sciences* 64(11):1506–1516.
<https://doi.org/10.1139/f07-117>

Examines avian predation risk of juvenile steelhead migrating through the Columbia River Estuary in relation to their osmoregulatory physiology, body length, rearing conditions (hatchery or wild), migration timing, and migration year from 2003-2006.

Lawonn, M. J. 2023. A status assessment of the double-crested cormorant (*Nannopterum auritum*) in the Columbia River estuary and implications for predation on outmigrating juvenile salmonids. *Oregon Department of Fish and Wildlife Science Bulletin* 2023-01.
<https://digital.osl.state.or.us/islandora/object/osl:1023906>

Reports on the status of double-crested cormorants in the Columbia River estuary after efforts from 2004-2020 to limit double-crested cormorant predation on juvenile salmonids. Discusses shifts in nesting behavior and distribution.

Lawonn, M. J. 2023. Summary of double-crested cormorant monitoring in the Columbia River estuary, 2020 and 2021. *Oregon Department of Fish and Wildlife Science Bulletin* 2023-02.
<https://digital.osl.state.or.us/islandora/object/osl:1023905>

Studies the status and extent of double-crested cormorants in the Columbia River estuary during 2020 and 2021. Identifies 29 colonies in the Columbia River Estuary and one new colony adjacent to the Dalles Dam.

Lyons, D. E. 2004. Foraging ecology of Caspian terns and double-crested cormorants in the Columbia River estuary. Master's thesis. Oregon State University, Corvallis, Oregon.
https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/vm40xv63m

Studies the foraging ecology of Caspian terns and double-crested cormorants in the Columbia River Estuary using point count surveys.

Lyons, D. E. 2010. Bioenergetics-based predator-prey relationships between piscivorous birds and juvenile salmonids in the Columbia River estuary. Doctoral dissertation. Oregon State University,

Corvallis, Oregon.

https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/08612r341

Estimates juvenile salmonid consumption by double-crested cormorants and Caspian terns, assessed impacts to at-risk salmonid populations by estimating salmonid mortality rates due to avian predation, and estimated potential demographic benefits to salmonids if avian predation were reduced.

Lyons, D. E., D. D. Roby, and K. Collis. 2007. Foraging patterns of Caspian terns and double-crested cormorants in the Columbia River Estuary. *Northwest Science* 81(2):91–103.

<https://doi.org/10.3955/0029-344X-81.2.91>

Examines spatial and temporal foraging patterns of Caspian terns and double-crested cormorants nesting in the Columbia River estuary, to potentially identify circumstances where juvenile salmonids might be more vulnerable to predation.

Lyons, D. E., A. F. Evans, N. J. Hostetter, A. Piggott, L. Weitkamp, T. P. Good, D. D. Roby, K. Collis, P. J. Loschl, and B. Cramer. 2014. Factors influencing predation on juvenile salmonids by double-crested cormorants in the Columbia River estuary: a retrospective analysis. Report to U.S. Army Corps of Engineers, Portland, Oregon.

<http://www.birdresearchnw.org/ESI%20DCCO%20Revised%20Retrospective%20Analysis%202014%2011%2007.pdf>

Uses principal components regression to evaluate the relationship between several annual measures of cormorant predation and a combination of colony size and environmental covariates.

Lyons, D. E., D. D. Roby, A. F. Evans, N. J. Hostetter, and K. Collis. 2011. Benefits to Columbia River anadromous salmonids from potential reductions in avian predation on the Columbia Plateau. Report to U.S. Army Corps of Engineers, Walla Walla, Washington.

<http://www.birdresearchnw.org/inland%20avian%20predation%20benefits%20analysis.pdf>

Examines the potential benefits of reducing avian predation associated with five colonies of piscivorous waterbirds in the Columbia Plateau region for three evolutionarily significant units of Chinook salmon, one ESU of sockeye salmon and two groups of steelhead.

Lyons, D. E., D. D. Roby, A. F. Evans, N. J. Hostetter, and K. Collis. 2014. Benefits to Columbia River anadromous salmonids from potential reductions in predation by double-crested cormorants nesting at the East Sand Island colony in the Columbia River estuary. Report to U.S. Army Corps of Engineers, Portland, Oregon.

<http://www.birdresearchnw.org/final%20esi%20dcco%20benefits%20analysis.pdf>

Examines the potential benefits of reductions in predation by double-crested cormorants nesting at the large colony on East Sand Island in the Columbia River estuary to three distinct population segments of steelhead, four evolutionarily significant units (ESUs) of Chinook salmon, and one ESU of sockeye salmon.

Maranto, C. J., T. P. Good, F. K. Wiese, and J. K. Parrish. 2011. Impact of the Potholes Reservoir Caspian tern breeding colony on out-migrating juvenile salmonids in the mid-Columbia River. *Transactions of the American Fisheries Society* 139(2):362-381. <https://doi.org/10.1577/T09-095.1>

Examines the foraging behavior and diet of Caspian terns *Hydroprogne caspia* breeding at Potholes Reservoir, Washington, in 2003, 2005, and 2006, develops a bioenergetics model to estimate impacts on juvenile salmonids.

Meyer, K. A., C. L. Sullivan, P. Kennedy, D. J. Schill, D. M. Teuscher, A. F. Brimmer, and D. T. King. 2016. Predation by American white pelicans and double-crested cormorants on catchable-sized hatchery rainbow trout in select Idaho lentic waters. *North American Journal of Fisheries Management* 36(2):294- 308. <https://doi.org/10.1080/02755947.2015.1120835>

Evaluates whether pelican predation is impacting angler catch of hatchery trout stocked in Idaho waters. estimated rates of pelican predation, and angler catch for 19 unique springtime fish stocking events over 3 years across 12 study waters.

Myers, A. M. 2007. Evaluating the fatty acid signature technique for studies of diet composition in piscivorous waterbirds. Master's thesis. Oregon State University, Corvallis, Oregon. https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/cz30pw84g

Evaluates the fatty acid signature technique with Caspian terns, conducting captive feeding trials conducted with Caspian tern chicks, determines that FASs of the birds reflected differences in their diets.

Myrvold, K. M. 2018. Shifts in great blue heron habitat use following nest site usurpation: implications for salmonids. *The American Midland Naturalist* 179(1):105-125. <https://doi.org/10.1674/0003-0031-179.1.105>

Uses individual tag data on juvenile salmonids to quantify how their geographic, taxonomic, and life-history representation in the diets of great blue herons changed after a pair of bald eagles usurped the colony's nesting site, forcing the colony to relocate.

National Marine Fisheries Service. 2002-2010. Detection of Passive Integrated Transponder (PIT) tags on piscivorous bird colonies in the Columbia River basin. Report to U.S. Army Corps of Engineers, Walla Walla, Washington. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=2505>

Reports on the collection of passive integrated transponder tag recoveries throughout the Columbia River Basin over multiple years.

Oregon State University and Real Time Research. 2005-2014. Research, monitoring, and evaluation of avian predation on salmonid smolts in the lower and mid-Columbia River. Annual Report to Bonneville Power Administration, Project 1997-024-00, Portland, Oregon. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41035>

Evaluates management initiatives implemented to reduce predation on juvenile salmonids by Caspian terns nesting on East Sand Island in the Columbia River estuary, and Goose Island in Potholes Reservoir.

Oregon State University and Real Time Research. 2014-2018. Implementation of the inland avian predation management plan. Report to U.S. Army Corps of Engineers Walla Walla District and U.S. Bureau of Reclamation. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41027>

Reports on management initiatives to limit the numbers of Caspian terns breeding at Goose Island and surrounding islands in Potholes Reservoir and on Crescent Island in McNary Reservoir.

Oregon State University and Real Time Research. 2015-2016. Avian predation on juvenile salmonids, evaluation of the Caspian Tern Management Plan in the Columbia River estuary. Annual Report to Bonneville Power Administration, Project 1997-024-00, Portland, Oregon. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41036>

Monitors, evaluates, and adaptively manage initiatives implemented to reduce the number of Caspian tern nesting on East Sand Island and reports on these efforts to reduce tern predation on juvenile salmonids.

Oregon State University and Real Time Research. 2018-2019. Implementation and evaluation of efforts to reduce predation on ESA-listed salmonids by Caspian terns nesting at East Sand Island, Columbia River estuary. Annual Report to Bonneville Power Administration, Project 1997-024-00, Portland, Oregon. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41038>

Monitors and evaluates management implemented by resource management agencies to reduce the number of Caspian terns nesting on East Sand Island in the Columbia River estuary as an approach to reducing tern predation rates on juvenile salmonids.

Payton, Q., A. Evans, and B. Cramer. 2016. Effects of biotic and abiotic factors on juvenile steelhead survival in the middle Columbia River, 2008-2015. Report to Public Utility District No. 2 of Grant County, Ephrata Washington and Blue Leaf Environmental, Ellensburg, Washington.
http://www.birdresearchnw.org/Final%20Report_Steelhead%20Survival%20Covariate%20Analysis.pdf

Evaluates factors explaining steelhead survival in the middle Columbia River during 2008-2015, comparing and contrasting survival models that incorporated various biotic and abiotic factors experienced by smolts during outmigration.

Payton, Q., J. Fryer, T. Garrison, and A. F. Evans. 2023. Estimating cause-specific mortality and survival of juvenile fall Chinook Salmon: an investigation of avian predation across large spatial scales. *North American Journal of Fisheries Management* 43(2):569–585.
<https://doi.org/10.1002/nafm.10871>

Uses a state-space Bayesian model that incorporated live detections of tagged fish and recoveries of tags from dead fish to jointly estimate predation and survival over multiple Columbia River reaches and years.

Payton, Q., N. J. Hostetter, and A. F. Evans. 2019. Jointly estimating survival and mortality: integrating recapture and recovery data from complex multiple predator systems. *Environmental & Ecological Statistics* 26(2):107–125. <https://doi.org/10.1007/s10651-019-00421-8>

Adds an extension to the capture–recapture–recovery model to allow for the incorporation of recoveries from indeterminate temporal or spatial origin.

Phillips, E. M., J. K. Horne, and J. E. Zamon. 2017. Predator–prey interactions influenced by a dynamic river plume. *Canadian Journal of Fisheries and Aquatic Sciences* 74(9):1375-1390.
<https://doi.org/10.1139/cjfas-2016-0302>

Analyzes how the Columbia River plume influences predator-prey interactions, distribution of seabirds and fish prey, and juvenile salmonid survival.

Phillips, E. M., J. K. Horne, and J. E. Zamon. 2021. Characterizing juvenile salmon predation risk during early marine residence. PLoS ONE 16(2):e0247241.
<https://doi.org/10.1371/journal.pone.0247241>

Utilizes a Holling type II functional response to estimate smolt predation risk based on observations of piscivorous seabirds and local densities of alternative prey fish in coastal Oregon and Washington.

Real Time Research. 2017-2020. East Sand Island passive integrated transponder tag recovery and avian predation rate analysis. Final Technical Report to U.S. Army Corps of Engineers, Portland, Oregon. <https://catalog.cbowl.org/cgi-bin/koha/opac-detail.pl?biblionumber=41039>

Generates population-specific predation rates on PIT tagged juvenile salmonids that integrated multiple factors of uncertainty in the tag recovery process, including imperfect detection of tags on bird colonies, on-colony tag deposition probabilities, and temporal changes in fish availability to Caspian terns nesting on East Sand Island.

Real Time Research and Blue Leaf Environmental. 2017-2018. Double-crested cormorant monitoring on East Sand Island and in the Columbia River estuary. Annual Report to U.S. Army Corps of Engineers, Portland, Oregon. <https://catalog.cbowl.org/cgi-bin/koha/opac-detail.pl?biblionumber=41041>

Monitors the East Sand Island and Astoria-Megler Bridge double-crested cormorant and Brandt's cormorant colonies during breeding seasons.

Real Time Research and Oregon State University. 2000-2003. Caspian tern research on the lower Columbia River. Report to Bonneville Power Administration and Interagency Caspian Tern Working Group. <https://catalog.cbowl.org/cgi-bin/koha/opac-detail.pl?biblionumber=41032>

Field studies assessing the impact of predation by Caspian terns on the survival of juvenile salmonids in the lower Columbia River and the Columbia River Estuary. Monitors the Rice Island breeding colony.

Real Time Research and Oregon State University. 2020-2022. Avian predation in the Columbia River Basin. Annual Report to Bonneville Power Administration, Grant County Public Utility District and the Priest Rapids Coordinating Committee. <https://catalog.cbowl.org/cgi-bin/koha/opac-detail.pl?biblionumber=47141>

Evaluates the efficacy of management actions to reduce predation by terns and cormorants on juvenile salmonids in the Columbia Basin Estuary and assesses the impact of predation on smolts by other piscivorous colonial waterbirds.

Roby, D. D., K. Collis, T. J. Lawes, K. S. Bixler, D. E. Lyons, O. Bailey, A. Turecek, and M. Hawbecker. 2020. Monitoring and evaluation of efforts to reduce predation on ESA-listed salmonids by Caspian terns nesting at East Sand Island, Columbia River estuary. Report to Bonneville Power Administration and Northwest Power and Conservation Council, Portland, Oregon.
<https://www.cbfish.org/Document.mvc/Viewer/P171786>.

Monitors and evaluates management implemented by resource management agencies to reduce the number of Caspian terns nesting on East Sand Island in the Columbia River Estuary.

Roby, D. D., K. Collis, and D. E. Lyons. 2005. Conservation and management for fish-eating birds and endangered salmon. Pages 161-165 in USDA Forest Service General Technical Report PSW-GTR-191, Washington, D.C.
https://www.fs.usda.gov/psw/publications/documents/psw_gtr191/psw_gtr191_0161-0165_robby.pdf

Evaluates efforts to relocate the Caspian tern colony on Rice Island in the Columbia River Estuary to East Sand Island, with the hypothesis that the terns would consume a greater number of forage fish near East Sand Island and this would alleviate some pressure on salmonids.

Roby, D. D., K. Collis, D. E. Lyons, J. Y. Adkins, P. Loschl, Y. Suzuki, T. Marcella, L. Kerr, A. Evans, B. Cramer, N. Hostetter, B. P. Sandford, R. D. Ledgerwood, D. R. Kuligowski, and S. Sebring. 2011. Impacts of avian predation on salmonid smolts from the Columbia and Snake rivers: 2004-2009 synthesis report. Report to U.S. Army Corps of Engineers, Walla Walla, Washington.
<http://www.birdresearchnw.org/Avian%20Predation%20Synthesis%20Report%202004-2009%20Final%20v2.pdf>

Investigates the impact on survival of juvenile salmonids from predation by piscivorous colonial waterbirds nesting in the Columbia Plateau region during 2004-2009. Uses bioenergetics methods to estimate prey consumption by Caspian terns nesting at Crescent Island and double-crested cormorants nesting at Foundation Island.

Roby, D. D., A. F. Evans, and K. Collis. 2021. Avian predation on salmonids in the Columbia River basin: a synopsis of ecology and management. Report to U.S Army Corps of Engineers, Bonneville Power Administration, Grant County Public Utility District/Priest Rapids Coordinating Committee, and Oregon Department of Fish and Wildlife.
https://www.birdresearchnw.org/Avian%20Predation%20Synthesis%20Report%20Final_v2.pdf

Combines research and results from avian predation projects and management initiatives throughout the Columbia River Basin.

Roby, D. D., D. E. Lyons, D. P. Craig, K. Collis, and G. H. Visser. 2003. Quantifying the effect of predators on endangered species using a bioenergetics approach: Caspian terns and juvenile salmonids in the Columbia River estuary. *Canadian Journal of Zoology* 81(2):250–265.

<https://doi.org/10.1139/z02-242>

Estimates the consumption of juvenile salmonids and other forage fishes by Caspian terns nesting on Rice Island in the Columbia River estuary in 1997 and 1998 using a bioenergetics modeling approach.

Ruggerone, G. T. 1986. Consumption of migrating juvenile salmonids by gulls foraging below a Columbia River dam. *Transactions of the American Fisheries Society* 115(5):736-742.

[https://doi.org/10.1577/1548-8659\(1986\)115<736:COMJSB>2.0.CO;2](https://doi.org/10.1577/1548-8659(1986)115<736:COMJSB>2.0.CO;2)

Estimates predation of juvenile salmonids by gulls below Wanapum Dam on the Columbia River in 1982.

Ryan, B. A. 2005. A system-wide assessment of avian predation on juvenile Salmonids in the Columbia River Basin based on passive integrated transponder tag recoveries. Doctoral dissertation.

Portland State University, Portland, Oregon. <http://www.worldcat.org/oclc/61155085>

Reports on recovered passive integrated transponder tags from piscivorous waterbird colonies in the Columbia River basin to evaluate avian predation in the Columbia River Basin.

Ryan, B. A., J. W. Ferguson, R. D. Ledgerwood, and E. P. Nunnallee. 2001. Detection of passive integrated transponder tags from juvenile salmonids on piscivorous bird colonies in the Columbia River basin. *North American Journal of Fisheries Management* 21(2):417-421.

[https://doi.org/10.1577/1548-8675\(2001\)021<0417:DOPITT>2.0.CO;2](https://doi.org/10.1577/1548-8675(2001)021<0417:DOPITT>2.0.CO;2)

Evaluates modifications made to 400-kHz passive integrated transponder tag detection equipment, previously used in water, to detect PIT tags in piscivorous bird-nesting areas in the Columbia River Basin.

Ryan, B. A., S. G. Smith, J. A. M. Butzerin, and J. W. Ferguson. 2003. Relative vulnerability to avian predation of juvenile salmonids tagged with passive integrated transponders in the Columbia River estuary, 1998-2000. *Transactions of the American Fisheries Society* 132(2):275-288.

[https://doi.org/10.1577/1548-8659\(2003\)132<0275:RVTAPO>2.0.CO;2](https://doi.org/10.1577/1548-8659(2003)132<0275:RVTAPO>2.0.CO;2)

Estimates the relative vulnerability of various salmonid stocks to these predators by using data from passive integrated transponder tags detected on these colonies from 1998-2001.

Schaeffer, L. 1992. Avian predators at ODFW hatcheries: their identification and control. Oregon Department of Fish and Wildlife, Portland, Oregon.
<https://digital.osl.state.or.us/islandora/object/osl:18430>

Aims to identify avian predators and potentially risky colonies near hatcheries and proposes steps to prevent avian predation at hatcheries.

Schniedermeier, E. 2018. The response of Caspian terns to managed reductions in nesting habitat in the Columbia Plateau region, Washington State, USA. Master's thesis. Oregon State University, Corvallis, Oregon.
https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/v692tc482

Investigates the response of Caspian terns to the loss of available nesting habitat in the Columbia Plateau region as a result of the management plan to reduce mortality of juvenile salmonids in the Columbia Plateau region.

Schniedermeier, E., D. D. Roby, D. E. Lyons, Y. Suzuki, and K. Collis. 2020. Caspian tern response to managed reductions in nesting habitat. *Wildlife Society Bulletin* 44(3):468–479.
<https://doi.org/10.1002/wsb.1111>

Investigates the response of Caspian terns during 2014–2016 to reductions in nesting habitat as a result of the management plan to reduce mortality of juvenile salmonids in the Columbia Plateau region.

Schreck, C. B., T. P. Stahl, L. E. Davis, D. D. Roby, and B. J. Clemens. 2006. Mortality estimates of juvenile spring-summer Chinook salmon in the lower Columbia River and estuary, 1992-1998: evidence for delayed mortality? *Transactions of the American Fisheries Society* 135(2):457-475.
<https://doi.org/10.1577/T05-184.1>

Evaluates the juvenile salmon transportation program by the indirect method of comparing smolt-to-adult returns. Data suggest that smolt mortality is very low for run of river and barged fish between Bonneville Dam and the estuary proper.

Sebring, S. H., M. C. Carper, R. D. Ledgerwood, B. P. Sandford, G. M. Matthews, and A. F. Evans. 2013. Relative vulnerability of PIT-tagged subyearling fall Chinook salmon to predation by Caspian terns and double-crested cormorants in the Columbia River estuary. *Transactions of the American Fisheries Society* 142(5):1321-1334. <https://doi.org/10.1080/00028487.2013.806952>

Quantified the percentage of PIT-tagged subyearling fall Chinook Salmon that were consumed by Caspian terns and double-crested cormorants nesting on East Sand Island in the Columbia River estuary.

Suzuki, Y. 2012. Piscivorous colonial waterbirds in the Columbia River estuary : demography, dietary contaminants, and management. Doctoral dissertation. Oregon State University, Corvallis, Oregon.

https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/47429c39b

Evaluates the demographics and inter-colony movements of Caspian terns belonging to the Pacific Coast metapopulation, with special emphasis on two breeding colonies, one on East Sand Island in the Columbia River estuary and the other on Crescent Island in the mid-Columbia River.

Suzuki, Y., J. Heinrichs, D. E. Lyons, D. D. Roby, and N. Schumaker. 2018. Modeling the Pacific Flyway population of Caspian terns to investigate current population dynamics and evaluate future management options: phase 3 model results. Report to Bonneville Power Administration and Northwest Power & Conservation Council, Portland, Oregon.

<https://www.cbfish.org/Document.mvc/Viewer/P161235>

Evaluates the effects of potential management options on future trends in the Pacific Flyway population of Caspian terns utilizing a demographic population model.

Tiller, B. L., I. D. Welch, C. A. McKinstry, and J. E. Bernhard. 2004. Assessment of potential juvenile salmon predation by American white pelicans in the vicinity of McNary Dam, 2002-2003.

Battelle, Richland, Washington. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=6738>

Aims to provide baseline data to quantify the extent of predation by American white pelicans in the McNary Pool and tailrace in 2002-2003.

Turecek, A., J. Tennyson, K. Collis, and B. Cramer. 2018. Double-crested cormorant monitoring on East Sand Island, 2017. Report to U.S. Army Corps of Engineers, Portland, Oregon.

<https://usace.contentdm.oclc.org/utills/getfile/collection/p16021coll3/id/791>

Reports on efforts repair and modify existing infrastructure on the double-crested cormorant colony on East Sand Island used for monitoring and implementation of the management plan, including removal of materials that may serve as a hazard to nesting birds and conduct surveys to enumerate and monitor double-crested cormorants and Brandt's cormorants.

Turecek, A., J. Tennyson, P. von Weller, K. Collis, and B. Cramer. Double-crested cormorant monitoring on East Sand Island and in the Columbia River estuary, 2018. Report to U.S. Army Corps of Engineers, Portland, Oregon.

<http://www.birdresearchnw.org/2018%20ESI%20DCCO%20Monitoring%20%20Annual%20Report%20Final%20Final.pdf>

Reports on monitoring of the East Sand Island double-crested cormorant colony during the 2018 breeding season to provide in-season information on the colony that would inform the adaptive management of double-crested cormorants.

U.S. Army Corps of Engineers. 1995-1999. Predation by gulls and effectiveness of predation control measures at Bonneville, The Dalles, and John Day Dams. U.S. Army Corps of Engineers, Cascade Locks, Oregon. <https://catalog.cbfl.org/cgi-bin/koha/opac-detail.pl?biblionumber=31775>

Monitors and reports on observed gull predation at Bonneville, The Dalles, and John Day Dams, as well as management initiatives to prevent predation of juvenile salmonids, namely the effectiveness of avian line arrays.

U.S. Army Corps of Engineers. 2015. Double-crested cormorant management plan to reduce predation of juvenile salmonids in the Columbia River estuary: final environmental impact statement. U.S. Army Corps of Engineers, Portland, Oregon. <https://usace.contentdm.oclc.org/digital/collection/p16021coll7/id/2203>

Evaluates several alternative management options to reduce predation-related losses of juvenile salmon and steelhead from double-crested cormorants nesting on East Sand Island in the Columbia River Estuary.

U.S. Army Corps of Engineers, 2014. Inland avian predation management plan environmental assessment. U.S. Army Corps of Engineers, Walla Walla, Washington. https://www.nww.usace.army.mil/Portals/28/docs/programsandprojects/IAPMP/Final_IAPMP_EA_Fullpackage%20vs1.pdf

Addresses a set of proposed actions to reduce avian predation on salmonids in the inland Columbia River Basin above Bonneville Dam.

U.S. Army Corps of Engineers. 2019-2022. Abundance, distribution, and dissuasion efforts of Caspian terns (*Hydroprogne caspia*) and double crested cormorants (*Nannopterum auritum*) on Rice, Miller Sands, and Pillar Rock islands of the Columbia River. U.S. Army Corps of Engineers, Cascade Locks, Oregon. <https://catalog.cbfl.org/cgi-bin/koha/opac-detail.pl?biblionumber=47403>

Annual reports on monitoring and dissuasion efforts directed towards Caspian terns and double-crested cormorants nesting on Rice Island, Miller Sands spit and Pillar Rock Island within the Columbia River Estuary.

U.S. Geological Survey, Oregon State University, and Real Time Research. 2015-2016. Evaluation of foraging behavior, dispersal, and predation on ESA-listed salmonids by Caspian terns displaced from managed colonies in the Columbia Plateau Region. Annual Report to Grant County Public Utility District and Priest Rapids Coordinating Committee. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41044>

Evaluates dispersal of Caspian terns dissuaded from nesting on Goose and Crescent islands and changes in Caspian tern predation rates on juvenile salmonids associated with management in the mid-Columbia River.

Various authors. 2005-2014. Research, monitoring, and evaluation of avian predation on salmonid smolts in the lower and mid-Columbia River. Report to Bonneville Power Administration and U.S. Army Corps of Engineers. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41035>

Annual reports on monitoring and surveying piscivorous avian colonies and associated management initiatives in the lower and mid-Columbia River.

Various authors. 2014-2018. Implementation of the inland avian predation management plan. Report to U.S. Army Corps of Engineers and U.S. Bureau of Reclamation. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41027>

Annual reports on the implementation of inland avian predation management initiatives in the Columbia Plateau region.

Various authors. 2015-2016. Evaluation of foraging behavior, dispersal, and predation on ESA-listed salmonids by Caspian terns displaced from managed colonies in the Columbia Plateau Region. Annual report to Grant County Public Utility District/Priest Rapids Coordinating Committee, Ephrata, Washington. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41044>

Evaluates dispersal of Caspian terns dissuaded from nesting on Goose and Crescent islands and changes in Caspian tern predation rates on juvenile salmonids as a consequence of management.

Various authors. 2017-2018. Implementation and evaluation of efforts to reduce predation on ESA-listed salmonids by Caspian tern nesting at East Sand Island, Columbia River estuary. Report to Bonneville Power Administration and Northwest Power and Conservation Council, Portland, Oregon. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41038>

Evaluates management implemented by resource management agencies to reduce the number of Caspian terns nesting on East Sand Island in the Columbia River Estuary. Monitored tern nesting activity on East Sand Island throughout the tern nesting season and assessed tern diet composition and factors that limited tern colony size and nesting success.

Various authors. 2017-2018. East Sand Island passive integrated transponder tag recovery and avian predation rate analysis. Report to U.S. Army Corps of Engineers, Portland, Oregon. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41039>

Evaluates the effectiveness of management plans in reducing predation rates on juvenile salmonids by terns and cormorants nesting on East Sand Island in the Columbia River Estuary.

Various authors. 2022. Distribution and dissuasion of Caspian terns (*Hydroprogne caspia*) and double-crested cormorants (*Nannopterum auritum*) on East Sand Island. Report to Bonneville Power Administration and U.S. Army Corps of Engineers.

2022: <https://usace.contentdm.oclc.org/digital/collection/p16021coll3/id/930/rec/2>

Reports on the effectiveness of management plans for the Caspian tern and double-crested cormorant colonies on East Sand Island in the Columbia River Estuary, goals for 2022 included maintaining a 1-acre area for tern nesting, preventing satellite colonies for terns, and monitoring double-crested cormorants.

Various authors. 2000-2003. Caspian tern research on the lower Columbia River : final season summary. Report to Bonneville Power Administration, Portland, Oregon. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41032>

Annual report following the management initiative to relocate Caspian tern nesting from Rice Island to East Sand Island in the Columbia River Estuary. Reports on the monitoring and evaluation of the program and Caspian tern colonies in the estuary.

Various authors. 2015-2016. Avian predation on juvenile salmonids: evaluation of the Caspian tern management plan in the Columbia River estuary. Report to Bonneville Power Administration, Project 1997-024-00, Portland, Oregon. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=41036>

Annual report on the monitoring and evaluation of efforts to reduce avian predation by Caspian terns in the Columbia River Estuary, in particular, monitoring and evaluating efforts to reduce nesting areas on East Sand Island.

Washington Cooperative Fish and Wildlife Research Unit. 1999-2001. Development of an index to bird predation of juvenile salmonids within the Yakima River. Annual Report to Washington Department of Fish and Wildlife. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=44157>

Three annual reports on observations of avian predation of juvenile salmonids along the Yakima River and the development of a predation index.

Weitkamp, L. A., T. P. Good, D. E. Lyons, and D. D. Roby. 2016. The influence of environmental variation on the Columbia River estuarine fish community: implications for predation on juvenile salmonids. *North Pacific Anadromous Fish Commission Bulletin* 6:33-44. <https://doi.org/10.23849/NPAFCB6%2F33.44>

Explores the influence of a suite of local and ocean basin-scale environmental variables on the composition and abundance of the estuarine fish assemblage, an important determinant of avian predation on juvenile salmon in the Columbia River estuary.

Wiese, F. K., J. K. Parrish, C. W. Thompson, and C. Maranto. 2008. Ecosystem-based management of predator-prey relationships: piscivorous birds and salmonids. *Ecological Applications* 18(3):681–700. <https://doi.org/10.1890/06-1825.1>

Uses a bioenergetics approach to estimate the consumption of salmonid smolts by waterbirds: common merganser, California and ring-billed gull, Caspian tern, and double-crested Cormorant, found in the mid-Columbia River from April through August, 2002–2004.

Yakima/Klickitat Fisheries Project. 2003-2004. Monitoring and Evaluation of avian predation on juvenile salmonids on the Yakima River, Washington. Annual Report to Bonneville Power Administration, Project 1995-063-25, Portland, Oregon. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=44153>

Reports on the abundance of various piscivorous birds in the Yakima River Basin and provides estimates of consumption of juvenile salmonids by piscivorous birds. Identifies seasonal patterns, diurnal patterns for gull abundance, and provides predation indices.

York, D. L., J. L. Cummings, J. E. Steuber, P. A. Pochop, and C. A. Yoder. 2000. Importance of migrating salmon smolt in Ring-billed (*Larus delawarensis*) and California Gull (*L. californicus*) diets near Priest Rapids Dam, Washington. *Western North American Naturalist* 60(2):216-220. <https://scholarsarchive.byu.edu/wnan/vol60/iss2/12>

Studies the food habits of ring-billed and California gulls near Priest Rapids Dam, Washington to assess the importance of fish in gull diets. Peak percent consumption of fish by both species occurred in May, coinciding with peak salmon outmigration.

Zamon, J. E., E. M. Phillips, and T. J. Guy. 2006. Marine bird aggregations associated with the tidally-driven plume and plume fronts of the Columbia River. *Deep Sea Research Part II: Topical Studies in Oceanography* 107:85-95 <https://doi.org/10.1016/j.dsr2.2013.03.031>

Examines densities of piscivorous seabirds relative to the plume region and plume fronts of the Columbia River, finds common murre and sooty shearwaters were the vast majority of birds in surveys of the coast and plume region.

Zorich, N. A., M. R. Jonas, and P. L. Madson. 2010. Avian predation at John Day Dam 2009 : estimated fish consumption using direct observation with diet analysis. U.S. Army Corps of Engineers, Cascade Locks, Oregon. <http://www.worldcat.org/oclc/809207992>

Reports on observed avian predation by gulls at John Day Dam in 2009. Observations by researchers, as well as stomach content analysis were used to estimate salmonid consumption at the dam.

Zorich, N. A., M. R. Jonas, and P. L. Madson. 2011. Avian predation at John Day and the Dalles Dams, 2010 : estimated fish consumption using direct observation with diet analysis. U.S. Army Corps of Engineers, Cascade Locks, Oregon. <http://www.worldcat.org/oclc/797563762>

Reports on observed avian predation by gulls at John Day Dam in 2010. Observations by researchers, as well as stomach content analysis were used to estimate salmonid consumption at the dam.

Zorich, N. A., M. R. Jonas, and P. L. Madson. 2012. Avian predation at John Day and the Dalles Dams 2011 : estimated fish consumption using direct observation. U.S. Army Corps of Engineers, Cascade Locks, Oregon. <http://www.worldcat.org/oclc/809213225>

Reports on observed avian predation by gulls at John Day Dam and the Dalles in 2011. Observations by researchers, as well as stomach content analysis were used to estimate salmonid consumption at the dam.

Pinniped

Beach, R. J., A. C. Geiger, S. J. Jeffries, S. D. Treacy, and B. L. Troutman. 1985. Marine mammals and their interactions with fisheries of the Columbia River and adjacent waters, 1980-1982. Northwest and Alaska Fisheries Center Processed Report 85-04.

https://repository.library.noaa.gov/view/noaa/23546/noaa_23546_DS1.pdf

Reports on observations of marine mammals and their interaction with commercial and sport fisheries of the Columbia River Basin and surrounding waters. Primarily focuses on harbor seals, their abundance, distribution, interactions with fisheries and feeding habits.

Brown, R., B. E. Wright, M. J. Tennis, and S. Jeffries. 2020. California sea lion (*Zalophus californianus*) monitoring in the lower Columbia River, 1997-2018. Northwest Naturalist 101(2): 92-103.

<https://doi.org/10.1898/1051-1733-101.2.92>

Reports on monitoring of California sea lions in the lower Columbia River from 1997 to 2018 to document seasonal and annual occurrences and determine portions of the population preying on salmonids.

Chasco, B. E., I. C. Kaplan, A. C. Thomas, A. Acevedo-Gutiérrez, D. P. Noren, M. J. Ford, M. B. Hanson, J. J. Scordino, S. J. Jeffries, K. N. Marshall, A. O. Shelton, C. Matkin, B. J. Burke, and E. J. Ward. 2017a. Competing tradeoffs between increasing marine mammal predation and fisheries harvest of Chinook salmon. Scientific Reports 7(1). <https://doi.org/10.1038/s41598-017-14984-8>

Utilizes a spatio-temporal bioenergetics model of the Northeast Pacific Ocean to quantify how predation by three species of pinnipeds and killer whales on Chinook salmon has changed since the 1970s along the west coast of North America.

Couture, F., V. Christensen, and C. Walters. 2024. The combined effects of predation, fishing, and ocean productivity on salmon species targeted by marine mammals in the Northeast Pacific. PLoS ONE 19(3):e0296358. <https://doi.org/10.1371/journal.pone.0296358>

Reviews the impacts of pinniped predation on Chinook and coho salmon populations across the western coast of North America from 1979 through 2020.

Fiscus, C. H. 1980. Marine mammal-salmonid interactions: a review. Pages 121-132 in W. J. McNeil and D. C. Himsworth, editors. Salmonid ecosystems of the North Pacific. Oregon State University Press, Corvallis. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=35718>

Reviews existing research on interactions between marine mammals and North Pacific salmonid stocks. Examines interactions within marine contexts as well as migration periods.

Fryer, J. K. 1998. Frequency of pinniped-caused scars and wounds on adult spring–summer Chinook and sockeye salmon returning to the Columbia River. *North American Journal of Fisheries Management* 18(1):46-51. [https://doi.org/10.1577/1548-8675\(1998\)018%3C0046:FOPCSA%3E2.0.CO;2](https://doi.org/10.1577/1548-8675(1998)018%3C0046:FOPCSA%3E2.0.CO;2)

Reports on the increase in the percentage of adult Pacific salmon with abrasions caused by pinnipeds at Bonneville dam, from 2.8% in 1991 to 25.9% in 1996 for sockeye and from 10.5% in 1991 to 31.8% in 1994 for spring-summer Chinook.

Harmon, J. R., K. L. Thomas, K. W. McIntyre, N. N. Paasch. 1994. Prevalence of marine-mammal tooth and claw abrasions on adult anadromous salmonids returning to the Snake River. *North American Journal of Fisheries Management* 14(3):661-663. [https://doi.org/10.1577/1548-8675\(1994\)014%3C0661:POMMTA%3E2.3.CO;2](https://doi.org/10.1577/1548-8675(1994)014%3C0661:POMMTA%3E2.3.CO;2)

Reports on the percentage of adult salmonids with abrasions caused by pinnipeds returning to the Snake River. Notes between 14 and 19.2% for spring-summer Chinook salmon and between 5.4 and 14.2% for steelhead.

Jeffries, S. 1984. Marine mammals of the Columbia River estuary: final report on the marine mammals work unit of the Columbia River Estuary Data Development Program. Columbia River Estuary Data Development Program. https://www.estuarypartnership.org/sites/default/files/resource_files/17%20-%20MARINE%20MAMMALS%20OF%20THE%20COLUMBIA%20RIVER%20ESTUARY.pdf

Reports on observed marine mammals in the Columbia River Estuary, primarily harbor seals, California sea lions and northern/Steller sea lions. Discusses dispersal, feeding habits, and abundance of marine mammals within the estuary. Lists anchovies, eulachon, salmonids, and lampreys as frequent prey fish for pinnipeds.

Keefer, M. L., R. J. Stansell, S. C. Tackley, W. T. Nagy, K. M. Gibbons, C. A. Peery, and C. C. Caudill. 2012. Use of radiotelemetry and direct observations to evaluate sea lion predation on adult Pacific salmonids at Bonneville Dam. *Transactions of the American Fisheries Society* 141(5):1236–1251. <https://doi.org/10.1080/00028487.2012.688918>

Studies the increasing aggregation of California and Steller sea lions at Bonneville Dam from 2002 through 2010. Notes the principal prey species for sea lions were resident white sturgeon and migratory steelhead, though this shifted to predominantly Chinook during the spring run.

Laake, J. L., P. Browne, R. L. DeLong, and H. R. Huber. 2002. Pinniped diet composition: a comparison of estimation models. *Fisheries Bulletin* 100:434-447. <http://hdl.handle.net/1834/31076>

Develops and presents a model that estimates diet composition by reconstructing prey biomass from fecal samples. Model is applied to harbor seal samples collected in the lower Columbia River.

National Marine Fisheries Service West Coast Region. 1997. Reducing predation impacts on at-risk fish by California and Steller sea lions in the Columbia River basin: environmental assessment. National Marine Fisheries Service West Coast Region, Portland, Oregon. https://repository.library.noaa.gov/view/noaa/29019/noaa_29019_DS1.pdf

Reports on the distribution and abundance of pinnipeds in the Columbia River and interactions between pinnipeds and sport and commercial fisheries. Reviews mitigation efforts reducing pinniped predation on salmonids and interactions with fisheries.

Naughton, G. P., M. L. Keefer, T. S. Clabough, M. A. Jepson, S. R. Lee, C. A. Peery, and C. C. Caudill. 2011. Influence of pinniped-caused injuries on the survival of adult Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*) in the Columbia River Basin. Canadian Journal of Fisheries and Aquatic Sciences 68(9):1615–1624. <https://doi.org/10.1139/f2011-064>

Conducts radiotelemetry to evaluate pinniped-caused injury effects on migration survival of Columbia River Chinook salmon and steelhead. Finds injury was not consistently associated with adult survival to spawning tributaries, but some negative survival effects were detected.

Oregon Department of Fish and Wildlife. 2014-Present. Willamette Falls pinniped monitoring project. Oregon Department of Fish and Wildlife. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=40408>

Reports on monitoring of pinnipeds at Willamette falls downstream to the mouth of the Clackamas River, monitoring the abundance of the predators and accounting the fish species consumed by the pinnipeds.

Oregon Department of Fish and Wildlife. 2017. Population viability of Willamette River winter steelhead: an assessment of the effect of sea lions at Willamette Falls. Oregon Department of Fish and Wildlife. <https://digital.osl.state.or.us/islandora/object/osl:91958>

Population viability analysis for Willamette River winter steelhead, finds a strong negative effect on the viability of steelhead associated with sea lion presence at Willamette Falls.

Oregon Department of Fish and Wildlife. 2018-2022. Annual report: pinniped management at Willamette Falls. Oregon Department of Fish and Wildlife. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=40998>

Reports on management efforts to control sea lion populations at Willamette Falls, including removals, trapping, and conducting dietary analysis on euthanized sea lions.

Park, D. L. 1993. Effects of marine mammals on Columbia River salmon listed under the Endangered Species Act. Report to Bonneville Power Administration, Project 93-013, Portland, Oregon. <https://doi.org/10.2172/10180004>

Reviews the status of harbor seals and sea lions in the Columbia River, and assesses the potential toll of predation by these pinnipeds on migrating salmon.

Riemer, S. D., and R. F. Brown. 1996. Pinniped food habits in Oregon. Oregon Department of Fish and Wildlife, Portland. https://ir.library.oregonstate.edu/concern/technical_reports/xs55mk409

Reports on the food habits of pinnipeds throughout Oregon based on scat collections from Cascade Head, Rogue Reef, Orford Reef, and in the Columbia, Rogue, Siletz, Umpqua, and Alsea rivers.

Rub, A. M. W., and B. P. Sandford. 2020. Evidence of a 'dinner bell' effect from acoustic transmitters in adult Chinook Salmon. Marine Ecology Progress Series 641:1–11. <https://doi.org/10.3354/meps13323>

Presents information examining the 'dinner bell' hypothesis, which posits that marine mammals hear or otherwise sense soundwaves produced by acoustic transmitters and use the signal to selectively prey on fish carrying them.

Rub, A. M. W., N. A. Som, M. J. Henderson, B. P. Sandford, D. M. Van Doornik, D. J. Teel, M. J. Tennis, O. P. Langness, B. K. van der Leeuw, and D. D. Huff. 2019. Changes in adult Chinook salmon (*Oncorhynchus tshawytscha*) survival within the lower Columbia River amid increasing pinniped abundance. Canadian Journal of Fisheries and Aquatic Sciences 76(10):1862-1873. <https://doi.org/10.1139/cjfas-2018-0290>

Examines the odds of survival for adult Chinook salmon, estimates a decrease of 32% for every additional 467 sea lions present within the Columbia River and to increase by 32% for every increase of 1.5 in the log of American shad, an alternate prey fish.

Scordino, J. J. 2010. West Coast pinniped program investigations on California sea lion and Pacific harbor seal impacts on salmonids and other fishery resources. Pacific States Marine Fisheries Commission. https://www.psmfc.org/wp-content/uploads/2012/01/expand_pinniped_report_2010.pdf

Reports on the results of the West Coast Pinniped Program, which assessed the growth and status of California sea lion and Pacific harbor seal populations, and pinniped interactions with commercial and recreational fisheries.

Sorel, M. H., R. W. Zabel, D. S. Johnson, A. M. Wargo Rub, and S. J. Converse. 2020. Estimating population-specific predation effects on Chinook salmon via data integration. *Journal of Applied Ecology* 58(2):372–381. <https://doi.org/10.1111/1365-2664.13772>

Quantifies mortality associated with increasing sea lion abundance, by examining the effect of seasonal sea lion abundance on adult Chinook salmon survival during migrations through the Lower Columbia River.

Tidwell, K. S., B. A. Carrothers, D. T. Blumstein, and Z. A. Schakner. 2021. Steller sea lion (*Eumetopias jubatus*) response to non-lethal hazing at Bonneville Dam. *Frontiers in Conservation Science* 2: 760866. <https://doi.org/10.3389/fcosc.2021.760866>

Assesses the efficacy of hazing on steller sea lions at Bonneville Dam by observing the behavior of sea lions during spring Chinook passage seasons with and without hazing efforts taking place. During hazing, Steller sea lions were more likely to move away from hazers on the dam, decreased their foraging, and increased their time investigating the environment.

U.S. Army Corps of Engineers. 2002-Present. Evaluation of pinniped predation on adult salmonids and other fish in the Bonneville Dam tailrace. U.S. Army Corps of Engineers, Cascade Locks, Oregon. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=40398>

Reports on the monitoring program to assess the impact of pinniped predation on adult salmonids in the Bonneville Dam tailrace, reports typically cover two years of observations of pinniped activity.

Various agencies. 2008-Present. Field report: pinniped management activities at and below Bonneville Dam. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=40556>

Reports on pinniped control efforts in the lower Columbia River basin by a variety of agencies, including abundance and distribution monitoring, relocation, and nonlethal hazing.

Walker, D. E. 2015. Seals and sea lions in the Columbia River: an evaluation and summary of research. *Journal of Northwest Anthropology* 49(2):179-217. <https://www.critfc.org/wp-content/uploads/2016/03/WalkerCRITFCReport2015.pdf>

Analyzes historical and oral accounts of seals and sea lions within the Columbia River. Focuses on traditional tribal relationships with and uses of seals and sea lions.

Wright, B. E., S. D. Riemer, R. F. Brown, A. M. Ougzin, and K. A. Bucklin. 2007. Assessment of harbor seal predation on adult salmonids in a Pacific Northwest Estuary. *Ecological Applications* 17(2):338–351. <https://doi.org/10.1890/05-1941>

Utilizes survey sampling methodology, acoustic telemetry, and molecular genetics to quantify the amount of harbor seal predation on a depressed run of coho salmon in Oregon.

Wright, B. E., M. J. Tennis, and R. F. Brown. 2010. Movements of male California sea lions captured in the Columbia River. *Northwest Science* 84(1):60–72. <https://doi.org/10.3955/046.084.0107>

Compares movements of 14 male California sea lions known to have consumed salmonids at either Bonneville Dam or Willamette Falls with 12 animals of unknown foraging history. Found that the known animals did return to both sites, but none of the unknown sea lions exhibited this behavior.

Piscivory

Anderson, J. J., E. Gurarie, and R. W. Zabel. 2005. Mean free-path length theory of predator–prey interactions: application to juvenile salmon migration. *Ecological Modelling* 186(2):196-211. <https://doi.org/10.1016/j.ecolmodel.2005.01.014>

Expands traditional predator–prey models by incorporating directed and random movements of both predators and prey. Applies the model to juvenile salmon migrating through a field of piscivores and finds that traditional predator–prey models were not adequate to describe observations.

Arakawa, H., and R. T. Lampman. 2020. An experimental study to evaluate predation threats on two native larval lampreys in the Columbia River Basin, USA. *Ecology of Freshwater Fish* 29(4):611–622. <https://doi.org/10.1111/eff.12537>

Assesses predation of Pacific lamprey and western brook lamprey larvae by northern pikeminnow, smallmouth bass, white sturgeon and common carp. Finds that most predatory fish are more likely to consume larval lamprey in conditions where sediment is not present.

Arakawa, H., R. T. Lampman, and J. E. Hess. 2021. Whose kids did you eat? genetic identification of species and parents of larval lampreys in fish predator guts. *Transactions of the American Fisheries Society* 150(5):551–559. <https://doi.org/10.1002/tafs.10307>

Experimental predation study and analysis of larval Pacific lampreys in the gut contents of predators' digestive tracts via both morphological and molecular methods to test underestimation of larval lamprey consumption.

Baldwin, C. M., J. G. McLellan, M. C. Polacek, and K. Underwood. 2003. Walleye predation on hatchery releases of kokanees and rainbow trout in Lake Roosevelt, Washington. *North American Journal of Fisheries Management* 23(3):660-676. <https://doi.org/10.1577/M02-021>

Evaluates the predatory impacts of piscivores on hatchery-released and net-pen-released kokanees and rainbow trout. Notes that predatory fish may effectively be “swamped” by large hatchery releases but can still limit recruitment depending on long term predation rates.

Beals, T., and R. Lampman. 2020. Removal and monitoring of predator fishes by hook-and-line angling in the Chandler Canal (Prosser, WA) upstream of the fish bypass. Report to Bonneville Power Administration, Project 2008-470-00. <https://www.cbfish.org/Document.mvc/Viewer/P176738>

Reports on angling efforts to control predatory fish populations in the Chandler Canal which diverts water for irrigation and power production from Prosser Dam on the Yakima River from May through July 2019. Removed 96 fish from four species: smallmouth bass, channel catfish, black crappie, and northern pikeminnows.

Beamesderfer, R. C., and B. E. Rieman. 1991. Abundance and distribution of northern squawfish, walleyes, and smallmouth bass in John Day Reservoir, Columbia River. *Transactions of the American Fisheries Society* 120(4):439-447. [https://doi.org/10.1577/1548-8659\(1991\)120%3C0439:AADONS%3E2.3.CO;2](https://doi.org/10.1577/1548-8659(1991)120%3C0439:AADONS%3E2.3.CO;2)

Utilizes mark-recapture and catch-per-unit effort data to estimate abundances and distributions of northern pikeminnow, walleyes, and smallmouth bass in John Day Reservoir.

Beamesderfer, R. C., B. E. Rieman, L. J. Bledsoe, and S. Vigg. 1990. Management implications of a model of predation by a resident fish on juvenile salmonids migrating through a Columbia River Reservoir. *North American Journal of Fisheries Management* 10(3):290-304. [https://doi.org/10.1577/1548-8675\(1990\)010%3C0290:MIOAMO%3E2.3.CO;2](https://doi.org/10.1577/1548-8675(1990)010%3C0290:MIOAMO%3E2.3.CO;2)

Presents a model of predation by northern pikeminnow on juvenile salmonids migrating through John Day Reservoir. Model shows that survival of salmonids is weakly affected by changes in predator distribution, changes in predator consumption rate near the upstream dam, residence time or flow.

Beamesderfer, R. C., D. L. Ward, and A. A. Nigro. 1996. Evaluation of the biological basis for a predator control program on northern squawfish (*Ptychocheilus oregonensis*) in the Columbia and Snake rivers. *Canadian Journal of Fisheries and Aquatic Sciences* 53(12):2898–2908.
<https://doi.org/10.1139/f96-225>

Reviews the removal of northern pikeminnow from the Columbia and Snake Rivers during the 90s. Proposes that the numbers of northern pikeminnow can be significantly reduced by exploitation rates of 10-20%, easing predation on salmonids.

Bennett, D. H., and G. P. Naughton 1999. Predator abundance and salmonid prey consumption in the tailrace and forebay of Lower Granite Dam. Completion Report to U.S. Army Corps of Engineers, Walla Walla, Washington. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=32905>

Compares relative and absolute abundance and consumption rates of juvenile salmonids by smallmouth bass and northern pikeminnow in the tailrace and forebay of Lower Granite dam, and the Snake and Clearwater River arms of the upper reservoir.

Bottom, D. L., and K. K. Jones. 1990. Species composition, distribution, and invertebrate prey of fish assemblages in the Columbia River Estuary. *Progress in Oceanography* 25(1–4):243–270.
[https://doi.org/10.1016/0079-6611\(90\)90009-Q](https://doi.org/10.1016/0079-6611(90)90009-Q)

Assesses the composition of the fish community in the Columbia River Estuary during 1980-1981, examines the abundance and stomach fullness of fishes throughout the estuary to assess the prey availability and predator efficiency.

Buchanan, D. V., R. M. Hooton, and J. R. Moring. 1981. Northern squawfish (*Ptychocheilus oregonensis*) predation on juvenile salmonids in sections of the Willamette River Basin, Oregon. *Canadian Journal of Fisheries and Aquatic Sciences* 38(3):360–364. <https://doi.org/10.1139/f81-047>

Assesses instances of predation of juvenile salmonids by northern pikeminnow in the Willamette River Basin, Oregon. Finds that although 59% of the pikeminnow collected contained food in their stomachs, only 2% contained salmonids.

Burley, C. C., and T. P. Poe. 1994. Significance of predation in the Columbia River from Priest Rapids Dam to Chief Joseph Dam. Report to Chelan, Douglas and Grant County Public Utility Districts. <https://catalog.cbflw.org/cgi-bin/koha/opac-detail.pl?biblionumber=3349>

Assesses the impact of predation by native and introduced species on juvenile salmonids migrating through the Columbia River from Priest Rapids to Chief Joseph dams.

Carey, M. P., B. L. Sanderson, T. A. Friesen, K. A. Barnas, and J. D. Olden. 2011. Smallmouth bass in the Pacific Northwest: A threat to native species; a benefit for anglers. *Reviews in Fisheries Science* 19(3):305–315. <https://doi.org/10.1080/10641262.2011.598584>

Reviews the state of information on smallmouth bass in the Pacific Northwest, discusses potential impacts on native species, especially salmonids, and outlines gaps in current research, also discusses management approaches.

Collis, K., R. E. Beaty, and B. R. Crain. 1995. Changes in catch rate and diet of northern squawfish associated with the release of hatchery-reared juvenile salmonids in a Columbia River reservoir. *North American Journal of Fisheries Management* 15(2):346-357. [https://doi.org/10.1577/1548-8675\(1995\)015%3C0346:CICRAD%3E2.3.CO;2](https://doi.org/10.1577/1548-8675(1995)015%3C0346:CICRAD%3E2.3.CO;2)

Investigated the distribution and predation activities of northern pikeminnow at three locations where hatchery-reared juvenile salmonids were released in Bonneville Pool. Significant increases in pikeminnow catch rates were found at all locations.

Counihan, T. D., J. M. Hardiman, D. S. Burgess, K. E. Simmons, G. Holmberg, J. A. Rogala, and R. R. Polacek. 2012. Assessing native and introduced fish predation on migrating juvenile salmon in Priest Rapids and Wanapum Reservoirs, Columbia River, Washington, 2009–11. U.S. Geological Survey Open-File Report 2012-1130. <https://pubs.usgs.gov/of/2012/1130/pdf/ofr20121130.pdf>

Analyzes the diets of northern pikeminnow, smallmouth bass, and walleye from the tailrace of Rock Island Dam downstream to the tailrace of Priest Rapids Dam in 2009 and 2010 to assess the impact of their predation on juvenile salmonids.

Emmett, R. L., and G. K. Krutzikowsky. 2008. Nocturnal feeding of Pacific hake and jack mackerel off the mouth of the Columbia River, 1998-2004: implications for juvenile salmon predation. *Transactions of the American Fisheries Society* 137(3):657-676. <https://doi.org/10.1577/T06-058.1>

Examines the diets of Pacific hake and jack mackerel off the mouth of the Columbia River. Finds that while both Pacific hake and jack mackerel ate juvenile salmonids, it was at very low amounts.

Emmett, R. L., G. K. Krutzikowsky, and P. Bentley. 2006. Abundance and distribution of pelagic piscivorous fishes in the Columbia River Plume during Spring/early summer 1998–2003: Relationship to oceanographic conditions, forage fishes, and juvenile salmonids. *Progress in Oceanography* 68(1):1–26. <https://doi.org/10.1016/j.pocean.2005.08.001>

Reports on observed shifts in the abundance and temporo-spatial distribution of predatory fish in the Columbia River Plume from 1998-2003. Also examines changes in forage fish and salmonid distribution in relation to ocean conditions.

Emmett, R. L., and D. B. Sampson. 2007. The relationships between predatory fish, forage fishes, and juvenile salmonid marine survival off the Columbia River: a simple trophic model analysis. *Reports of California Cooperative Oceanic Fisheries Investigations* 48:92-105. <https://ir.library.oregonstate.edu/concern/defaults/qb98mg08n>

Presents a trophic model simulating interactions between predatory fish, forage fish, and juvenile Pacific salmon off the Columbia River to assess if predation by fish can account for marine mortality of juvenile salmon.

Erhardt J. M., and K. F. Tiffan. 2018. Post-release predation mortality of age-0 hatchery-reared Chinook salmon from non-native smallmouth bass in the Snake River. *Fisheries Management and Ecology* 25(6):474-487. <https://doi.org/10.1111/fme.12322>

Reports on post-release predation of age-0 Chinook salmon by smallmouth bass in the Snake River. Noted an immediate 30-fold increase in salmon consumption, though this decreased to pre-release levels within 1-2 days.

Erhardt, J. M., K. F. Tiffan, and W. P. Connor. 2018. Juvenile Chinook salmon mortality in a snake river reservoir: Smallmouth bass predation revisited. *Transactions of the American Fisheries Society* 147(2):316–328. <https://doi.org/10.1002/tafs.10026>

Examines the diet composition of Smallmouth Bass and estimates the consumption and predation loss of juvenile Chinook salmon in Lower Granite Reservoir on the Snake River.

Faler, M. P., L. M. Miller, and K. I. Welke. 1988. Effects of variation in flow on distributions of northern squawfish in the Columbia River below McNary Dam. *North American Journal of Fisheries Management* 8(1):30-35. [https://doi.org/10.1577/1548-8675\(1988\)008<0030:EOVIFO>2.3.CO;2](https://doi.org/10.1577/1548-8675(1988)008<0030:EOVIFO>2.3.CO;2)

Reports on the movements of 23 northern pikeminnow below a dam during the migration of juvenile salmonids in 1984 and 1985. Northern pikeminnow remained in protected shoreline

areas in spring and early summer, when discharge rates were high, but moved close to the dam and the juvenile bypass outflow area in mid to late summer, when discharge rates were low.

Friesen, T. A. and D. L. Ward. 1999. Management of northern pikeminnow and implications for juvenile salmonid survival in the lower Columbia and Snake Rivers. *North American Journal of Fisheries Management* 19(2):406-420. [https://doi.org/10.1577/1548-8675\(1999\)019<0406:MONPAI>2.0.CO;2](https://doi.org/10.1577/1548-8675(1999)019<0406:MONPAI>2.0.CO;2)

Reviews the efficacy of management programs on the Columbia and Snake River to lower numbers of northern pikeminnow. Finds that sport-reward, dam-angling, and gill-net fisheries were able to increase exploitation of pikeminnow and this coincided with a decrease on predation on salmonids.

Fritts, A. L., and T. N. Pearsons. 2004. Smallmouth bass predation on hatchery and wild salmonids in the Yakima River, Washington. *Transactions of the American Fisheries Society* 133(4):880–895. <https://doi.org/10.1577/T03-003.1>

Assesses predation on hatchery and wild salmonids by nonnative smallmouth bass in the Lower Yakima River from 1998-2001. Increased abundance of smallmouth bass was noted during spring, and salmonids were identified in the guts of smallmouth bass throughout the year but were most prevalent in May.

Fritts, A. L., and T. N. Pearsons. 2006. Effects of predation by nonnative smallmouth bass on native salmonid prey: the role of predator and prey size. *Transactions of the American Fisheries Society* 135(4):853–860. <https://doi.org/10.1577/T05-014.1>

Assesses the role of predator and prey fish size in predation of Chinook salmon by smallmouth bass in the lower Yakima River, finds salmonids risk of predation generally decreased with increasing predator and prey size.

Fritts, A. L., and T. N. Pearsons. 2008. Can non-native smallmouth bass, *Micropterus Dolomieu*, be swamped by hatchery fish releases to increase juvenile Chinook salmon, *Oncorhynchus tshawytscha*, survival? *Environmental Biology of Fishes* 83(4):485–494. <https://doi.org/10.1007/s10641-008-9375-1>

Examines whether releasing more Chinook salmon than a population of smallmouth bass would be able to eat could serve as an effective strategy by calculating the maximum bioenergetic consumption potential of non-native smallmouth bass in the Yakima River through 1998-2002 and comparing this with estimates of Chinook salmon consumption.

Furey, N. B., S. G. Hinch, M. G. Mesa, and D. A. Beauchamp. 2016. Piscivorous fish exhibit temperature-influenced binge feeding during an annual prey pulse. *Journal of Animal Ecology* 85(5):1307–1317. <https://doi.org/10.1111/1365-2656.12565>

Assesses how temperature, body size and food availability influence the degree of binge-feeding by comparing field observations with laboratory experiments of bull trout. Also simulates bull trout consumption and growth during salmon smolt out-migrations.

Gadomski, D. M., and M. J. Parsley. 2004. Laboratory studies on the vulnerability of young white sturgeon to predation. *North American Journal of Fisheries Management* 25(2):667–674. <https://doi.org/10.1577/M03-220.1>

Laboratory study examining the vulnerability of older larvae and juvenile white sturgeon to predators. Finds that channel catfish and northern pikeminnow will eat white sturgeon at relatively larger sizes, while walleyes and sculpins will opportunistically eat smaller larvae and juveniles.

Gadomski, D. M., and M. J. Parsley. 2005a. Effects of turbidity, light level, and cover on predation of white sturgeon larvae by prickly sculpins. *Transactions of the American Fisheries Society* 134(2):369–374. <https://doi.org/10.1577/T03-213.1>

Investigates predation at various turbidity levels and finds that significantly more white sturgeon yolk sac larvae were eaten at lower turbidity levels. Also examines the role of light level and the presence or absence of rock cover.

Gadomski, D. M., and M. J. Parsley. 2005. Vulnerability of young white sturgeon, *Acipenser transmontanus*, to predation in the presence of alternative prey. *Environmental Biology of Fishes* 74(3–4):389–396. <https://doi.org/10.1007/s10641-005-3038-2>

Laboratory trials examining predator preferences for white sturgeon when compared to other potential prey species by prickly sculpins and northern pikeminnows.

Griffiths, F. P. 1940. Considerations of the introduction and distribution of exotic fishes in Oregon. *Transactions of the American Fisheries Society* 69(1):240-243. [https://doi.org/10.1577/1548-8659\(1939\)69\[240:COTIAD\]2.0.CO;2](https://doi.org/10.1577/1548-8659(1939)69[240:COTIAD]2.0.CO;2)

Reviews some instances of fish introductions in Oregon, highlighting the introduction of eastern brook trout, as well as the introduction of predatory fish and their potential impacts on the survival of juvenile salmon.

Hardiman, J. M., T. D. Counihan, D. S. Burgess, K. E. Simmons, G. Holmberg, J. A. Rogala, J.A., and R. R. Polacek. 2012. Assessing fish predation on migrating juvenile steelhead and a retrospective comparison to steelhead survival through the Priest Rapids Hydroelectric Project, Columbia River, Washington, 2009-11. U.S. Geological Survey Open-File Report 2012-1129. <https://doi.org/10.3133/ofr20121129>

Studies predator-prey interactions at Priest Rapids Hydroelectric Project in order to assess the impacts of predation on juvenile steelhead and produce standardized predation indices for waters near the Wanapum and Priest Rapids dams.

Harvey, C. J., and P. M. Kareiva. 2005. Community context and the influence of non-indigenous species on juvenile salmon survival in a Columbia River reservoir. *Biological Invasions* 7(4):651–663. <https://doi.org/10.1007/s10530-004-5854-2>

Uses food web models, parameterized with data from field studies, to ask how reducing the number of non-indigenous species co-occurring with endangered salmon would affect salmon mortality.

Harvey, S. J. 2011. Diet, growth and bioenergetics of Northern Pike (*Esox lucius Linnaeus, 1758*) in Box Canyon Reservoir, Pend Oreille River, Washington. Master's thesis. Eastern Washington University, Cheney. <https://dc.ewu.edu/theses/6/>

Describes the food habits of northern pike and using bioenergetics modeling assess the mass and total numbers of each species of forage fish the northern pike population consumed in Box Canyon Reservoir, Pend Orielle River.

Hatch, K., J. McCormack, and R. E. Beaty. 1998. Site-specific gillnetting for Northern pikeminnow concentrated to feed on hatchery-released juvenile salmonids in the lower Columbia River in 1997. Columbia River Inter-Tribal Fish Commission, Portland, Oregon. <https://catalog.cbfiwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=17949>

Reports on gillnetting efforts for northern pikeminnow along the lower Columbia River in spring and summer of 1997.

Hemingway, R. J., K. F. Tiffan, J. M Erhardt, T. N. Rhodes, and B. K. Bickford. 2019 Fall Chinook salmon (*Oncorhynchus tshawytscha*), sand roller (*Percopsis transmontana*), and smallmouth bass (*Micropterus dolomieu*) interactions in a Snake River reservoir: a tale of three species. *Northwestern Naturalist* 100(1):26-36. <https://doi.org/10.1898/NWN18-13>

Assesses whether endemic sand rollers negatively affect fall Chinook salmon by potentially competing with them for resources in shoreline habitats or, benefit the salmon by providing a buffer against smallmouth bass predation.

Hughes, R. M., and A. T. Herlihy. 2012. Patterns in catch per unit effort of native prey fish and alien piscivorous fish in 7 Pacific Northwest USA rivers. *Fisheries* 37(5):201–211. <https://doi.org/10.1080/03632415.2012.676833>

Evaluates the effect of alien piscivorous fish on native prey species in seven Pacific Northwest rivers. Concludes that piscivorous alien fish are associated with reduced population sizes of native prey species, at least during the summer low-flow period.

Isaak, D. J., and T. C. Bjornn. 1996. Movement of northern squawfish in the tailrace of a lower Snake River dam relative to the migration of juvenile anadromous salmonids. *Transactions of the American Fisheries Society* 125(5):780-793. [https://doi.org/10.1577/1548-8659\(1996\)125<0780:MONSIT>2.3.CO;2](https://doi.org/10.1577/1548-8659(1996)125<0780:MONSIT>2.3.CO;2)

Monitors the movements of northern pikeminnow in the tailrace of Lower Granite Dam during the 1992 and 1993 seasonal migrations of juvenile salmonids.

Lawrence, D. J., J. D. Olden, and C. E. Torgersen. 2012. Spatiotemporal patterns and habitat associations of smallmouth bass (*Micropterus dolomieu*) invading salmon-rearing habitat. *Freshwater Biology* 57(9):1929–1946. <https://doi.org/10.1111/j.1365-2427.2012.02847.x>

Examines the range and overlap of smallmouth bass with Chinook salmon in the North Fork John Day River.

Lawrence, D. J., B. Stewart-Koster, J. D. Olden, A. S. Ruesch, C. E. Torgersen, J. J. Lawler, D. P. Butcher, and J. K. Crown. 2014. The interactive effects of climate change, riparian management, and a nonnative predator on stream-rearing salmon. *Ecological Applications* 24(4):895–912. <https://doi.org/10.1890/13-0753.1>

Utilizes global climate forecasts with a local-scale water temperature model to predict mid- and end-of-century temperatures in streams in the Columbia River basin and predicts the distribution of Chinook salmon and bass would change as modeled streams warmed.

Maule, A. G., and H. F. Horton. 1984. Feeding ecology of walleye, *Stizostedion vitreum vitreum*, in the mid-Columbia River, with emphasis on the interactions between walleye and juvenile

anadromous fishes. Fishery Bulletin 82(2):411-418.

<https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/fish-bull/maule.pdf>

Studies the spring and summer feeding ecology of walleye in the John Day pool with emphasis on walleye interactions with juvenile salmonids and American shad.

McMahon, T. E., and D. H. Bennett. 1996. Walleye and northern pike: boost or bane to northwest fisheries? Fisheries Magazine 21(8):6-13. [https://doi.org/10.1577/1548-8446\(1996\)021%3C0006:WANP%3E2.0.CO;2](https://doi.org/10.1577/1548-8446(1996)021%3C0006:WANP%3E2.0.CO;2)

Reviews the introduction of walleye and northern pike into northwest fisheries. Discusses their impacts, and both legal and illegal introductions, as well as long-term risks associated with these introductions.

Mesa, M. G. 1994. Effects of multiple acute stressors on the predator avoidance ability and physiology of juvenile Chinook salmon. Transactions of the American Fisheries Society 123(5):786-793. [https://doi.org/10.1577/1548-8659\(1994\)123<0786:EOMASO>2.3.CO;2](https://doi.org/10.1577/1548-8659(1994)123<0786:EOMASO>2.3.CO;2)

Results of laboratory experiments to examine the predator avoidance ability and physiological stress responses of juvenile Chinook salmon subjected to stressors designed to simulate routine hatchery practices or dam passage.

Moser, M. L., A. D. Jackson, M. C. Lucas, and R. P. Mueller. 2014. Behavior and potential threats to survival of migrating lamprey ammocoetes and macrophthalmia. Reviews in Fish Biology and Fisheries 25(1):103–116. <https://doi.org/10.1007/s11160-014-9372-8>

Reviews risks to lamprey larvae during downstream movement, while not exclusively focused on predation, conditions which lead to higher predation risks are discussed.

Muir, W. D., D. M. Marsh, B. P. Sandford, S. G. Smith, and J. G. Williams. 2006. Post-hydropower system delayed mortality of transported Snake River stream-type Chinook salmon: unraveling the mystery. Transactions of the American Fisheries Society 135(6):1523-1534. <https://doi.org/10.1577/T06-049.1>

Compares post-hydropower system mortality for transported and in-river passing Chinook salmon between Lower Granite and Bonneville dams. Finds greater post-hydropower system mortality for smolts transported early in the season but greater mortality for in-river migrating smolts later in the season.

Muhlfeld, C. C., D. H. Bennett, R. K. Steinhorst, B. Marotz, and M. Boyer. 2008. Using bioenergetics modeling to estimate consumption of native juvenile salmonids by nonnative northern pike in the upper Flathead River System, Montana. *North American Journal of Fisheries Management* 28(3):636-648. <https://doi.org/10.1577/M07-004.1>

Estimates the abundance of nonnative northern pike and applies food habits data to estimate their annual consumption of native bull trout and Westslope cutthroat trout juveniles in the upper Flathead River system, Montana.

Murphy, C. A., J. D. Romer, K. Stertz, I. Arismendi, R. Emig, F. Monzyk, and S. L. Johnson. 2021. Damming salmon fry: evidence for predation by non-native warmwater fishes in reservoirs. *Ecosphere* 12(9):e03757. <https://doi.org/10.1002/ecs2.3757>

Attempts to identify predators of Chinook salmon fry as they enter reservoirs below their spawning grounds in the Middle Fork Willamette River, Oregon. Finds that that non-native warmwater game fishes, including bass and crappie., preyed more heavily on Chinook Salmon fry in the spring than native fish predators including northern pikeminnow.

Naughton, G. P., D. H. Bennett, and K. B. Newman. 2004. Predation on juvenile salmonids by smallmouth bass in the Lower Granite reservoir system, Snake River. *North American Journal of Fisheries Management* 24(2):534–544. <https://doi.org/10.1577/M02-177.1>

Estimates the consumption of juvenile salmon and steelhead by smallmouth bass in the tailrace and forebay of the Lower Granite Dam and compared this consumption with that in the two major river arms of the upper Lower Granite Reservoir, Snake River.

Nigro, A. A. 1990. Developing a predation index and evaluating ways to reduce salmonid losses to predation in the Columbia River basin. Oregon Department of Fish and Wildlife, Portland, Oregon.
<https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=42af2bd1c8393a4603d59991a3e0651f8667265f>

Develops an index to estimate predation losses of juvenile salmonids in reservoirs throughout the Columbia River, describes the relationships among predator-caused mortality of juvenile salmonids and physical and biological variables, examine the feasibility of developing bounty, commercial or recreational fisheries on northern pikeminnow.

Pacific States Marine Fisheries Commission, Oregon Department of Fish and Wildlife, and Washington Department of Fish and Wildlife. 2007-2019. Report on the predation index, predator control fisheries, and program evaluation for the Columbia River basin Experimental Northern Pikeminnow Management Program. Report to Bonneville Power Administration, Project 1990-

077-00, Portland, Oregon. <https://catalog.cbowl.org/cgi-bin/koha/opac-detail.pl?biblionumber=47385>

Annual reports on management initiatives to control predation of Pacific salmonids by northern pikeminnow in the Columbia River Basin.

Petersen, J. H. 1994. Importance of spatial pattern in estimating predation on juvenile salmonids in the Columbia River. *Transactions of the American Fisheries Society* 123(6):924-930.
[https://doi.org/10.1577/1548-8659\(1994\)123<0924:IOSPIE>2.3.CO;2](https://doi.org/10.1577/1548-8659(1994)123<0924:IOSPIE>2.3.CO;2)

Presents findings that predation rate and predator density vary greatly between near-dam and mid-reservoir areas, suggesting that reservoirs in the Columbia River should be divided into at least three or four areas for estimating salmonid losses.

Petersen, J. H. 2001. Density, aggregation, and body size of northern pikeminnow preying on juvenile salmonids in a large river. *Journal of Fish Biology* 58(4):1137-1148.
<https://doi.org/10.1111/j.1095-8649.2001.tb00561.x>

Assesses the roles of density, aggregation and body size of northern pikeminnow on predation of juvenile salmonids. Finds larger predators are more likely to consume salmonids, and that spatial and temporal patchiness of salmonid prey may be generating differences in local density, aggregation, and body size of their predators.

Petersen, J. H. 2002. Compensatory feeding following a predator removal program: detection and mechanisms. Report to Bonneville Power Administration, Project 1990-078-00, Portland, Oregon. <https://www.cbfish.org/Document.mvc/Viewer/00003395-1>

Examines field data and potential mechanisms of compensatory feeding that might be occurring within the northern pikeminnow populations within the Columbia and Snake River basins prior to and after removal efforts.

Petersen, J. H., and D. L. DeAngelis. 1992. Functional response and capture timing in an individual-based model: predation by northern squawfish (*Ptychocheilus oregonensis*) on juvenile salmonids in the Columbia River. *Canadian Journal of Fisheries and Aquatic Sciences* 49(12):2551–2565.
<https://doi.org/10.1139/f92-282>

Models the behavior of individual northern pikeminnow preying on juvenile salmonids to address questions about capture rate and the timing of prey captures.

Petersen, J. H., and D. L. DeAngelis. 2000. Dynamics of prey moving through a predator field: a model of migrating juvenile salmon. *Mathematical Biosciences* 165(2):97–114. [https://doi.org/10.1016/S0025-5564\(00\)00017-1](https://doi.org/10.1016/S0025-5564(00)00017-1)

Presents a model for prey traveling through a relatively stationary area of predators based on interactions between salmonids and northern pikeminnow.

Petersen, J. H., D. M. Gadomski, and T. P. Poe. 1994. Differential predation by northern squawfish (*Ptychocheilus oregonensis*) on live and dead juvenile salmonids in the Bonneville Dam tailrace (Columbia River). *Canadian Journal of Fisheries and Aquatic Sciences* 51(5):1197-1204. <https://doi.org/10.1139/f94-119>

Assesses northern pikeminnow predation of juvenile salmonids by comparing predation rates of living and dead juvenile salmonids. Finds higher rates of dead salmon in releases leads to northern pikeminnow consuming a higher rate of dead salmon.

Petersen, J. H., and J. F. Kitchell. 2001. Climate regimes and water temperature changes in the Columbia River: bioenergetic implications for predators of juvenile Salmon. *Canadian Journal of Fisheries and Aquatic Sciences* 58(9):1831–1841. <https://doi.org/10.1139/f01-111>

Examines how climatic regime shifts may have affected predation rates on juvenile Pacific salmonids by northern pikeminnow, smallmouth bass, and walleye in the Columbia River.

Petersen, J. H., and D. L. Ward. 1999. Development and corroboration of a bioenergetics model for northern pikeminnow feeding on juvenile salmonids in the Columbia River. *Transactions of the American Fisheries Society* 128(5):784-801. [https://doi.org/10.1577/1548-8659\(1999\)128%3C0784:DACOAB%3E2.0.CO;2](https://doi.org/10.1577/1548-8659(1999)128%3C0784:DACOAB%3E2.0.CO;2)

Develops and corroborates a bioenergetics model for northern pikeminnow. Predictions of modeled predation rate on salmonids were compared with field data from three areas of John Day Reservoir.

Poe, T. P., H. C. Hansel, S. Vigg, D. E. Palmer, L. A. Prendergast. 1991. Feeding of predaceous fishes on out-migrating juvenile salmonids in John Day Reservoir, Columbia River. *Transactions of the American Fisheries Society* 120(4):405-420. [https://doi.org/10.1577/1548-8659\(1991\)120%3C0405:FOPFOO%3E2.3.CO;2](https://doi.org/10.1577/1548-8659(1991)120%3C0405:FOPFOO%3E2.3.CO;2)

Documents the diets of northern pikeminnow, smallmouth bass, walleye and channel catfish in John Day Reservoir to determine the extent of predation on juvenile salmonids during seaward migrations of the salmonids from 1983-1986.

Poe, T. P., and B. E. Rieman. 1988. Predation by resident fish on juvenile salmonids in John Day Reservoir, 1983-1986. Report to Bonneville Power Administration, Project 82-12, Portland, Oregon. <https://catalog.cbfiw.org/cgi-bin/koha/opac-detail.pl?biblionumber=37373>

Assesses the impact of predation on juvenile salmonids by channel catfish, smallmouth bass, walleye and northern pikeminnow in John Day River. Examines abundance, consumption rates, distribution, food habits and feeding activities.

Rieman, B. E., and R. C. Beamesderfer. 1990. Dynamics of a northern squawfish population and the Potential to reduce predation on juvenile salmonids in a Columbia River Reservoir. *North American Journal of Fisheries Management* 10(2):228-241. [https://doi.org/10.1577/1548-8675\(1990\)010%3C0228:DOANSP%3E2.3.CO;2](https://doi.org/10.1577/1548-8675(1990)010%3C0228:DOANSP%3E2.3.CO;2)

Utilizes simulation models to determine the potential influence of exploitation of northern pikeminnow on salmonid predation. Simulations were based on estimates of mortality, relative year-class strength, and growth made from a 4-year study of resident fish predators in John Day Reservoir.

Rieman, B. E., R. C. Beamesderfer, A. A. Nigro, S. Vigg, H. C. Hansel, and D. E. Palmer. 1986. Preliminary estimates of loss of juvenile anadromous salmonids to predators in John Day Reservoir and development of a predation model. Interim Report to Bonneville Power Administration, Projects 82-3 and 82-12, Portland, Oregon. https://docs.cbfiw.org/StreamNet_References/BPAsn29251.pdf

Estimates the loss of juvenile anadromous salmonids to walleye and northern pikeminnow in John Day Reservoir. Presents a model of predation based on predator number and consumption rate, models recruitment, exploitation, natural mortality and growth.

Rieman, B. E., R. C. Beamesderfer, S. Vigg, and T. P. Poe. 1991. Estimated loss of juvenile salmonids to predation by northern squawfish, walleyes, and smallmouth bass in John Day Reservoir, Columbia River. *Transactions of the American Fisheries Society* 120(4):448-458. [https://doi.org/10.1577/1548-8659\(1991\)120%3C0448:ELOJST%3E2.3.CO;2](https://doi.org/10.1577/1548-8659(1991)120%3C0448:ELOJST%3E2.3.CO;2)

Estimates the loss of juvenile salmonids to predation by northern pikeminnow, walleyes, and smallmouth bass in John Day Reservoir during 1983–1986.

Rose, B. P., G. S. Hansen, D. E. Ayers, and M. G. Mesa. 2013. Late summer and fall diet and condition of smallmouth bass, walleye, and channel catfish in the middle Columbia River, USA. Final Report

to Bonneville Power Administration, Project 2008-719-00. Portland, Oregon.
<https://www.cbfish.org/Document.mvc/Viewer/P136245>

Quantifies the late summer and autumn diets of smallmouth bass, walleye, and channel catfish in the three lowermost reservoirs on the Columbia River, to evaluate the extent of predation of American shad.

Rose, B. P., G. S. Hansen, and M. G. Mesa. 2010. Understanding the influence of predation by introduced fishes on juvenile salmonids in the Columbia River Basin: closing some knowledge gaps. Interim Report to Bonneville Power Administration, Project 2008-719-00. Portland, Oregon.
<https://www.cbfish.org/Document.mvc/Viewer/P126806>

Examines the role of American shad as substitute prey fish for introduced predators of salmonids and the contribution of American shad predation to predators' energy reserves, growth, and perhaps over-winter survival.

Rubenson, E. S. 2019. Life history, distribution, and impact of nonnative smallmouth bass (*Micropterus dolomieu*) at range boundaries in the Columbia River Basin. Doctoral dissertation. University of Washington, Seattle. <http://hdl.handle.net/1773/43690>

Addresses the mechanisms that drive or limit distribution changes of smallmouth bass, its current distributions in the Columbia River Basin, and the potential impacts expanding smallmouth bass may have on juvenile salmonids.

Rubenson, E. S., D. J. Lawrence, and J. D. Olden. 2020. Threats to rearing juvenile Chinook salmon from nonnative smallmouth bass inferred from stable isotope and fatty acid biomarkers. Transactions of the American Fisheries Society 149(3):350–363. <https://doi.org/10.1002/tafs.10237>

Assesses the trophic role of smallmouth bass in the upstream reaches of the North Fork John Day River using stable isotope and fatty acid data.

Rubenson, E. S., and J. D. Olden. 2020. An invader in salmonid rearing habitat: current and future distributions of smallmouth bass (*Micropterus dolomieu*) in the Columbia River Basin. Canadian Journal of Fisheries and Aquatic Sciences 77(2):314–325. <https://doi.org/10.1139/cjfas-2018-0357>

Develops range boundary regions of nonnative smallmouth bass and evaluate its overlap with native salmonids, as well as predicting increases in range of smallmouth bass with climate change.

Sampson, D. B. 2006. The relationships between fluctuations in oceanographic conditions, forage fishes, predatory fishes, predator food habits, and juvenile salmonid marine survival off the Columbia River. Doctoral dissertation. Oregon State University, Corvallis, Oregon.

https://ir.library.oregonstate.edu/concern/graduate_thesis_or_dissertations/6969z278t

Assesses the effect of predation on salmonids off the Columbia River during their marine stages of life by conducting stomach analysis of predatory fishes, primarily Pacific hake and Jack mackerel. Numbers of forage fishes were also studied.

Sanderson, B. L., K. A. Barnas, and A. M. Rub. 2009. Nonindigenous species of the Pacific Northwest: an overlooked risk to endangered salmon? *BioScience* 59(3):245–256.

<https://doi.org/10.1525/bio.2009.59.3.9>

Quantifies the impact of nonindigenous species on threatened and endangered salmonids. The results indicate that the effect of nonindigenous species on salmon could equal or exceed that of four commonly addressed causes of adverse impacts.

Sauter, S. T., R. M. Schrock, J. H. Petersen, and A. G. Maule. 2004. Assessment of smolt condition: biological and environmental interactions: the impact of prey and predators on juvenile salmonids. Final Report to Bonneville Power Administration, Project 1987-401-00, Portland, Oregon. <https://www.cbfish.org/Document.mvc/Viewer/00004740-1>

Report utilizing bioenergetics modeling to investigate predation on juvenile salmonids by northern pikeminnow, smallmouth bass, and walleye in the lower Columbia River reservoirs.

Sharpe, C. S., P. C. Topping, T. N. Pearsons, J. F. Dixon, and H. J. Fuss. 2008. Predation of naturally-produced subyearling Chinook by hatchery steelhead juveniles in western Washington rivers. Washington Department of Fish and Wildlife.

<https://wdfw.wa.gov/sites/default/files/publications/00182/wdfw00182.pdf>

Assesses the risk of hatchery steelhead predation on wild subyearling Chinook salmon in the Deschutes, Green, Coweeman and Kalama Rivers. Finds overall low incidence of predation by steelhead on subyearling Chinook.

Shively, R. S., T. P. Poe, and S. T. Sauter. 1996. Feeding response by northern squawfish to a hatchery release of juvenile salmonids in the Clearwater River, Idaho. *Transactions of the American Fisheries Society* 125(2):230-236. [https://doi.org/10.1577/1548-8659\(1996\)125%3C0230:FRBNST%3E2.3.CO;2](https://doi.org/10.1577/1548-8659(1996)125%3C0230:FRBNST%3E2.3.CO;2)

Assesses the gut contents of northern pikeminnow in the Clearwater River before and after the release of yearling Chinook salmon from the Dworshak National Fish Hatchery. Finds after the release salmonids constituted the majority of gut contents for the following week.

Shively, R. S., T. P. Poe, M. B. Sheer, and R. Peters. 1996. Criteria for reducing predation by northern squawfish near juvenile salmonid bypass outfalls at Columbia River dams. *Regulated Rivers: Research & Management* 12(4-5):493-500. [https://doi.org/10.1002/\(SICI\)1099-1646\(199607\)12:4<5%3C493::AID-RRR411%3E3.0.CO;2-C](https://doi.org/10.1002/(SICI)1099-1646(199607)12:4<5%3C493::AID-RRR411%3E3.0.CO;2-C)

Provides criteria for siting juvenile fish bypass outfalls to reduce predation of juvenile salmonids by northern pikeminnow developed with locational data from radio-tagged northern pikeminnow in The Dalles Dam trailrace.

Smith C. D., J. M. Plumb, N. S. Adams, and G. J. Wyatt. 2021. Predator and prey events at the entrance of a surface-oriented fish collector at North Fork Dam, Oregon. *Fisheries Management and Ecology* 28(2):172-182. <https://doi.org/10.1111/fme.12465>

Assesses the cooccurrence of predator-size fish and juvenile salmonids, at the entrance to a floating surface collector in the forebay of North Fork Dam on the Clackamas River.

Sontag, D. M. 2013. Predation, turbidity, and other factors influencing juvenile Salmonid survival in the lower Snake River. Master's thesis. Eastern Washington University, Cheney, Washington. <https://dc.ewu.edu/theses/168/>

Aims to quantify consumption rates of juvenile salmonids by three introduced species, smallmouth bass, walleye and channel catfish in the Lower Snake River.

Sorel, M. H., A. G. Hansen, K. A. Connelly, A. C. Wilson, E. D. Lowery, and D. A. Beauchamp. 2016. Predation by northern pikeminnow and tiger muskellunge on juvenile salmonids in a high-head reservoir: implications for anadromous fish reintroductions. *Transactions of the American Fisheries Society* 145(3):521-536. <https://doi.org/10.1080/00028487.2015.1131746>

Evaluates predation risks for juvenile salmonids by northern pikeminnow and tiger muskellunge in a proposed reintroduction in Merwin Reservoir in the North Fork Lewis River.

Stainbrook, C. E. 1982. Selected life history aspects of American shad (*Alosa sapidissima*) and predation on young-of-the-year shad in Lake Umatilla of the Columbia River. Master's Thesis. Oregon State University, Corvallis, Oregon. <http://hdl.handle.net/1957/41994>

Reports on the life history aspects of American Shad in Lake Umatilla during 1980 and 1980. Predation on young shad by resident predator fish species was variable and appeared to be dependent on the Abundance of young-of-the-year shad.

Stroud, D. H. P., A. O. Blake, G. C. Claghorn, B. Nine, S. Wolvert, and A. T. Scholz. 2010. Salmonid consumption in the Sanpoil River Arm of Lake Roosevelt by smallmouth bass and walleye using bioenergetic modeling. Report to Bonneville Power Administration, Project 1995-011-00, Portland, Oregon. <https://www.cbfish.org/Document.mvc/Viewer/P125249>

Assesses the percentage of hatchery-raised kokanee salmon and naturally produced rainbow trout consumed by walleye and smallmouth bass as the salmon and trout migrate through the Sanpoil River Arm of Lake Roosevelt.

Stroud, D. H. P., G. C. Claghorn, K. A. Wagner, B. Nine, S. Wolvert, and A. T. Scholz. 2010. Bioenergetic models for walleye and smallmouth bass to determine the number of rainbow trout and kokanee salmon they consume in the Sanpoil River Arm of Lake Roosevelt. Report to Bonneville Power Administration, Project 1995-011-00, Portland, Oregon. <https://www.cbfish.org/Document.mvc/Viewer/P115131>

Assesses the numbers of hatchery-raised kokanee salmon and naturally produced rainbow trout consumed by walleye and smallmouth bass as the salmon and trout migrate through the Sanpoil River Arm of Lake Roosevelt.

Tabor, R. A., R. S. Shively, and T. P. Poe. Predation on juvenile salmonids by smallmouth bass and northern squawfish in the Columbia River near Richland, Washington. *North American Journal of Fisheries Management* 13(4):831-838. [https://doi.org/10.1577/1548-8675\(1993\)013%3C0831:POJSBS%3E2.3.CO;2](https://doi.org/10.1577/1548-8675(1993)013%3C0831:POJSBS%3E2.3.CO;2)

Examines the importance of juvenile salmonids in the diet of smallmouth bass and northern pikeminnow at a 6-km stretch of the Columbia River.

Taylor, T. N., K. M. Myrvold, and B. P. Kennedy. 2016. Food habits of sculpin spp. in small Idaho streams: no evidence of predation on newly emerged steelhead alevins. *Northwest Science* 90(4):484-490. <https://doi.org/10.3955/046.090.0408>

Investigates the extent to which sculpin prey on newly emerged steelhead in Idaho streams. Gut content analysis revealed a diet of primarily invertebrates, with piscivory found in less than 2% of samples.

Thompson, A. M., R. R. O'Connor, M. A. Timko, L. S. Sullivan, S. E. Rizor, J. H. Hannity, C. D. Wright, C. A. Fitzgerald, M. M. Meagher, J. D. Stephenson, J. R. Skalski, and R. L. Townsend. 2012. Evaluation of Downstream juvenile steelhead survival and predator-prey interactions using JSATS through the Priest Rapids Reservoir in 2011. Report to Public Utility District No. 2 of Grant County, Washington, Ephrata, Washington.

https://www.blueleafenviro.com/files/documents/GPUD11_BLEFinalReport_ThompsonEtAl2012.pdf

Assesses the survival of juvenile steelhead migrating downstream through the Wanapum and Priest Rapids dams, measures the single-release survival of downstream migrant juvenile steelhead and to determine where losses from predators occurred throughout the Priest Rapids Reservoir.

Tiffan, K. F., J. M. Erhardt, R. J. Hemingway, B. K. Bickford, and T. N. Rhodes. 2020. Impact of smallmouth bass predation on subyearling fall Chinook salmon over a broad river continuum. *Environmental Biology of Fishes* 103(10):1231–1246. <https://doi.org/10.1007/s10641-020-01016-0>

Examines impact of smallmouth bass predation on subyearling fall Chinook salmon in the Snake River to assess seasonal and habitat related changes in bass diet and associated subyearling consumption and loss.

Tiffan, K. F., J. R. Hatten, and D. A. Trachtenbarg. 2016. Assessing juvenile salmon rearing habitat and associated predation risk in a lower Snake River reservoir. *River Research and Applications* 32(5):1030-1038. <https://doi.org/10.1002/rra.2934>

Assesses the amount and spatial arrangement of subyearling rearing habitat in Lower Granite Reservoir on the Snake River, uses field collections of subyearlings and smallmouth bass to infer predation risk associated with specific habitats.

U.S. Fish and Wildlife Service. 1990-1993. System-wide significance of predation on juvenile salmonids in the Columbia and Snake River reservoirs. Annual Report to Bonneville Power Administration, Project 1990-078-00, Portland, Oregon. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=44786>

Annual reports examining the impact of predation on juvenile salmonids by northern pikeminnow in the Columbia River basin, indexes predation, assesses the efficacy of northern pikeminnow control efforts, and reviews factors in northern pikeminnow recruitment.

U.S. Fish and Wildlife Service. 1991-1994. Significance of selective predation and development of prey protection measures for juvenile salmonids in Columbia and Snake River reservoirs. Annual

Report to Bonneville Power Administration, Project 82-003, Portland, Oregon.
<https://catalog.cbowl.org/cgi-bin/koha/opac-detail.pl?biblionumber=44784>

Reports on the impacts of various factors associated with dam passage on predation of juvenile salmonids by northern pikeminnow. Examines whether northern pikeminnow will consume dead salmonids, the impacts of stress and dissolved gas supersaturation on juvenile salmonids ability to avoid predators.

Various agencies. 1991-2002. Development of a system-wide predator control program: stepwise implementation of a predation index predator, control fisheries, and evaluation plan in the Columbia River basin. Annual Report to Bonneville Power Administration, Project 90-077, Portland, Oregon. <https://catalog.cbowl.org/cgi-bin/koha/opac-detail.pl?biblionumber=996>

Annual reports on basin-wide efforts to harvest northern pikeminnow to reduce predation by northern pikeminnow on juvenile salmonids during their emigration from streams in the Columbia River basin to the ocean.

Vigg, S., and C. C. Burley. 1991. Temperature-dependent maximum daily consumption of juvenile salmonids by northern squawfish (*Ptychocheilus oregonensis*) from the Columbia River. Canadian Journal of Fisheries and Aquatic Science. 48(12):2491-2498.
<https://doi.org/10.1139/f91-290>

Quantifies the daily consumption rate of juvenile salmonids by northern pikeminnow in the Columbia River as a function of temperature. As temperatures increased, consumption increased exponentially.

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(4): 421-438. [https://doi.org/10.1577/1548-8659\(1991\)120%3C0421:ROCOJS%3E2.3.CO;2](https://doi.org/10.1577/1548-8659(1991)120%3C0421:ROCOJS%3E2.3.CO;2)

Samples adult northern pikeminnow, walleyes, smallmouth bass, and channel catfish from four regions of the John Day Reservoir from 1983-1986 to quantify their consumption of prey fish, specifically ocean migrating Pacific salmon and steelhead.

Ward, D. L., J. H. Petersen, J. J. Loch. 1995. Index of Predation on juvenile salmonids by northern squawfish in the lower and middle Columbia River and in the lower Snake River. Transactions of the American Fisheries Society 124(3):321-334. [https://doi.org/10.1577/1548-8659\(1995\)124%3C0321:IOPOJS%3E2.3.CO;2](https://doi.org/10.1577/1548-8659(1995)124%3C0321:IOPOJS%3E2.3.CO;2)

Develops and presents a predation index to describe predation on juvenile salmonids by northern pikeminnow in the middle Columbia and lower Snake Rivers. evaluates various catch indices and finds that catch per unit effort best reflected differences among northern pikeminnow abundances.

Ward, D. L., and M. P. Zimmerman. 2011. Response of smallmouth bass to sustained removals of northern pikeminnow in the lower Columbia and Snake Rivers. *Transactions of the American Fisheries Society* 128(6):1020-1035. [https://doi.org/10.1577/1548-8659\(1999\)128%3C1020:ROSBTS%3E2.0.CO;2](https://doi.org/10.1577/1548-8659(1999)128%3C1020:ROSBTS%3E2.0.CO;2)

Examines impacts of northern pikeminnow management and removal in the Columbia and Snake Rivers on smallmouth bass populations. Finds no increase in population of smallmouth bass or seeming increase in predation on salmonids.

Washington Department of Fish and Wildlife. 1990-2003. Yakima River species interactions studies. Annual Report to Bonneville Power Administration, Project 1995-064-24, Portland, Oregon. <https://catalog.cbfwl.org/cgi-bin/koha/opac-detail.pl?biblionumber=31232>

Annual reports on species interactions associated with the release of hatchery smolt into the upper Yakima River, including monitoring fish predation indices.

Weitkamp, L. A., S. A. Hinton, and P. J. Bentley. 2015. Seasonal abundance, size, and host selection of western river (*Lampetra ayresii*) and Pacific (*Entosphenus tridentatus*) lampreys in the Columbia River estuary. *Fishery Bulletin* 113(2):212-226. <https://doi.org/10.7755/fb.113.2.9>

Analyzes western river and Pacific lamprey behavior in the Columbia River estuary, finds that the most frequently wounded fish were American shad, subyearling Chinook salmon, shiner perch and pacific herring.

Williams, J. E. 2014. Habitat relationships of native and non-native fishes of the Willamette River, Oregon. Master's thesis. Oregon State University, Corvallis, Oregon. <http://hdl.handle.net/1957/49883>

Samples fish distributions from the confluence of the McKenzie River to the confluence of the Columbia River to assess fish community composition, differences in community composition between mainstem river and slough habitats, and relationships between native and non-native fish species and physical habitat characteristics.

Zapel, E. T., and J. J. Anderson. 2008. Historical information and literature review on predation and predation rates on salmonids associated with passage through lower Snake and Columbia River hydroelectric projects under different flow conditions. Report to NOAA Fisheries. <https://www.cbfish.org/Document.mvc/Viewer/P107961>

Explores the historical data available on predation of salmonids by northern pikeminnow, with particular focus on predation behavior in the vicinity of the tailrace areas below large hydropower dams on the Columbia and Snake Rivers.

Zimmerman, M. P. 1999. Food habits of smallmouth bass, walleyes, and northern pikeminnow in the Lower Columbia River Basin during outmigration of juvenile anadromous salmonids. Transactions of the American Fisheries Society 128(6):1036-1054. [https://doi.org/10.1577/1548-8659\(1999\)128%3C1036:FHOSBW%3E2.0.CO;2](https://doi.org/10.1577/1548-8659(1999)128%3C1036:FHOSBW%3E2.0.CO;2)

Compares the diets of adult smallmouth bass, walleyes, and northern pikeminnow collected in impounded and unimpounded reaches of the lower Columbia and lower Snake rivers during the outmigration of juvenile anadromous salmonids.

Zimmerman, M. P., and R. M. Parker. 1995. Relative density and distribution of smallmouth bass, channel catfish and walleye in the Lower Columbia and snake rivers. Northwest Science 69(1): 19-28. <https://hdl.handle.net/2376/1331>

Utilizes two indices derived from catch and effort to compare density and relative abundance of smallmouth bass, channel catfish, and walleye along the lower Columbia River and lower Snake River.

Zimmerman, M. P., and D. L. Ward. 1999. Index of predation on juvenile salmonids by northern pikeminnow in the lower Columbia River Basin, 1994-1996. Transactions of the American Fisheries Society 128(6) 995-1007. [https://doi.org/10.1577/1548-8659\(1999\)128%3C0995:IPOJS%3E2.0.CO;2](https://doi.org/10.1577/1548-8659(1999)128%3C0995:IPOJS%3E2.0.CO;2)

Estimates relative abundance of northern pikeminnow and relative consumption of juvenile salmonids by northern pikeminnow at standardized sites in the lower Columbia and lower Snake rivers from 1994 to 1996.

Multiple Types of Predators

Courter, I. I., T. Chance, R. Gerstenberger, M. Roes, S. Gibbs, and A. Spidle. 2022. Hatchery propagation did not reduce natural steelhead productivity relative to habitat conditions and predation in a

mid-Columbia River subbasin. *Canadian Journal of Fisheries and Aquatic Sciences* 79(11):1879-1895. <https://doi.org/10.1139/cjfas-2021-0351>

Estimates the effect of the proportion of hatchery-origin spawners, proportionate natural influence, and hatchery fish releases on natural adult winter steelhead recruitment in the Hood River, Oregon, over a 27-year period. Finds predator abundance (avian and pinniped) are negatively associated with steelhead productivity.

Emmett, R. L. 1997. Estuarine and ocean survival of Northeastern Pacific salmon: proceedings of the workshop. Newport, Oregon. NMFS-NWFSC-29: 147-158.

https://repository.library.noaa.gov/view/noaa/2995/noaa_2995_DS1.pdf#page=157

Reviews the status of salmonid predators in estuarine environments along the west coast of North America. Focuses on marine mammals with some discussion of avian predators.

Independent Multidisciplinary Science Team. 1998. Pinniped and seabird predation: implications for recovery of threatened stocks of salmonids in Oregon under the Oregon Plan for Salmon and Watersheds. Report to the Oregon Plan for Salmon and Watersheds, Salem, Oregon.

https://ir.library.oregonstate.edu/concern/technical_reports/j9602070t

Evaluates the extent of predatory impacts of marine mammals and seabirds on salmonids and recommends actions to mitigate impacts.

Independent Scientific Advisory Board. 2019. A review of predation impacts and management effectiveness for the Columbia River basin. Independent Scientific Advisory Board, Portland, Oregon. <https://docs.cbfwl.org/biblio40434.pdf>

Provides a review of the biological and economic impacts of native and nonnative predators, the effectiveness of predator management control efforts currently implemented, and the potential impacts on the Columbia River basin from the introduction and spread of northern pike.