

Report on the Progress of Recovery Strategy and
Action Plan Implementation for the Nooksack
Dace (*Rhinichthys cataractae* ssp.) and the
Salish Sucker (*Catostomus* sp. cf. *catostomus*) in
Canada for the Period 2016 to 2021

Nooksack Dace



Salish Sucker



2022

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Cover illustration: Nooksack Dace (top) and Salish Sucker (bottom). Photos by Mike Pearson.

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“Rapport sur les progrès de la mise en œuvre des programmes de rétablissement et du plan d’action pour le naseux de la Nooksack (*Rhinichthys cataractae* ssp.) et le meunier de Salish (*Catostomus* sp. cf. *catostomus*) au Canada pour la période 2016 à 2021”

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Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#) agreed to establish complementary legislation and programs that provide for the protection of species at risk throughout Canada. Under section 46 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the competent minister is responsible for reporting on the implementation of the recovery strategy for a species at risk, and on the progress towards meeting its objectives within five years of the date when the final recovery strategy was placed on the Species at Risk Public Registry, and in every subsequent five-year period until its objectives have been achieved or the species' recovery is no longer feasible. Under section 55 of SARA, the competent minister must monitor the implementation of an action plan and the progress towards meeting its objectives and assess and report on its implementation and its ecological and socio-economic impacts five years after the plan comes into effect.

Reporting on the progress of recovery strategy and action plan implementation requires reporting on the collective efforts of the competent minister, provincial and territorial governments, and all other parties involved in conducting activities that contribute to the species' recovery. Recovery strategies identify broad strategies and approaches that will provide the best chance of ensuring the survival and recovery of species at risk. Action plans provide the detailed recovery planning that supports the strategic direction set out in the recovery strategy for the species. Some of the identified broad strategies and approaches are sequential to the progress or completion of others and not all may be undertaken or show significant progress during the timeframe of a report on the progress of recovery strategy and action plan implementation (progress report).

The Minister of Fisheries and Oceans is the competent minister under SARA for the Nooksack Dace and the Salish Sucker and has prepared this progress report.

As stated in the preamble to SARA, success in the protection and recovery of species at risk depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in the recovery strategy and action plan and will not be achieved by Fisheries and Oceans Canada or any other jurisdiction alone. The cost of recovering and conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the recovery strategy and action plan for the Nooksack Dace and the Salish Sucker for the benefit of the species and Canadian society as a whole.

Acknowledgments

This progress report was prepared by Carrie Kwok and Andrew Baylis with contributions from Erin Gertzen, Heather Lamson, and Ahdia Hassan (Fisheries and Oceans Canada [DFO]). To the extent possible, this progress report has been prepared with inputs from Jordan Rosenfeld (British Columbia Ministry of Environment & Climate Change Strategy) and Mike Pearson (Pearson Ecological). DFO would also like to express its appreciation to all individuals and organizations who have contributed to the recovery of the Nooksack Dace and the Salish Sucker.

Executive summary

The Nooksack Dace (*Rhinichthys cataractae* ssp.) was listed as endangered under the *Species at Risk Act* (SARA) in 2003 and the Salish Sucker (*Catostomus* sp. cf. *catostomus*) was listed under SARA as endangered in 2005 and reclassified as threatened in 2019. The “Recovery Strategy for the Nooksack Dace (*Rhinichthys cataractae*) in Canada” was published on the Species at Risk Public Registry in 2008 ([Pearson et al. 2008](#)). The “Recovery Strategy for the Salish Sucker (*Catostomus* sp. cf. *catostomus*) in Canada” was published on the Species at Risk Public Registry in 2016 ([DFO 2016a](#)). Both recovery strategies were amended in 2020 to include updates to the biology, recovery feasibility assessment, threats, population and distribution objectives, and critical habitat ([DFO 2020a, b](#)).

The “Action Plan for the Nooksack Dace (*Rhinichthys cataractae*) and the Salish Sucker (*Catostomus* sp. cf. *catostomus*) in Canada” was published on the Species at Risk Public Registry in 2017 ([DFO 2017](#)). The action plan was amended in 2020 to reflect changes made in the amended recovery strategies for the two species ([DFO 2020c](#)).

Nooksack Dace

The main threats identified for the Nooksack Dace include: sediment deposition, seasonal lack of water, harmful substances, physical destruction of habitat, hypoxia, riffle loss to impoundment, and habitat fragmentation. The most widespread and highest risk threat to Nooksack Dace across its Canadian range is sediment deposition.

The population and distribution objectives for the Nooksack Dace are:

- population objective: Nooksack Dace are moderately abundant¹ in 60 percent of currently or historically occupied reaches by 2030. Occupied reaches means those reaches that currently contain or historically contained more than 10 percent riffle habitat by length in each of the species’ four native watersheds in British Columbia (BC)
- distribution objective: Nooksack Dace presence is confirmed in 80 percent of currently or historically occupied reaches by 2030. Occupied reaches means those reaches that currently contain or historically contained more than 10 percent riffle habitat by length in each of the species’ four native watersheds in BC

Salish Sucker

The main threats identified for the Salish Sucker include: hypoxia, seasonal lack of water, harmful substances, sediment deposition, habitat fragmentation, physical destruction of habitat, and introduction of aquatic invasive species. The most widespread and highest risk threat to Salish Sucker across its Canadian range is severe hypoxia.

The population and distribution objectives for the Salish Sucker are:

- population objective:
 - long-term: reach or exceed watershed-specific population objectives identified in table 5 of the recovery strategy by 2035
- distribution objectives:
 - short-term: continued presence in all eleven currently occupied watersheds

¹ Moderate abundance is defined by a catch per unit effort exceeding 0.25 fish per Gee minnow trap (n=10) between April 1 and September 30 or observation of more than 50 fry per riffle (n=10 riffles, or complete reach census, whichever is less) between July 1 and August 31 (DFO 2020a).

- long-term: presence in all critical habitat reaches by 2035

The “Report on the Progress of Recovery Strategy and Action Plan Implementation for the Nooksack Dace (*Rhinichthys cataractae* ssp.) and the Salish Sucker (*Catostomus* sp. cf. *catostomus*) in Canada for the Period 2016 to 2021” (progress report) summarizes the progress made by Fisheries and Oceans Canada (DFO) and its partners towards implementing the recovery strategies and action plan and achieving their objectives from 2016 to 2021. During this time period, progress has been made in:

- monitoring recovery of Nooksack Dace and Salish Sucker through ongoing distribution and population abundance surveys and surveying for undocumented populations in suitable habitats
- filling knowledge gaps that inhibit recovery of Nooksack Dace and Salish Sucker, including increased understanding of threats to the species
- development, implementation, and monitoring of habitat restoration and enhancement projects
- development and dissemination of public education materials and information to foster community stewardship and participation in species recovery

While progress has been made in recovery, none of the performance indicators for Nooksack Dace and Salish Sucker have been met, and population and distribution objectives have not been met. Further work is required to meet population and distribution objectives for both species. Continued efforts will be necessary to ensure long-term survival and recovery of Nooksack Dace and Salish Sucker in BC, including:

- ongoing surveys to evaluate population abundance estimates and trends
- ongoing habitat restoration and enhancement to improve habitat access and habitat quality
- continued public outreach and watershed stewardship, particularly within the agricultural community
- exploration of short-term and long-term options to address the cumulative effects of local and watershed-scale threats, such as nutrient loading, sedimentation and seasonal water availability, in areas with known Nooksack Dace and Salish Sucker distribution and critical habitat
- increased engagement with interested agencies, groups and individuals that support the recovery of Nooksack Dace and Salish Sucker

Further research may result in identification of additional critical habitat and/or refine the understanding of the functions, features and attributes of the currently identified critical habitat as necessary to support achieving the species’ population and distribution objectives.

DFO remains committed to recovering the Nooksack Dace and the Salish Sucker. The work underway and completed to date has built a strong foundation for continued research, recovery and management of this species over the next reporting period.

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1 Introduction

The “Recovery Strategy for the Nooksack Dace (*Rhinichthys cataractae*) in Canada” was published on the Species at Risk Public Registry in 2008 ([Pearson et al. 2008](#)) and the “Recovery Strategy for the Salish Sucker (*Catostomus* sp. cf. *catostomus*) in Canada” was published on the Species at Risk Public Registry in 2016 (Fisheries and Oceans Canada [[DFO 2016a](#)]). Both recovery strategies were amended in 2020 to include updates to the biology, recovery feasibility assessment, threats, population and distribution objectives, and critical habitat ([DFO 2020a, b](#)).

The “Action Plan for the Nooksack Dace (*Rhinichthys cataractae*) and the Salish Sucker (*Catostomus* sp. cf. *catostomus*) in Canada” was published on the Species at Risk Public Registry in 2017 ([DFO 2017](#)). The action plan was amended in 2020 to reflect changes made in the amended recovery strategies for the two species ([DFO 2020c](#)).

This progress report outlines the progress made towards meeting the broad strategies, approaches, and recovery measures listed in the recovery strategies and action plan for the Nooksack Dace and the Salish Sucker from 2016 to 2021 and is part of a series of documents for these species that are linked and should be taken into consideration together; including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status reports ([COSEWIC 2012, 2018](#)), the recovery potential assessments (RPAs; [DFO 2008, 2015](#)), the “Report on the Progress of Recovery Strategy Implementation for Nooksack Dace (*Rhinichthys cataractae*) in Canada for the Period 2008 – 2015” ([DFO 2016b](#)), the amended recovery strategies (herein referred to as the Nooksack Dace recovery strategy and the Salish Sucker recovery strategy; [DFO 2020a, b](#)), and the amended action plan (herein referred to as the action plan; [DFO 2020c](#)).

Section 2 of the progress report provides an overview of key information on the threats to the species, population and distribution objectives for achieving their recovery, and performance indicators to measure the progress of recovery. Section 3 reports the progress of activities identified in the recovery strategies and action plan, to support achieving the population and distribution objectives. Section 4 summarizes the progress toward achieving the population and distribution objectives.

2 Background

2.1 COSEWIC assessment summary and threats to the species and its critical habitat

Nooksack Dace

In 2000, COSEWIC assessed the Nooksack Dace as endangered. The species was subsequently listed as endangered under Schedule 1 of the *Species at Risk Act* (SARA) in 2003. COSEWIC re-examined and confirmed the status of the Nooksack Dace as endangered in 2007 and 2018, as described in the COSEWIC assessment and status reports ([COSEWIC 2007, 2018](#)).

Assessment Summary: November 2018**Common name:** Nooksack Dace**Scientific name:** *Rhinichthys cataractae***Status:** Endangered

Reason for designation: This small fish is a habitat specialist dependent on stream riffles with loose, rocky substrates. In Canada, it is found in disjunct habitat patches in the Fraser River Valley Lowlands where its distribution is severely limited. It is subject to ongoing habitat loss by destruction of riffle habitat from urban, industrial, and agricultural practices. Streams where the species is found are also impacted by lack of water in late summer due to ground and surface water extraction and climate change. Sediment accumulation in riffles, caused by bank erosion, resulting from gravel mining and/or runoff from urban storm drains, has led to further degradation of water quality and habitat.

Occurrence: British Columbia

Status history: Designated endangered in April 1996. Status re-examined and confirmed in May 2000, April 2007, and November 2018.

Section 5 of the Nooksack Dace recovery strategy provides information on threats to Nooksack Dace's survival and recovery. These threats include: sediment deposition, seasonal lack of water, harmful substances, physical destruction of habitat, hypoxia, riffle loss to impoundment, and habitat fragmentation. Threat assessments for each population are available in appendix D of the Nooksack Dace recovery strategy. The most widespread and highest risk threat to Nooksack Dace across its Canadian range is sediment deposition.

Critical habitat for the Nooksack Dace was identified, to the extent possible, in section 8 of the Nooksack Dace recovery strategy. The Nooksack Dace recovery strategy also provides examples of activities that are likely to result in destruction of critical habitat (that is, threats to critical habitat). The list of activities provided in table 8 of the recovery strategy is neither exhaustive nor exclusive, and their inclusion has been guided by the relevant threats to habitat described in the recovery strategy. For more details on the activities likely to result in the destruction of critical habitat, consult the Nooksack Dace recovery strategy. Protection of Nooksack Dace's critical habitat from destruction was achieved in 2016 through a SARA critical habitat order under subsections 58(4) and (5), which invoked the subsection 58(1) prohibition against the destruction of identified critical habitat. The critical habitat order was amended in 2020 to refine features and attributes of critical habitat.

Salish Sucker

In 2002, COSEWIC assessed the Salish Sucker as endangered. The species was subsequently added to Schedule 1 of SARA in 2005. Salish Sucker was reclassified as threatened in 2019 following a new COSEWIC assessment and status report ([COSEWIC 2012](#)).

Assessment Summary: November 2012

Common name: Salish Sucker

Scientific name: *Catostomus* sp. cf. *catostomus*

Status: Threatened

Reason for designation: This small fish has a restricted and fragmented range in southwestern British Columbia where it is susceptible to a continuing decline in habitat quality. An improvement in status from endangered stems from a small increase in the number of known locations (from 9 to 14), including one location thought to have been extirpated, and some improvements in quality of habitat in areas subject to restoration.

Occurrence: British Columbia

Status history: Designated endangered in April 1986. Status re-examined and confirmed in November 2002. Status re-examined and designated threatened in November 2012.

Section 5 of the Salish Sucker recovery strategy provides information on the threats to Salish Sucker's survival and recovery. These threats include: hypoxia, seasonal lack of water, harmful substances, sediment deposition, habitat fragmentation, physical destruction of habitat, and introduction of aquatic invasive species. Threat assessments for each population are available in appendix D of the Salish Sucker recovery strategy. The most widespread and highest risk threat to Salish Sucker across its Canadian range is hypoxia.

Critical habitat for the Salish Sucker was identified, to the extent possible, in section 8 of the recovery strategy. The Salish Sucker recovery strategy also provides examples of activities that are likely to result in destruction of critical habitat (that is, threats to critical habitat). The list of activities provided in table 9 of the recovery strategy is neither exhaustive nor exclusive, and their inclusion has been guided by the relevant threats to habitat described in the recovery strategy. For more details on the activities likely to result in the destruction of critical habitat, consult the Salish Sucker recovery strategy. Protection of Salish Sucker's critical habitat from destruction was achieved in 2019 through a SARA critical habitat order under subsections 58(4) and (5), which invoked the subsection 58(1) prohibition against the destruction of identified critical habitat.

2.2 Recovery

This section summarizes the population and distribution objectives and performance indicators for Nooksack Dace and Salish Sucker. Population and distribution objectives establish, to the extent possible, the number of individuals and/or populations, and their geographic distribution, that are necessary for the recovery of the species. Performance indicators provide a way to define and measure progress toward achieving those population and distribution objectives. Table 1 describes the population and distribution objectives and performance indicators for Nooksack Dace and Salish Sucker; taken from both recovery strategies.

Table 1. Population and distribution objectives and corresponding performance indicators for the Nooksack Dace and Salish Sucker, as identified in the recovery strategies.

Population and distribution objectives (Nooksack Dace)	Performance Indicators (Nooksack Dace)
Population objective: Nooksack Dace are moderately abundant ² in 60 percent of currently or historically occupied reaches by 2030	Nooksack Dace is found at moderate density ³ in: <ul style="list-style-type: none"> - more than 60 percent of historically occupied reaches in each watershed, which indicates recovery of that watershed's population abundance - more than 60 percent of historically occupied reaches in all four occupied watersheds in British Columbia (BC), which indicates recovery of Nooksack Dace population abundance in Canada
Distribution objective: Nooksack Dace presence is confirmed in 80 percent of currently or historically occupied reaches by 2030	Nooksack Dace is present ⁴ in: <ul style="list-style-type: none"> - more than 80 percent of reaches in each watershed, which indicates recovery of a watershed's population distribution - more than 80 percent of reaches in all four occupied watersheds in BC, which indicates recovery of the Nooksack Dace distribution in Canada
Population and distribution objectives (Salish Sucker)	Performance Indicators (Salish Sucker)
Long-term population objective: reach or exceed watershed-specific population objectives identified in table 5 of the recovery strategy by 2035	Salish Sucker is found at abundance levels corresponding with population targets ⁵ , where: <ul style="list-style-type: none"> - the population target for each watershed is met or exceeded, which indicates recovery of that watershed's population abundance - the population targets across all eleven⁶ occupied watersheds in BC are met or exceeded, which indicates recovery of Salish Sucker in Canada
Short-term distribution objective: continued presence in all eleven ⁷ currently occupied watersheds.	Salish Sucker is present ⁴ in: <ul style="list-style-type: none"> - all reaches that have been identified as critical habitat in each watershed, which indicates recovery of a watershed's population distribution

² Moderate abundance is defined by a catch per unit effort exceeding 0.25 fish per Gee minnow trap (n=10) between April 1 and September 30 or observation of more than 50 fry per riffle (n=10 riffles, or complete reach census, whichever is less) between July 1 and August 31 (DFO 2020a).

³ Moderate density is indicated by a catch per unit effort of >0.25 Nooksack Dace per Gee minnow trap (Pearson 2004) with a minimum effort of 1 trap per 5 m of riffle length or 20 traps per reach.

⁴ Presence is indicated by the capture of an individual in the reach within the past 5 years.

⁵ Population targets are described in table 5 and use abundance estimates derived from mark-recapture sampling.

⁶ A twelfth population of Salish Sucker was discovered in Freytag Creek on Chawathil First Nation IR4 in 2018 after the population and distribution objectives were developed in the recovery strategy (Mike Pearson, pers. comm. 2018).

Long-term distribution objective: presence in all critical habitat reaches by 2035.	- all reaches that have been identified as critical habitat across all eleven ⁷ occupied watersheds in BC, which indicates recovery of the Salish Sucker distribution in Canada
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3 Progress towards recovery

Each of the recovery strategies divides recovery planning and implementation into five broad strategies to address identified threats. Under these broad strategies, twelve research and management approaches to meet the population and distribution objectives were identified (table 2). The action plan divides the broad strategies and approaches further into 34 recovery measures (table 3).

Table 2. Broad strategies and research and management approaches for Nooksack Dace and Salish Sucker, as identified in the recovery strategies.

Broad strategy	Research and management approaches	Relevant species
Inventory and monitoring	Approach 1-A: monitor recovery	Nooksack Dace and Salish Sucker
Research	Approach 2-B: fill knowledge gaps that inhibit recovery	Nooksack Dace and Salish Sucker
Management and coordination	Approach 3-C: reduce sediment entry to instream habitats	Nooksack Dace and Salish Sucker
Management and coordination	Approach 3-D: minimize entry of harmful substances to instream habitats	Nooksack Dace and Salish Sucker
Management and coordination	Approach 3-E: reduce fragmentation of instream habitats	Nooksack Dace and Salish Sucker
Management and coordination	Approach 3-F: ensure the integrity and proper function and reduce the fragmentation of riparian areas throughout watersheds	Nooksack Dace and Salish Sucker
Management and coordination	Approach 3-G: protect existing habitat, restore lost or degraded habitat, and create new habitat	Nooksack Dace and Salish Sucker
Management and coordination	Approach 3-H: establish and maintain adequate baseflow (Nooksack Dace) and water depth (Salish Sucker) in all habitats with high potential productivity	Nooksack Dace and Salish Sucker
Management and coordination	Approach 3-I: reduce incidence of severe hypoxia in instream critical habitat	Salish Sucker
Stewardship and outreach	Approach 4-J: encourage stewardship amongst private landowners, local governments and the general public	Nooksack Dace and Salish Sucker
Stewardship and outreach	Approach 4-K: support stewardship projects to increase awareness of aquatic invasive species	Salish Sucker
International collaboration	Approach 5-L: explore opportunities for coordinating population assessment and recovery efforts with interested groups in the United States	Nooksack Dace and Salish Sucker

Table 3. Recovery measures for Nooksack Dace and Salish Sucker, as identified in the action plan.

Recovery measure	Approach
1. Develop protocols for monitoring Nooksack Dace and Salish Sucker recovery, including watershed-level assessments of the populations of both species as needed. Explore options for incorporating any available information on ecological benefits provided to other species by Nooksack Dace and Salish Sucker recovery efforts into monitoring reports.	1-A

Recovery measure	Approach
2. Improve quantitative sampling methods to monitor recovery of Nooksack Dace populations.	1-A
3. Survey for undocumented populations of Nooksack Dace and Salish Sucker in streams near documented populations that may contain suitable habitat.	1-A
4. Track annual extent of drainage maintenance works affecting critical habitat of Nooksack Dace and Salish Sucker.	2-B
5. Identify high priority areas in watersheds where Nooksack Dace or Salish Sucker are present for in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that would benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G
6. Provide information and advice related to results of habitat restoration projects to stewardship groups, agencies and consultants involved in similar works in order to increase the value of such projects for both species and ensure that features that benefit either or both species can be incorporated into habitat projects directed at other species.	3-E, 3-F, 3-G
7. Identify watersheds vulnerable to inadequate base flow for Nooksack Dace and water depth for Salish Sucker.	3-H
8. Pursue the negotiation of stewardship agreements under SARA or other forms of conservation agreements with interested agencies, organizations or individuals regarding actions that will support the recovery of Nooksack Dace and/or Salish Sucker, including habitat restoration and management.	4-J
9. Implement protocols for monitoring Nooksack Dace and Salish Sucker recovery.	1-A
10. Identify sediment sources and quantify sediment accumulation in riffles in watersheds containing Nooksack Dace or Salish Sucker.	2-B
11. Determine levels and types of sediment in riffles that are harmful to Nooksack Dace and Salish Sucker.	2-B
12. Identify biologically based minimum in-stream flows (Nooksack Dace) and water depth (Salish Sucker) in habitats with high potential productivity.	2-B
13. Analyze, and re-assess as needed, data on the extent and severity of hypoxia, its relationship with in-stream flows, land use and Salish Sucker population levels. Ensure research results are shared with interested groups.	2-B
14. Collect detailed seasonal oxygen profiles for selected Salish Sucker critical habitat reaches.	2-B
15. Estimate the extent and severity of harmful substances in watersheds where Nooksack Dace or Salish Sucker are present. Where possible, identify possible sources of contamination and engage relevant agencies, stewardship groups and landowners regarding reducing or eliminating these sources.	3-D
16. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G
17. Identify beaver management protocols and practices that increase flow without degrading or physically destroying pool or riffle habitats used by Nooksack Dace in watersheds where they are present; and map the extent of beaver and human impoundments of critical habitat for Nooksack Dace in Pepin Creek.	3-E, 3-F, 3-G
18. Ensure that Nooksack Dace and Salish Sucker needs are included as targets of existing incentive programs that support and promote riparian planting, in-stream habitat restoration projects and the voluntary adoption of beneficial land management practices by private landowners; explore possible mechanisms for additional incentives to encourage private landowners to undertake riparian planting or in-stream habitat restoration projects that benefit Nooksack Dace or Salish Sucker; and explore options for overcoming barriers that may reduce landowners' willingness to undertake such actions and projects.	3-E, 3-F, 3-G

Recovery measure	Approach
19. Engage interested agencies, groups and individuals in order to develop and negotiate conservation agreements under SARA or other management agreements to ensure that minimum in-stream flow (Nooksack Dace) and water depth (Salish Sucker) requirements are met in habitats with high potential productivity.	3-H
20. Develop and encourage voluntary adoption of habitat enhancement guidelines for Nooksack Dace, Salish Sucker and co-occurring species at risk.	4-J
21. Work with stakeholders in Washington to understand transboundary population structure and movements in Bertrand Creek, Fishtrap Creek and Pepin Creek.	5-L
22. Characterize the impacts of introduced predators on the mortality and habitat use by different life stages of Salish Sucker.	2-B
23. Undertake projects to prevent and mitigate sedimentation of riffles from urban, agricultural and industrial sources.	3-C
24. Undertake projects to reduce harmful substances of local watersheds by storm water or other sources, including development of settling ponds in urban areas.	3-D
25. Adopt practices to reduce or eliminate sources of harmful substances for local watersheds, including practices related to pesticide and herbicide application and use and spill response planning.	3-D
26. Undertake mitigation for permanent and/or seasonal barriers to Nooksack Dace and Salish Sucker movement such as perched or undersized culverts.	3-E, 3-F, 3-G
27. Promote or support the inclusion of Nooksack Dace and Salish Sucker habitat needs in existing incentive programs that support and promote in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects and the adoption of land management practices by private landowners.	3-E, 3-F, 3-G
28. Consider the needs of Nooksack Dace and Salish Sucker in Official Community Plans, and implement projects to manage discharge rates and maintain adequate water quantity.	3-H
29. Adopt or continue to apply beneficial nutrient management practices, urban design practices and/or water management practices that reduce nutrient loading in watersheds where Salish Sucker are present.	3-I
30. Develop a stewardship and engagement strategy for Nooksack Dace and Salish Sucker to increase efficiency and effectiveness of stewardship actions, including incorporating information about Nooksack Dace and Salish Sucker into existing stewardship initiatives.	4-J
31. Consider entering into a stewardship agreement under SARA or another type of conservation agreement regarding actions that will support the recovery of Nooksack Dace and/or Salish Sucker, including habitat restoration and management.	4-J
32. Develop and provide public education materials and information on Nooksack Dace, Salish Sucker, watershed ecology and actions that individuals and groups can take to benefit both species to landowners, members of the public and interested groups through presentations, field tours, landowner contact programs or other outreach tools.	4-J
33. Consider and incorporate Nooksack Dace and Salish Sucker needs in new and existing plans, programs, strategies, and stewardship initiatives for the management of watersheds where either or both species is present.	4-J
34. Develop and implement stewardship projects that include the public education materials and information to recreational fishers and other relevant groups on the impacts that introduced predators can have on Salish Sucker and local watershed ecology.	4-K

Progress in carrying out these broad strategies, approaches and recovery measures is reported in section 3.1 of this report. Section 3.2 reports on the activities identified in the schedule of studies to identify critical habitat. Section 3.3 reports on the progress made towards meeting the performance indicators identified in the recovery strategies.

3.1 Activities supporting recovery

Tables 4 and 5 provide information on the implementation of activities undertaken to address broad strategies and approaches identified in the recovery strategies as well as recovery measures identified in the action plan. A number of recovery activities were implemented prior to 2016 and have been documented under section 7.1 of the amended recovery strategies and in the “Report on the Progress of Recovery Strategy Implementation for Nooksack Dace (*Rhinichthys cataractae*) in Canada for the Period 2008 to 2015” ([DFO 2016b](#)).

3.1.1 Recovery activities for Nooksack Dace

Table 4. Details of activities supporting the recovery of the Nooksack Dace from 2016 to 2021.

Recovery measure ⁷	Approach	Description and results	Participants ⁸
<p>1. Develop protocols for monitoring Nooksack Dace and Salish Sucker recovery, including watershed-level assessments of the populations of both species as needed. Explore options for incorporating any available information on ecological benefits provided to other species by Nooksack Dace and Salish Sucker recovery efforts into monitoring reports.</p>	<p>1-A</p>	<p>Protocols for monitoring Nooksack Dace recovery have not been developed; however, standardized monitoring methods have been implemented. Minnow trapping and visual fry surveys were conducted from 2017 to 2018 to assess distribution and estimate population abundance in the four occupied watersheds. Combined across all watersheds, Nooksack Dace was found to be present in 40% of sampled critical habitat reaches. Moderate abundance⁹ of Nooksack Dace was observed in 20% of sampled critical habitat reaches.</p> <ul style="list-style-type: none"> - Eleven of 13 critical habitat reaches in Bertrand Creek watershed were sampled. Nooksack Dace was present in 64% (7 of 11) of sampled reaches. Moderate abundance of Nooksack Dace (that is, catch per unit effort [CPUE] greater than 0.25 fish per trap or 50 fry per riffle) was observed in 46% (5 of 11) of sampled critical habitat reaches. - Both critical habitat reaches in Brunette River watershed were sampled. Nooksack Dace was present in 50% (1 of 2) of sampled reaches. Moderate abundance was not observed - Seven of 9 critical habitat reaches in Fishtrap Creek watershed were sampled. Nooksack Dace was present in 14% (1 of 7) of sampled reaches. Moderate abundance was not observed. - Five of 6 critical habitat reaches in Pepin Creek watershed were sampled. Nooksack Dace was 	<p>BC Ministry of Environment & Climate Change Strategy (BC ENV), Fisheries and Oceans Canada (DFO), Fraser Valley Conservancy (FVC), Pearson Ecological (PE)</p>

⁷ While recovery measures are noted for both Nooksack Dace and Salish Sucker, this table only addresses activities completed for Nooksack Dace. Activities completed for Salish Sucker can be found in Table 5 below.

⁸ Participants are listed in alphabetical order, with project leads identified in bold. DFO acknowledges the large network of people that contribute to recovery of Nooksack Dace and regrets any potential omissions of contributors.

⁹ Moderate abundance is defined by a catch per unit effort exceeding 0.25 fish per Gee minnow trap (n=10) between April 1 and September 30 or observation of more than 50 fry per riffle (n=10 riffles, or complete reach census, whichever is less) between July 1 and August 31 (DFO 2020a).

Recovery measure ⁷	Approach	Description and results	Participants ⁸
		present in 20% (1 of 5) of sampled reaches. Moderate abundance was not observed.	
2. Improve quantitative sampling methods to monitor recovery of Nooksack Dace populations.	1-A	A robust quantitative method of estimating abundance has not been developed due to low capture efficiencies for Nooksack Dace. As outlined in the recovery strategy, Gee minnow trapping of adults and visual fry surveys have been selected as the preferred sampling methods for Nooksack Dace.	N/A
3. Survey for undocumented populations of Nooksack Dace and Salish Sucker in streams near documented populations that may contain suitable habitat.	1-A	Field surveys and genetic analyses of fin clips were conducted from 2017 to 2018 to confirm potential new populations of Nooksack Dace from upper Chilliwack River, Chilliwack Lake, Harrison Lake and three of its tributaries. Preliminary results suggested that 90% of the sampled dace from Chilliwack River upstream of Chilliwack Lake had Nooksack Dace mitochondrial DNA (mDNA) markers (does not meet the 99% required to be considered a pure population; Eric Taylor, University of British Columbia [UBC] pers. comm.), with lower percentage of Nooksack Dace mitochondrial DNA markers at other sample sites. This indicates that a small amount of historical admixture has occurred with the Columbia form of Longnose Dace. Dace samples at the tributaries of Harrison Lake had 0% Nooksack Dace mDNA.	BC ENV, DFO, PE, UBC (Eric Taylor Lab.)
4. Track annual extent of drainage maintenance works affecting critical habitat of Nooksack Dace and Salish Sucker.	2-B	No work was completed on this recovery measure during the reporting period.	N/A
5. Identify high priority areas in watersheds where Nooksack Dace or Salish Sucker are present for in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that would benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	A comprehensive inventory of completed and ongoing habitat restoration activities occurring in Nooksack Dace critical habitat was conducted in 2021. High priority opportunities for future habitat restoration and creation projects were identified.	DFO, PE

Recovery measure ⁷	Approach	Description and results	Participants ⁸
6. Provide information and advice related to results of habitat restoration projects to stewardship groups, agencies and consultants involved in similar works in order to increase the value of such projects for both species and ensure that features that benefit either or both species can be incorporated into habitat projects directed at other species.	3-E, 3-F, 3-G	Information and advice on habitat restoration projects is communicated by species experts on an ongoing basis. DFO funding opportunities for habitat restoration (for example, Habitat Stewardship Program, and the Aboriginal Fund for Species at Risk, Canada Nature Fund for Aquatic Species at Risk) encourage multi-species, threat-based and area-based approaches.	DFO
7. Identify watersheds vulnerable to inadequate base flow for Nooksack Dace and water depth for Salish Sucker.	3-H	Hydrometric stations were installed in Bertrand Creek watershed (2 sites at the mainstem and 1 site at Howe's Creek) in 2019 and 2020 to continuously monitor flow. These hydrometric data are publicly available at Aquarius . This tool, along with Water Survey of Canada station data at Fishtrap and Pepin creeks, is publicly available. Watersheds vulnerable to inadequate base flow could be identified through analysis of this continuous flow data; however, this has not been completed.	BC Ministry of Forests, Lands, Natural Resources Operations and Rural Development (FLNRORD)
8. Pursue the negotiation of stewardship agreements under SARA or other forms of conservation agreements with interested agencies, organizations or individuals regarding actions that will support the recovery of Nooksack Dace and/or Salish Sucker, including habitat restoration and management.	4-J	No work was completed on this recovery measure during the reporting period.	N/A
9. Implement protocols for monitoring Nooksack Dace and Salish Sucker recovery.	1-A	Formal protocols for monitoring Nooksack Dace recovery have not been developed for implementation; however, population monitoring is ongoing via a standardized method (refer to recovery measure 1).	BC ENV, DFO, FVC, PE
10. Identify sediment sources and quantify sediment accumulation in riffles in watersheds containing Nooksack Dace or Salish Sucker.	2-B	In 2018, 256 underwater substrate photos were taken in Nooksack Dace critical habitat to evaluate sediment accumulation in riffles. Photos will be analyzed to characterize current habitat quality. Specific sediment sources within Nooksack Dace watersheds have not been identified.	BC ENV, DFO, PE

Recovery measure ⁷	Approach	Description and results	Participants ⁸
11. Determine levels and types of sediment in riffles that are harmful to Nooksack Dace and Salish Sucker.	2-B	As specified in the action plan, this recovery measure for Nooksack Dace was completed in 2017.	N/A
12. Identify biologically based minimum in-stream flows (Nooksack Dace) and water depth (Salish Sucker) in habitats with high potential productivity.	2-B	As specified in the action plan, this recovery measure for Nooksack Dace was completed in 2017.	N/A
13. Analyze, and re-assess as needed, data on the extent and severity of hypoxia, its relationship with in-stream flows, land use and Salish Sucker population levels. Ensure research results are shared with interested groups.	2-B	This recovery measure does not apply to Nooksack Dace.	N/A
14. Collect detailed seasonal oxygen profiles for selected Salish Sucker critical habitat reaches.	2-B	This recovery measure does not apply to Nooksack Dace.	N/A
15. Estimate the extent and severity of harmful substances in watersheds where Nooksack Dace or Salish Sucker are present. Where possible, identify possible sources of contamination and engage relevant agencies, stewardship groups and landowners regarding reducing or eliminating these sources.	3-D	<p>The British Columbia (BC) - Washington (WA) Nooksack River Transboundary Technical Collaboration Group (TCG) was formed to conduct a 3-year water quality monitoring program from 2018 to 2021 to monitor, identify, and reduce fecal bacteria concentrations in the Nooksack River watershed, which include the Bertrand Creek, Fishtrap Creek, and Pepin Creek sub-basin watersheds (BC-WA Nooksack River Transboundary TCG 2019, 2020, 2021). Outreach and compliance promotion was conducted with agricultural, industrial, and residential sectors as well as municipalities.</p> <p>See activities under recovery measure 16 for habitat restoration activities that contribute to reduction of harmful substances to instream habitats, namely riparian vegetation planting.</p>	BC ENV, Whatcom Clean Water Program

Recovery measure ⁷	Approach	Description and results	Participants ⁸
16. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted at Gordon's Brook (tributary to Pepin Creek; PEP13 reach) from 2017 to 2021 (approximately 10,000 m ² enhanced). Restoration activities included development and implementation of a beaver management plan, ephemeral wetland construction, native vegetation planting, and monitoring/ maintenance. Deterrence of beaver habitat reconstruction (for example, removal and lowering of beaver dams, relocation of beavers) has been partially successful and monitoring is ongoing.	DFO, FVC , Fraser Valley Watersheds Coalition (FVWC), Harrison Nature Stewards, Metro Vancouver Parks (Metro Van Parks), Pacific Salmon Foundation (PSF), PE
16. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted at Fishtrap Creek in 2018 (approximately 1,000 m ² enhanced). Restoration activities included side channel construction, large woody debris complexing, riffle placement, and riparian vegetation planting.	BC Ministry of Transportation and Infrastructure (BC MoTI) , City of Abbotsford
16. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted in Bertrand Creek watershed from 2019 to 2020 (approximately 2,150 m ² enhanced). Restoration activities included native vegetation planting, invasive plant removal, monitoring/ maintenance, and riparian health assessments.	Bertrand Creek Enhancement Society (BCES), DFO, Langley Environmental Partners Society (LEPS) , PE, Township of Langley (ToL)

Recovery measure ⁷	Approach	Description and results	Participants ⁸
<p>17. Identify beaver management protocols and practices that increase flow without degrading or physically destroying pool or riffle habitats used by Nooksack Dace in watersheds where they are present; and map the extent of beaver and human impoundments of critical habitat for Nooksack Dace in Pepin Creek.</p>	<p>3-E, 3-F, 3-G</p>	<p>A beaver management plan was developed and implemented at Gordon’s Brook (a tributary of Pepin Creek) which included mapping the extent of beaver activity within that reach; beaver deterrence has been partially successful and monitoring is ongoing (refer to recovery measure 16). Development of a beaver management plan for the full critical habitat extent of Nooksack Dace at Pepin Creek is underway.</p>	<p>DFO, FVC, FVWC, Harrison Nature Stewards, Metro Van Parks, PSF, PE</p>
<p>18. Ensure that Nooksack Dace and Salish Sucker needs are included as targets of existing incentive programs that support and promote riparian planting, in-stream habitat restoration projects and the voluntary adoption of beneficial land management practices by private landowners; explore possible mechanisms for additional incentives to encourage private landowners to undertake riparian planting or in-stream habitat restoration projects that benefit Nooksack Dace or Salish Sucker; and explore options for overcoming barriers that may reduce landowners’ willingness to undertake such actions and projects.</p>	<p>3-E, 3-F, 3-G</p>	<p>Stewardship practices guides from the Stewardship Centre for British Columbia (SCBC) were updated in 2018 for drainage maintenance/ stewardship and riparian restoration/ enhancement activities that relate directly to Nooksack Dace and their habitats (SCBC 2018a, b). The updated guides provide best practices for restoring/enhancing riparian areas (for example, livestock exclusion fencing, creation of riparian wetlands) and for drainage maintenance (for example, working sensitively with machinery in water).</p> <p>Habitat restoration projects conducted in the Bertrand Creek watershed were conducted in partnership with landowners on their private properties (refer to recovery measure 16). Landowner engagement was conducted in conjunction with the restoration projects to promote best land management practices.</p> <p>No incentive programs currently exist that directly target Nooksack Dace.</p>	<p>BCES, DFO, LEPS, PE, SCBC, ToL</p>
<p>19. Engage interested agencies, groups and individuals in order to develop and negotiate conservation agreements under SARA or other management agreements to ensure that minimum in-stream flow (Nooksack Dace) and water depth (Salish Sucker) requirements are met in habitats with high potential productivity.</p>	<p>3-H</p>	<p>No work was completed on this recovery measure during the reporting period.</p>	<p>N/A</p>

Recovery measure ⁷	Approach	Description and results	Participants ⁸
20. Develop and encourage voluntary adoption of habitat enhancement guidelines for Nooksack Dace, Salish Sucker and co-occurring species at risk.	4-J	Habitat enhancement guidelines were drafted in 2018 to provide guiding principles and practical advice for incorporating habitat features that benefit Nooksack Dace into non-targeted habitat restoration projects and instream works (Pearson 2018 in draft).	DFO, FVC, PE
21. Work with stakeholders in Washington to understand transboundary population structure and movements in Bertrand Creek, Fishtrap Creek and Pepin Creek.	5-L	No work was completed on this recovery measure during the reporting period.	N/A
22. Characterize the impacts of introduced predators on the mortality and habitat use by different life stages of Salish Sucker.	2-B	This recovery measure does not apply to Nooksack Dace.	N/A
23. Undertake projects to prevent and mitigate sedimentation of riffles from urban, agricultural and industrial sources.	3-C	<p>See activities under recovery measure 16 for details on recovery activities related to riparian vegetation planting and bank stabilization to prevent and mitigate sediment entry and sedimentation of riffles. Reduction of sedimentation from urban and industrial sources has not been achieved.</p> <p>Any works, undertakings, or activities that result in the death of fish or the harmful alteration, disruption, or destruction of fish habitat are subject to regulatory review and authorization under the federal <i>Fisheries Act</i> to prevent and mitigate sedimentation. The BC <i>Riparian Areas Protection Act</i> (RAPA) protects riparian areas from new development, which limits additional sediment entry into stream habitat. Both the <i>Fisheries Act</i> and the <i>Riparian Areas Protection Regulation</i>, established under RAPA, were amended in 2019.</p>	DFO, Municipal Government
24. Undertake projects to reduce harmful substances of local watersheds by storm water or other sources, including development of settling ponds in urban areas.	3-D	No work was completed on this recovery measure during the reporting period.	N/A

Recovery measure ⁷	Approach	Description and results	Participants ⁸
<p>25. Adopt practices to reduce or eliminate sources of harmful substances for local watersheds, including practices related to pesticide and herbicide application and use and spill response planning.</p>	<p>3-D</p>	<p>Stewardship practices guides from the SCBC were updated in 2018 for drainage maintenance/ stewardship and riparian restoration/ enhancement activities that relate directly to Nooksack Dace and their habitats (SCBC 2018a, b). The updated guides provide best practices for reducing input of harmful substances (for example, proper application and storage of pesticides, herbicides, and fertilizers).</p> <p>The British Columbia (BC - Washington (WA) Nooksack River Transboundary Technical Collaboration Group conducted outreach and promoted compliance to reduce or eliminate sources of harmful substances to agricultural, industrial, and residential sectors as well as municipalities from 2018 to 2021.</p>	<p>BC ENV, SCBC, Whatcom Clean Water Program</p>
<p>26. Undertake mitigation for permanent and/or seasonal barriers to Nooksack Dace and Salish Sucker movement such as perched or undersized culverts.</p>	<p>3-E, 3-F, 3-G</p>	<p>No work was completed on this recovery measure during the reporting period.</p>	<p>N/A</p>

Recovery measure ⁷	Approach	Description and results	Participants ⁸
<p>27. Promote or support the inclusion of Nooksack Dace and Salish Sucker habitat needs in existing incentive programs that support and promote in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects and the adoption of land management practices by private landowners.</p>	<p>3-E, 3-F, 3-G</p>	<p>Habitat restoration projects conducted in the Bertrand Creek watershed were conducted in partnership with landowners on their private properties (refer to recovery measure 16). Landowner engagement was conducted in conjunction with the restoration projects to promote best land management practices.</p> <p>Stewardship practices guides from the SCBC were updated in 2018 for drainage maintenance/ stewardship and riparian restoration/ enhancement activities that relate directly to Nooksack Dace and their habitats (SCBC 2018a, b). The updated guides provide best practices for restoring/enhancing riparian areas (for example, livestock exclusion fencing, creation of riparian wetlands) and for drainage maintenance (for example, working with machinery in water).</p> <p>No incentive programs currently exist that directly target Nooksack Dace needs.</p>	<p>BCES, DFO, LEPS, PE, SCBC, ToL</p>
<p>28. Consider the needs of Nooksack Dace and Salish Sucker in Official Community Plans, and implement projects to manage discharge rates and maintain adequate water quantity.</p>	<p>3-H</p>	<p>No work was completed on this recovery measure during the reporting period.</p>	<p>N/A</p>
<p>29. Adopt or continue to apply beneficial nutrient management practices, urban design practices and/or water management practices that reduce nutrient loading in watersheds where Salish Sucker are present.</p>	<p>3-I</p>	<p>This recovery measure does not apply to Nooksack Dace.</p>	<p>N/A</p>
<p>30. Develop a stewardship and engagement strategy for Nooksack Dace and Salish Sucker to increase efficiency and effectiveness of stewardship actions, including incorporating information about Nooksack Dace and Salish Sucker into existing stewardship initiatives.</p>	<p>4-J</p>	<p>A Nooksack Dace stewardship and engagement strategy has not been developed; however, engagement and public outreach for Nooksack Dace has been conducted during this progress reporting period (refer to recovery measures 18 and 32).</p>	<p>BCES, DFO, Invasive Species Council of Metro Vancouver (ISC), LEPS, PE, SCBC, ToL</p>

Recovery measure ⁷	Approach	Description and results	Participants ⁸
31. Consider entering into a stewardship agreement under SARA or another type of conservation agreement regarding actions that will support the recovery of Nooksack Dace and/or Salish Sucker, including habitat restoration and management.	4-J	No work was completed on this recovery measure during the reporting period.	N/A
32. Develop and provide public education materials and information on Nooksack Dace, Salish Sucker, watershed ecology and actions that individuals and groups can take to benefit both species to landowners, members of the public and interested groups through presentations, field tours, landowner contact programs or other outreach tools.	4-J	Twenty species at risk education sessions were delivered from 2017 to 2020 which included awareness and promotion of Nooksack Dace recovery to students, government, and professional organizations in Langley. Education sessions were conducted in numerous formats, including classroom presentations/workshops, interpretative walks, and volunteer planting.	DFO, ISC, LEPS
33. Consider and incorporate Nooksack Dace and Salish Sucker needs in new and existing plans, programs, strategies, and stewardship initiatives for the management of watersheds where either or both species is present.	4-J	Various ongoing initiatives consider Nooksack Dace needs (refer to recovery measures 18, 27, 30, 32).	BCES, DFO, ISC, LEPS , PE, SCBC , ToL
34. Develop and implement stewardship projects that include the public education materials and information to recreational fishers and other relevant groups on the impacts that introduced predators can have on Salish Sucker and local watershed ecology.	4-K	This recovery measure does not apply to Nooksack Dace.	N/A

3.1.2 Recovery activities for Salish Sucker

Table 5. Details of activities supporting the recovery of the Salish Sucker from 2016 to 2021.

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>1. Develop protocols for monitoring Nooksack Dace and Salish Sucker recovery, including watershed-level assessments of the populations of both species as needed. Explore options for incorporating any available information on ecological benefits provided to other species by Nooksack Dace and Salish Sucker recovery efforts into monitoring reports.</p>	<p>1-A</p>	<p>Protocols for monitoring Salish Sucker recovery have not been developed; however, standardized monitoring methods have been implemented. Mark-recapture surveys were conducted from 2016 to 2020 to estimate population abundance at Mountain Slough, Bertrand Creek, Little Campbell River, Salmon River, and Hopedale Slough/Salwein Creek, Fishtrap Creek, and Freytag Creek watersheds (7 of the 12 occupied watersheds). Populations in Pepin Creek, Chilliwack Delta, Agassiz Slough, and Miami Creek watersheds were not sampled over this reporting period. Based on survey results between 2016 and 2020, population objectives from the recovery strategy are not being met across all sampled Salish Sucker populations.</p> <ul style="list-style-type: none"> - Mountain Slough: population abundance at Mountain Slough could not be estimated during 2016 surveys due to low catch rates, and presumably low abundance. Observed habitat availability was low. - Bertrand Creek watershed: population abundance at Perry Homestead Creek was estimated at 570 adults (341 to 1,082 adults at 95% confidence interval) during 2017 surveys. Population abundance at Cave Creek was estimated at 315 adults (260 to 400 adults at 95% confidence interval) during 2019 surveys. Population abundance could not be estimated at Howe's Creek and Bertrand mainstem during 2020 surveys due to low catch rates, and presumably low abundance. - Little Campbell River watershed: overall population abundance for the entire watershed is estimated in the low hundreds. Population abundance in the reach at 	<p>A Rocha Canada (A Rocha), British Columbia Ministry of Environment & Climate Change Strategy (BC ENV), Cheam First Nation, Chilliwack Field Naturalists, Fisheries and Oceans Canada (DFO), Fraser Valley Conservancy (FVC), Fraser Valley Watersheds Coalition (FVWC), Little Campbell Watershed Society, Lower Fraser Fisheries</p>

¹⁰ While recovery measures are noted for both Nooksack Dace and Salish Sucker, this table only addresses activities completed for Salish Sucker. Activities completed for Nooksack Dace can be found in Table 4 above.

¹¹ Participants are listed in alphabetical order, with project leads identified in bold. DFO acknowledges the large network of people that contribute to recovery of Salish Sucker and regrets any potential omissions of contributors.

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
		<p>Red Willow Ranch was estimated at 231 adults in 2017, 179 +/- 8 adults in 2018, 175 +/- 40 adults in 2019, and 128 +/- 54 adults in 2020. Population abundance in the reach at Campbell Heights was estimated at 70 +/- 21 adults in 2020.</p> <ul style="list-style-type: none"> - Salmon River watershed: population abundance at Tyre Creek (SLN 42 reach) was estimated at 178 adults (160 to 214 adults at 95% confidence interval) in 2016. Population abundance throughout the upper Salmon River watershed could not be estimated during 2019 surveys due to low captures. Limited surveys in the Lower Salmon River yielded zero captures in 2020. - Hopedale Slough/ Salwein Creek watershed: population abundance could not be estimated at Hopedale Slough during 2019 surveys due to low captures. Population abundance at Salwein Creek was estimated at 188 adults (108 to 342 adults at 95% confidence interval) during 2020 surveys. - Fishtrap Creek: population abundance could not be estimated at Fishtrap Creek during 2019 surveys due to low captures. - Freytag Creek: a new population was discovered in 2018 at Freytag Creek on Chawathil First Nation IR4 near Hope, BC. Population abundance was estimated at 63 adults (47 to 93 adults at 95% confidence interval) with limited distribution during 2019 surveys. - General fish sampling was conducted at Hope Slough/Elk Creek from 2017 to 2019. No Salish Sucker was captured. 	<p>Alliance (LFFA), Pearson Ecological (PE), seyem' Qwantlen Resources Ltd., Save Our Slough, Skwah First Nation, Soowahlie First Nation, Trinity Western University (TWU), University of British Columbia (UBC), The WaterWealth Project, Watershed Watch Salmon Society</p>
<p>2. Improve quantitative sampling methods to monitor recovery of Nooksack Dace populations.</p>	<p>1-A</p>	<p>This recovery measure does not apply to Salish Sucker.</p>	<p>N/A</p>

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
3. Survey for undocumented populations of Nooksack Dace and Salish Sucker in streams near documented populations that may contain suitable habitat.	1-A	Surveys for undocumented populations of Salish Sucker at Alouette River, Fraser River (Herring Island Swamp), Nicomen Slough/Norrish Creek, Stave watershed, and Widgeon Creek/Pitt Addington Marsh were conducted in 2017 and 2018; Salish Sucker individuals were not observed. Surveys were also conducted at Chilliwack Lake in 2019 and 2020; fin clips of suspected Salish Sucker individuals were collected. Results of genetic analysis are pending.	BC ENV, DFO, FVC , FVWC, Katzie First Nation, Leq'a:mel First Nation, PE , Soowalie First Nation, The WaterWealth Project, UBC
4. Survey for undocumented populations of Nooksack Dace and Salish Sucker in streams near documented populations that may contain suitable habitat.	1-A	A Salish Sucker population was discovered in 2018 in Freytag Creek on Chawathil First Nation IR4 near Hope, BC. Following this discovery, fish trapping and inventory mapping of spawning, juvenile rearing, adult foraging, and overwintering habitat areas was conducted from 2019 to 2020. Habitat mapping results indicated minimal suitable habitat at Chawathil First Nation IR4 (one 1-acre pond and approximately 200 m length of creek at the inlet).	Chawathil First Nation , DFO, PE
5. Survey for undocumented populations of Nooksack Dace and Salish Sucker in streams near documented populations that may contain suitable habitat.	1-A	In 2020, an environmental DNA (eDNA) primer was developed for Salish Sucker for use as a non-invasive sampling method that detects presence of the species' genetic material from environmental samples (for example, water). eDNA sampling could be used to survey suspected locations of Salish Sucker in the future.	J Hobbs Ecological Consulting Ltd. , Metro Van Parks, PE
6. Track annual extent of drainage maintenance works affecting critical habitat of Nooksack Dace and Salish Sucker.	2-B	No work was completed on this recovery measure during the reporting period.	N/A
7. Identify high priority areas in watersheds where Nooksack Dace or Salish Sucker are present for in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that would benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	A comprehensive inventory of completed and ongoing habitat restoration activities occurring in Salish Sucker critical habitat was conducted in 2021. High priority opportunities for future habitat restoration and creation projects were identified.	DFO, PE

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>8. Identify high priority areas in watersheds where Nooksack Dace or Salish Sucker are present for in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that would benefit Nooksack Dace, Salish Sucker or both species.</p>	<p>3-E, 3-F, 3-G</p>	<p>Watershed-level riparian habitat surveys were conducted in the Little Campbell River watershed in 2019 to evaluate rate of canopy cover loss and regeneration. Priority riparian restoration areas were identified.</p>	<p>A Rocha, DFO</p>
<p>9. Provide information and advice related to results of habitat restoration projects to stewardship groups, agencies and consultants involved in similar works in order to increase the value of such projects for both species and ensure that features that benefit either or both species can be incorporated into habitat projects directed at other species.</p>	<p>3-E, 3-F, 3-G</p>	<p>Information and advice on habitat restoration projects is communicated by species experts on an ongoing basis. DFO funding opportunities for habitat restoration (for example, Habitat Stewardship Program, and the Aboriginal Fund for Species at Risk, Canada Nature Fund for Aquatic Species at Risk) encourage multi-species, threat-based and area-based approaches.</p>	<p>DFO</p>
<p>10. Identify watersheds vulnerable to inadequate base flow for Nooksack Dace and water depth for Salish Sucker.</p>	<p>3-H</p>	<p>The threat of seasonal low flow and water depth was monitored and quantified in the Little Campbell River watershed. Results from dry reach monitoring at the 200th Street crossing indicated that peak dewatering occurred in mid-September: 1.7 km channel length in 2018, 1.8 km channel length in 2019, and 1.6 km channel length in 2020. These dry reach events decrease available habitat and fragments existing habitat for Salish Sucker.</p> <p>Howe’s Creek, a tributary of Bertrand Creek, has had several dewatering events during dry summers between 2013 and 2020 (Pearson pers. comms. 2020).</p> <p>No further work has been conducted during this reporting period to identify and monitor low water depth in other Salish Sucker-occupied watersheds.</p>	<p>A Rocha, DFO, PE</p>

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
11. Identify watersheds vulnerable to inadequate base flow for Nooksack Dace and water depth for Salish Sucker.	3-H	Hydrometric stations were installed in Bertrand Creek watershed (2 sites at the mainstem and 1 site at Howe’s Creek) in 2019 and 2020 to continuously monitor flow. These hydrometric data are publicly available at Aquarius . This tool, along with Water Survey of Canada station data at Fishtrap Creek, Pepin Creek, and Salmon River is publicly available. Watersheds vulnerable to inadequate base flow could be identified through analysis of this continuous flow data; however, this has not been completed.	BC Ministry of Forests, Lands, Natural Resources Operations and Rural Development (FLNRORD)
12. Pursue the negotiation of stewardship agreements under SARA or other forms of conservation agreements with interested agencies, organizations or individuals regarding actions that will support the recovery of Nooksack Dace and/or Salish Sucker, including habitat restoration and management.	4-J	No work was completed on this recovery measure during the reporting period.	N/A

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
13. Implement protocols for monitoring Nooksack Dace and Salish Sucker recovery.	1-A	Formal protocols for monitoring Salish Sucker recovery have not been developed; however, population monitoring using standardized sampling methods is ongoing (refer to recovery measure 1).	A Rocha, BC ENV, Cheam First Nation, Chilliwack Field Naturalists, DFO, FVC, FVWC, Little Campbell Watershed Society, LFFA, PE, seyem' Qwantlen Resources Ltd., Save Our Slough, Skwah First Nation, Soowahlie First Nation, TWU, UBC, The WaterWealth Project, Watershed Watch Salmon Society
14. Identify sediment sources and quantify sediment accumulation in riffles in watersheds containing Nooksack Dace or Salish Sucker.	2-B	Analysis of substrate photos taken in 2018 within Nooksack Dace critical habitat could inform sediment accumulation issues in riffles in watersheds occupied by both Nooksack Dace and Salish Sucker (refer to recovery measure 10 in table 4 for details). Specific sediment sources within Salish Sucker watersheds have not been identified.	BC ENV, DFO, PE
15. Determine levels and types of sediment in riffles that are harmful to Nooksack Dace and Salish Sucker.	2-B	The levels and types of sediment in riffles that are harmful to Salish Sucker have not been evaluated. However, research on effects of sediment accumulation on Nooksack Dace may inform the threat to Salish Sucker; as specified in the action plan. This was completed in 2017.	N/A

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>16. Identify biologically based minimum in-stream flows (Nooksack Dace) and water depth (Salish Sucker) in habitats with high potential productivity.</p>	<p>2-B</p>	<p>Hydrometric monitoring (water depth and discharge rates) was conducted on the Little Campbell River (north of the 16th Ave crossing) from June 2019 to April 2021. Discharge rates fell below 10% mean annual discharge from June to November 2019 and June to October 2020. In addition, continuous water data (including water depth, temperature, dissolved oxygen, conductivity, and pH) was collected between November 2018 and March 2021 using water quality sondes at two locations (16th Ave and 176th Street crossings) within the Little Campbell River watershed. Results from dry reach monitoring at 200th Street crossing indicated that peak dewatering occurred in mid-September (refer to recovery measure 7 in this table).</p>	<p>A Rocha, DFO</p>
<p>17. Analyze, and re-assess as needed, data on the extent and severity of hypoxia, its relationship with in-stream flows, land use and Salish Sucker population levels. Ensure research results are shared with interested groups.</p>	<p>2-B</p>	<p>Analysis of survey data from 2003 to 2018 on fish community and water quality (dissolved oxygen and temperature) throughout Salish Sucker critical habitat showed that hypoxia is driven by a synergy between low summer flows, elevated temperatures, and high primary production associated with eutrophication (Rosenfeld et al. 2021). Results showed that over 40% of Salish Sucker critical habitat experiences hypoxia (dissolved oxygen <4 mg/L) by late summer. Salish Sucker showed strong selection against high water temperatures and weak negative selection against low dissolved oxygen. Climate projections showed declining summer flows and elevated temperatures, which could result in increasing hypoxia without watershed-scale management, including reduction and mitigation of nutrient loading.</p>	<p>BC ENV, DFO, PE, UBC</p>
<p>18. Analyze, and re-assess as needed, data on the extent and severity of hypoxia, its relationship with in-stream flows, land use and Salish Sucker population levels. Ensure research results are shared with interested groups.</p>	<p>2-B</p>	<p>Flow manipulation experiments conducted in 2018 showed that eutrophication is a key driver of hypoxia in reduced flows, and that Salish Sucker are sensitive to water quality and temperature conditions (Zinn 2020).</p>	<p>BC ENV, DFO, UBC</p>

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
19. Collect detailed seasonal oxygen profiles for selected Salish Sucker critical habitat reaches.	2-B	<p>Continuous dissolved oxygen data was collected using water quality sondes within the Little Campbell River watershed (16th Ave and 176th Street crossings) from November 2018 to March 2021.</p> <p>Detailed seasonal oxygen profiles have not been collected in other watersheds.</p>	A Rocha , DFO
20. Collect detailed seasonal oxygen profiles for selected Salish Sucker critical habitat reaches.	2-B	Dissolved oxygen data has been collected through previous surveys and restoration projects. Reaches that experience severe hypoxia have been documented and include reaches in Mountain Slough (above an existing beaver dam), McCallum Slough, Little Campbell River, and Freytag Creek.	A Rocha, Chawathil First Nation, DFO, FVC, FVWC, LFFA, PE
21. Estimate the extent and severity of harmful substances in watersheds where Nooksack Dace or Salish Sucker are present. Where possible, identify possible sources of contamination and engage relevant agencies, stewardship groups and landowners regarding reducing or eliminating these sources.	3-D	<p>The British Columbia-Washington Nooksack River Transboundary Technical Collaboration Group (TCG) was formed to conduct a 3-year water quality monitoring program from 2018 to 2021 to monitor, identify, and reduce fecal bacteria concentrations in the Nooksack River watershed, which include the Bertrand Creek, Fishtrap Creek, and Pepin Creek sub-basin watersheds (BC-WA Nooksack River Transboundary TCG 2019, 2020, 2021). Outreach and compliance promotion was conducted with agricultural, industrial, and residential sectors as well as municipalities.</p> <p>See activities under recovery measure 16 for habitat restoration activities that contribute to reduction of harmful substances to instream habitats, namely riparian vegetation planting.</p>	BC ENV, Whatcom Clean Water Program

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
22. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Macroinvertebrate and water quality sampling was conducted in Hope Slough and Elk Creek (a tributary to Hope Slough) from 2017 to 2019 to evaluate existing habitat conditions, identify habitat issues, and help build technical capacity among participating First Nations and the broader community. Water and habitat quality issues were observed. Invasive plant removal was conducted at Elk Creek in 2019 as part of an Oregon Spotted Frog habitat restoration project (approximately 400 m ² enhanced) which provides direct habitat benefits to Salish Sucker.	Cheam First Nation, Chilliwack Field Naturalists , DFO, FVC , PE, Save Our Slough, Skwah First Nation, Soowahlie First Nation, The WaterWealth Project, Watershed Watch Salmon Society
23. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted in Salmon River watershed from 2017 to 2019 (approximately 2,500 m ² enhanced). Restoration activities included native vegetation planting, tree protection (beaver guards), and off-channel pond construction. Landowner engagement was also conducted. As part of the restoration project, Indigenous Knowledge interviews on Salish Sucker were conducted with Kwantlen community members in 2018. Interview transcriptions were added to the Kwantlen Territory knowledge database.	DFO, FVWC, Greater Vancouver Zoo (GVZ), Langley Environmental Partners Society (LEPS) , LFFA, PE, seyem' Qwantlen Resources Ltd. , TWU
24. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted at Agassiz Slough and McCallum Slough from 2017 to 2021 (approximately 10,512 m ² enhanced). Restoration activities included native vegetation planting, invasive plant removal, tree protection (beaver guards), and monitoring/ maintenance. Landowner engagement was also conducted. Planting resulted in low plant survival and restoration success was limited.	DFO, FVC , FVWC, Metro Van Parks, Pacific Salmon Foundation (PSF), PE

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>25. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.</p>	<p>3-E, 3-F, 3-G</p>	<p>Habitat restoration was conducted at Fishtrap Creek in 2018 (approximately 1,000 m² enhanced). Restoration activities included side channel construction, large woody debris complexing, riffle placement, and riparian vegetation planting.</p>	<p>BC Ministry of Transportation and Infrastructure (BC MoTI), City of Abbotsford</p>
<p>26. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.</p>	<p>3-E, 3-F, 3-G</p>	<p>Habitat restoration was conducted at Luckakuck Creek and Semmihault Creek in Chilliwack Delta from 2018 to 2020 (approximately 10,000 m² enhanced). Restoration activities included deepening of existing pond in a side channel to Luckakuck Creek, riffle construction to control pond water levels and improve fish access, native vegetation planting, and pre-and post- restoration monitoring, and maintenance. Landowner engagement was also conducted. Riparian vegetation planting was also conducted at Semmihault Creek as part of an Oregon Spotted Frog habitat restoration project (approximately 1,600 m² enhanced) which provides direct habitat benefits to Salish Sucker.</p>	<p>DFO, FVC, FVWC, Metro Van Parks, PSF, PE</p>
<p>27. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.</p>	<p>3-E, 3-F, 3-G</p>	<p>Habitat restoration was conducted at Gordon's Brook (tributary to Pepin Creek) from 2018 to 2020 (approximately 10,000 m² enhanced). Restoration activities included native vegetation planting, monitoring/maintenance, ephemeral wetland construction, and development and implementation of beaver management plan. Deterrence of beaver habitat reconstruction (for example, removal and lowering of beaver dams, relocation of beavers) has been partially successful and monitoring is ongoing.</p>	<p>Ibid</p>

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
28. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted at Miami River from 2018 to 2019 (approximately 15,000 m ² enhanced). Restoration activities included substrate enhancement, native vegetation planting, instream habitat enhancement (construction of off-channel ponds and spawning riffle), and monitoring/ maintenance. Landowner engagement was also conducted. Use of constructed habitat (off-channel ponds) by Salish Sucker has been confirmed.	Ibid, Harrison Nature Stewards
29. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted at Little Campbell River watershed from 2018 to 2021 (approximately 1,000 m ² enhanced). Restoration activities included native vegetation planting, invasive plant removal, and monitoring/ maintenance. Landowner engagement was also conducted.	A Rocha , DFO
30. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted at Bertrand Creek watershed from 2019 to 2020 (approximately 2,150 m ² enhanced). Restoration activities included culvert replacement at Cave Creek, native vegetation planting, invasive plant removal, monitoring/ maintenance, and riparian health assessments. Landowner engagement was also conducted.	BCES, DFO, LEPS , PE, Township of Langley (ToL)
31. Develop, implement and monitor in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects that will benefit Nooksack Dace, Salish Sucker or both species.	3-E, 3-F, 3-G	Habitat restoration was conducted at Freytag Creek on Chawathil First Nation IR4 from 2019 to 2021 (approximately 5,000 m ² enhanced). Restoration activities included instream habitat enhancement, and monitoring/ maintenance. Elders and Knowledge Holders were interviewed on Chawathil habitat history and the restoration design from 2019 to 2020. Engagement yielded information on high historical flow rates.	Chawathil First Nation , DFO, LFFA, PE
32. Identify beaver management protocols and practices that increase flow without degrading or physically destroying pool or riffle habitats used by Nooksack Dace in watersheds where they are present; and map the extent of beaver and human impoundments of critical habitat for Nooksack Dace in Pepin Creek.	3-E, 3-F, 3-G	This recovery measure does not apply to Salish Sucker.	N/A

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>33. Ensure that Nooksack Dace and Salish Sucker needs are included as targets of existing incentive programs that support and promote riparian planting, in-stream habitat restoration projects and the voluntary adoption of beneficial land management practices by private landowners; explore possible mechanisms for additional incentives to encourage private landowners to undertake riparian planting or in-stream habitat restoration projects that benefit Nooksack Dace or Salish Sucker; and explore options for overcoming barriers that may reduce landowners' willingness to undertake such actions and projects.</p>	<p>3-E, 3-F, 3-G</p>	<p>Stewardship practices guides from the SCBC were updated in 2018 for drainage maintenance/ stewardship and riparian restoration/ enhancement activities that relate directly to Salish Sucker and their habitats (SCBC 2018a, b). The updated guides provide best practices for restoring/enhancing riparian areas (for example, livestock exclusion fencing, creation of riparian wetlands) and for drainage maintenance (for example, working with machinery in water).</p> <p>Several habitat restoration projects were conducted in partnership with First Nations and private landowners (refer to recovery measure 16). Engagement was conducted in conjunction with restoration projects to promote best land management practices, including a large door-to-door canvassing campaign in the Hope Slough watershed from 2017 to 2019 to raise species awareness and identify priority habitat enhancement opportunities. Over 200 landowners were contacted. Habitat assessments were conducted on the properties of interested landowners and information was shared about the Farmland Advantage¹² incentive program.</p> <p>No incentive programs currently exist that directly target Salish Sucker needs.</p>	<p>A Rocha, BCES, Chawathil First Nation, DFO, FVC, FVWC, GVZ, LEPS, LFFA, Metro Van Parks, PE, PSF, seym' Qwantlen Resources Ltd., SCBC, ToL, TWU</p>
<p>34. Engage interested agencies, groups and individuals in order to develop and negotiate conservation agreements under SARA or other management agreements to ensure that minimum in-stream flow (Nooksack Dace) and water depth (Salish Sucker) requirements are met in habitats with high potential productivity.</p>	<p>3-H</p>	<p>No work was completed on this recovery measure during the reporting period.</p>	<p>N/A</p>

¹² [Farmland Advantage](#) is a research and development program that works with farmers to protect and conserve critical, natural lands, streams and habitats in British Columbia.

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
35. Develop and encourage voluntary adoption of habitat enhancement guidelines for Nooksack Dace, Salish Sucker and co-occurring species at risk.	4-J	Habitat enhancement guidelines were drafted in 2018 to provide guiding principles and practical advice for incorporating habitat features that benefit Salish Sucker into non-targeted habitat restoration projects and instream works. These draft guidelines have not been published.	DFO, FVC, PE
36. Work with stakeholders in Washington to understand transboundary population structure and movements in Bertrand Creek, Fishtrap Creek and Pepin Creek.	5-L	No work was completed on this recovery measure during the reporting period.	N/A
37. Characterize the impacts of introduced predators on the mortality and habitat use by different life stages of Salish Sucker.	2-B	No work was completed on this recovery measure during the reporting period.	N/A
38. Undertake projects to prevent and mitigate sedimentation of riffles from urban, agricultural and industrial sources.	3-C	<p>See activities under recovery measure 16 for details on recovery activities related to riparian vegetation planting and bank stabilization to prevent and mitigate sediment entry and sedimentation of riffles. Reduction of sedimentation from urban and industrial sources has not been achieved.</p> <p>Any works, undertakings, or activities that result in the death of fish or the harmful alteration, disruption, or destruction of fish habitat are subject to regulatory review and authorization under the federal <i>Fisheries Act</i> to prevent and mitigate sedimentation. The BC RAPA protects riparian areas from new development, which limits additional sediment entry into stream habitat. Both the <i>Fisheries Act</i> and the <i>Riparian Areas Protection Regulation</i>, established under RAPA, were amended in 2019.</p>	DFO, Municipal Governments
39. Undertake projects to reduce harmful substances of local watersheds by storm water or other sources, including development of settling ponds in urban areas.	3-D	No work was completed on this recovery measure during the reporting period.	N/A

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>40. Adopt practices to reduce or eliminate sources of harmful substances for local watersheds, including practices related to pesticide and herbicide application and use and spill response planning.</p>	<p>3-D</p>	<p>Stewardship practices guides from the SCBC were updated in 2018 for drainage maintenance/ stewardship and riparian restoration/ enhancement activities that relate directly to Salish Sucker and their habitats (SCBC 2018a, b). The updated guides provide best practices for reducing input of harmful substances (for example, proper application and storage of pesticides, herbicides, and fertilizers).</p> <p>The British Columbia (BC) - Washington (WA) Nooksack River Transboundary Technical Collaboration Group conducted outreach and compliance promotion to reduce or eliminate sources of harmful substances to agricultural, industrial, and residential sectors as well as municipalities from 2018 to 2021.</p>	<p>BC ENV, SCBC, Whatcom Clean Water Program</p>
<p>41. Undertake mitigation for permanent and/or seasonal barriers to Nooksack Dace and Salish Sucker movement such as perched or undersized culverts.</p>	<p>3-E, 3-F, 3-G</p>	<p>Habitat restoration conducted at Luckakuck Creek and Semmihault Creek in Chilliwack Delta from 2018 to 2020 included riffle construction to control pond water levels and improve fish access.</p> <p>A culvert was replaced at Cave Creek in 2019 to improve upstream access to Salish Sucker habitat. The culvert requires ongoing maintenance to improve functionality.</p> <p>Refer to recovery measure 16 for details.</p>	<p>BCES, DFO, FVC, FVWC, LEPS, Metro Van Parks, PSF, PE, ToL</p>

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>42. Promote or support the inclusion of Nooksack Dace and Salish Sucker habitat needs in existing incentive programs that support and promote in-stream habitat restoration or creation projects, sediment mitigation projects, and riparian planting projects and the adoption of land management practices by private landowners.</p>	<p>3-E, 3-F, 3-G</p>	<p>Several habitat restoration projects were conducted in partnership with First Nations and private landowners (refer to recovery measure 16). Engagement was conducted in conjunction with the restoration projects to promote best land management practices, including a large door-to-door canvassing campaign in the Hope Slough watershed from 2017 to 2019 to raise species awareness and identify priority habitat enhancement opportunities. Over 200 landowners were contacted. Habitat assessments were conducted on the properties of interested landowners and information was shared about the Farmland Advantage incentive program.</p> <p>Stewardship practices guides from the SCBC were updated in 2018 for drainage maintenance/ stewardship and riparian restoration/ enhancement activities that relate directly to Salish Sucker and their habitats (SCBC 2018a, b). The updated guides provide best practices for restoring/enhancing riparian areas (for example, livestock exclusion fencing, creation of riparian wetlands) and for drainage maintenance (for example, working sensitively with machinery in water).</p> <p>No incentive programs currently exist that directly target Salish Sucker needs.</p>	<p>A Rocha, BCES, Chawathil First Nation, DFO, FVC, FVWC, GVZ, LEPS, LFFA, Metro Van Parks, PE, PSF, seyem' Qwantlen Resources Ltd., SCBC, ToL, TWU</p>
<p>43. Consider the needs of Nooksack Dace and Salish Sucker in Official Community Plans, and implement projects to manage discharge rates and maintain adequate water quantity.</p>	<p>3-H</p>	<p>No work was completed on this recovery measure during the reporting period.</p>	<p>N/A</p>

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>44. Adopt or continue to apply beneficial nutrient management practices, urban design practices and/or water management practices that reduce nutrient loading in watersheds where Salish Sucker are present.</p>	<p>3-I</p>	<p>Best nutrient and water management practices have been shared by local stewardship groups during activities associated with riparian vegetation planting and landowner engagement (refer to recovery measures 16 and 32).</p>	<p>A Rocha, BCES, Chawathil First Nation, DFO, FVC, FVWC, GVZ, ISC, LEPS, LFFA, Metro Van Parks, PE, PSF, seyem' Qwantlen Resources Ltd., ToL, TWU</p>
<p>45. Develop a stewardship and engagement strategy for Nooksack Dace and Salish Sucker to increase efficiency and effectiveness of stewardship actions, including incorporating information about Nooksack Dace and Salish Sucker into existing stewardship initiatives.</p>	<p>4-J</p>	<p>A Salish Sucker stewardship and engagement strategy has not been developed; however, engagement and public outreach for Salish Sucker has been conducted during this progress reporting period (refer to recovery measures 18 and 32).</p>	<p>A Rocha, BCES, Chawathil First Nation, DFO, FVC, FVWC, GVZ, ISC, LEPS, LFFA, Metro Van Parks, PE, PSF, seyem' Qwantlen Resources Ltd., SCBC, ToL, TWU</p>
<p>46. Consider entering into a stewardship agreement under SARA or another type of conservation agreement regarding actions that will support the recovery of Nooksack Dace and/or Salish Sucker, including habitat restoration and management.</p>	<p>4-J</p>	<p>No work was completed on this recovery measure during the reporting period.</p>	<p>N/A</p>

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
<p>47. Develop and provide public education materials and information on Nooksack Dace, Salish Sucker, watershed ecology and actions that individuals and groups can take to benefit both species to landowners, members of the public and interested groups through presentations, field tours, landowner contact programs or other outreach tools.</p>	<p>4-J</p>	<p>Outreach presentations were conducted at/with UBC (4), British Columbia Institute of Technology, Simon Fraser University, Chilliwack Field Naturalists, BC Nature Field Camp, Chilliwack Valley Ratepayers Association, and DFO Fishery Officer Workshop from 2017 to 2020.</p> <p>Three interpretive signs about Salish Sucker were installed at Greater Vancouver Zoo (GVZ) in 2017 and 2018.</p>	<p>DFO, FVC, FVWC, GVZ, PE</p>
<p>48. Develop and provide public education materials and information on Nooksack Dace, Salish Sucker, watershed ecology and actions that individuals and groups can take to benefit both species to landowners, members of the public and interested groups through presentations, field tours, landowner contact programs or other outreach tools.</p>	<p>4-J</p>	<p>Twenty species at risk education sessions were delivered from 2017 to 2020 which included awareness and promotion of Salish Sucker recovery to students, government, and professional organizations in Langley, BC. Education sessions were conducted in numerous formats, including classroom presentations/workshops, interpretative walks, and how volunteers can undertake planting. An outreach newsletter was printed in 2018 LEPS annual report to highlight Salish Sucker biology and distributed to partner organizations.</p>	<p>DFO, ISC, LEPS</p>
<p>49. Develop and provide public education materials and information on Nooksack Dace, Salish Sucker, watershed ecology and actions that individuals and groups can take to benefit both species to landowners, members of the public and interested groups through presentations, field tours, landowner contact programs or other outreach tools.</p>	<p>4-J</p>	<p>Over 120 people attended conservation science presentations in 2018 and 2019 which raised community awareness on species at risk conservation in the Little Campbell River watershed. These presentations included educational information on Salish Sucker and low flow and hypoxic issues within the watershed.</p> <p>Little Campbell River watershed report cards were developed in 2019 and 2020 to evaluate overall watershed health (including monitoring of Salish Sucker, low flows, and hypoxia). The 2019 report card was distributed to over 4,000 landowners. The 2020 report card was distributed to visitors of the A Rocha Brooksdale property.</p>	<p>A Rocha, DFO</p>

Recovery measure ¹⁰	Approach	Description and results	Participants ¹¹
50. Consider and incorporate Nooksack Dace and Salish Sucker needs in new and existing plans, programs, strategies, and stewardship initiatives for the management of watersheds where either or both species is present.	4-J	Various ongoing initiatives consider Salish Sucker needs (refer to recovery measures 18, 27, 30, 32)	A Rocha, BCES, Chawathil First Nation, DFO, FVC, FVWC, GVZ, LEPS, LFFA, Metro Van Parks, PE, PSF, seyem' Qwantlen Resources Ltd., SCBC, ToL, TWU
51. Develop and implement stewardship projects that include the public education materials and information to recreational fishers and other relevant groups on the impacts that introduced predators can have on Salish Sucker and local watershed ecology.	4-K	General public awareness of aquatic invasive species through outreach programs has increased over the reporting period owing to increased provincial- and national-scale aquatic invasive species prevention campaigns such as: Don't Let it Loose and Clean, Drain, and Dry. Signage on invasive Smallmouth Bass was installed at Cultus Lake (upstream of Salish Sucker habitat in Salwein Creek) after it was first detected in 2018.	BC ENV, FLNRORD, Freshwater Fisheries Society of BC (FFSBC)

3.2 Activities supporting the identification and refinement of critical habitat

Tables 6 and 7 provide information on the implementation of the studies outlined in the schedule of studies to identify and refine critical habitat within both recovery strategies ([DFO 2020a, b](#)). Each study has been assigned one of four statuses:

- 1) completed: the study has been carried out and concluded
- 2) in progress: the planned study is underway and has not concluded
- 3) not started: the study has been planned but has yet to start
- 4) cancelled: the planned study will not be started or completed

For both Nooksack Dace and Salish Sucker, critical habitat has been identified in the recovery strategies to the extent possible, using the best available information, and provides the functions, features, and attributes necessary to support the species' life-cycle

processes and to achieve the species' population and distribution objectives. Further research may result in identification of additional critical habitat and/or refine understanding of the functions, features and attributes of the currently identified critical habitat.

Table 6. Status and details of the implementation of the schedule of studies outlined in the Nooksack Dace recovery strategy.

Study	Recovery strategy timeline	Status	Descriptions and results	Participants ¹³
Reconnaissance surveys for undocumented Nooksack Dace populations (for example, Chilliwack River; Harrison Lake, Stave Lake, and Hayward Lake tributaries)	2018 to 2022	In progress	Field surveys and genetic analysis of fin clips were conducted from 2017 to 2018 to confirm potential new populations of Nooksack Dace from upper Chilliwack River, Chilliwack Lake, Harrison Lake and three of its tributaries (refer to recovery measure 3 in table 4).	BC Ministry of Environment & Climate Change Strategy (BC ENV) , Fisheries and Oceans Canada (DFO), Pearson Ecological (PE)
Evaluation of riffle quality in all critical habitat reaches using measures of sedimentation, minimum flows, macroinvertebrate productivity and diversity, and relative abundance of Nooksack Dace	2019 to 2023	In progress	<p>Harmful levels and types of sediment in riffles and biologically based minimum in-stream flows for Nooksack Dace have been identified. Both these factors impact riffle quality (refer to recovery measures 11 and 12 in table 4).</p> <p>In 2018, 256 underwater substrate photos were taken in Nooksack Dace critical habitat to evaluate sediment accumulation in riffles (refer to recovery measure 10 in table 4). Photos will be analyzed to characterize current habitat quality.</p> <p>Evaluation of riffle quality using measures of relative abundance of Nooksack Dace in specific critical habitat reaches has not been conducted.</p>	BC ENV, DFO, PE

¹³ Listed participants is based on best available information; DFO acknowledges the large network of people that contribute to recovery of Nooksack Dace or Salish Sucker and regrets any potential omissions of contributors. When more than one participant is associated with an activity, they are listed in alphabetical order with project leads identified in bold.

Table 7. Status and details of the implementation of the schedule of studies outlined in the Salish Sucker recovery strategy.

Study	Recovery strategy timeline	Status	Descriptions and results	Participants ¹³
Winter habitat use	2018 to 2020	In progress	<p>Winter sampling was conducted in Pepin Creek, Miami River, Mountain Slough and Bertrand Creek watersheds to evaluate Salish Sucker winter habitat distribution from 2018 to 2019. Winter occupancy of Salish Sucker in reaches that are typically dry or anoxic and devoid of fish in the summer was confirmed in all watersheds except for Mountain Slough.</p> <p>Inventory mapping of overwintering habitat areas was conducted in Freytag Creek from 2019 to 2020 and will inform critical habitat identification for the Chawathil population (refer to recovery measure 3 in table 5)</p> <p>It has not been determined whether these winter captures represent large scale seasonal movements and redistributions within the watershed.</p>	BC ENV, Chawathil First Nation, DFO, PE
Extent and severity of seasonal hypoxia in critical habitat	2018 to 2022	In progress	<p>Dissolved oxygen data has been collected through previous surveys and restoration projects. Reaches that experience severe hypoxia have been documented and include reaches in Mountain Slough (above an existing beaver dam), McCallum Slough, Little Campbell River, and Freytag Creek (refer to recovery measure 14 of table 5).</p> <p>Analysis of survey data from 2003 to 2018 showed that over 40% of Salish Sucker critical habitat experiences hypoxia (dissolved oxygen <4 mg/L) by late summer and that it is driven by a synergy between low summer flows, elevated temperatures, and high primary production associated with eutrophication (Rosenfeld et al. 2021; refer to recovery measure 13 in table 5).</p> <p>Continual monitoring and analysis of dissolved oxygen levels (including diurnal and seasonal patterns) will provide further understanding of the threat and trends of hypoxia in Salish Sucker critical habitat.</p>	A Rocha, BC ENV , Chawathil First Nation, DFO, Fraser Valley Conservancy (FVC), Fraser Valley Watersheds Coalition (FVWC), Lower Fraser Fisheries Alliance (LFFA), PE

Study	Recovery strategy timeline	Status	Descriptions and results	Participants ¹³
Identify spawning sites for all populations	2016 to 2021	In progress	<p>Knowledge of spawning sites is incomplete for all watersheds. Spawning locations at Agassiz Slough, Miami Creek, Chilliwack Delta, and Hopedale Slough watersheds are unknown (Pearson pers. comm. 2021). In other watersheds, it is assumed that riffles in occupied reaches are spawning sites based on previous field surveys.</p> <p>Trapping studies within Little Campbell River watershed from 2018 to 2021 confirmed spawning sites at the Red Willow Ranch reach and in a tributary near 192 Street.</p>	A Rocha, DFO, PE
Improve information used to identify juvenile critical habitat	2016 to 2020	In progress	Identification of suitable juvenile critical habitat has been documented through juvenile overwintering habitat surveys, pre- and post-construction monitoring of restoration projects, and mark-recapture surveys to estimate population abundances. Refer to recovery measures 1, 3, and 16 in table 5.	A Rocha, BC ENV, Chawathil First Nation, DFO, PE

3.3 Summary of progress towards recovery

3.3.1 Status of performance indicators

Table 8 and 9 provide a summary of the progress made toward meeting the performance indicators outlined in table 1. Each indicator has been assigned one of four statuses:

- 1) not met: the performance indicator has not been met, and little to no progress has been made
- 2) partially met, underway: moderate to significant progress has been made toward meeting one or more elements of the performance indicator, and further work is ongoing or planned
- 3) met: the performance indicator has been met and no further action is required
- 4) met, ongoing: the performance indicator has been met, but efforts will continue until such time the population is considered to be recovered

Table 8. Progress and details of the progress made toward meeting the performance indicators outlined in the Nooksack Dace recovery strategy.

Performance indicator	Status ¹⁴	Details
<p>Performance indicator for population objective: Nooksack Dace is found at moderate density¹⁵ in:</p> <ul style="list-style-type: none"> - more than 60% of historically occupied reaches in each watershed, which indicates recovery of that watershed’s population abundance - more than 60% of historically occupied reaches in all four occupied watersheds in British Columbia (BC), which indicates recovery of Nooksack Dace population abundance in Canada 	Not met	Based on 2018 surveys (refer to measure 1 in table 4), Nooksack Dace was detected in moderate densities (catch per unit effort [CPUE] >0.25 fish per trap) in 46% (5 of 11) of sampled critical habitat reaches in Bertrand Creek watershed. Moderate densities were not observed in Brunette (2 reaches sampled), Fishtrap (7 reaches sampled), and Pepin (5 reaches sampled) watersheds. Moderate abundance of Nooksack Dace was only observed in 20% of sampled critical habitat reaches in all four occupied watersheds in BC.

¹⁴ The progress status of performance indicators correspond with timelines laid out in the population and distribution objectives. See table 1 for further details.

¹⁵ Moderate density is indicated by a catch per unit effort of >0.25 Nooksack Dace per Gee minnow trap (Pearson 2004) with a minimum effort of 1 trap per 5 m of riffle length or 20 traps per reach.

Performance indicator	Status ¹⁴	Details
<p>Performance indicator for distribution objective: Nooksack Dace is present in:</p> <ul style="list-style-type: none"> - more than 80% of reaches in each watershed, which indicates recovery of a watershed’s population distribution - more than 80% of reaches in all four occupied watersheds in BC, which indicates recovery of the Nooksack Dace distribution in Canada 	<p>Not met</p>	<p>Based on 2018 surveys (refer to measure 1 in table 4), Nooksack Dace was found to be present at:</p> <ul style="list-style-type: none"> - 64% (7 of 11) of sampled critical habitat reaches in Bertrand Creek watershed - 50% (1 of 2) of sampled critical habitat reaches in Brunette River watershed - 14% (1 of 7) of sampled critical habitat reaches in Fishtrap Creek watershed - 20% (1 of 5) of sampled critical habitat reaches in Pepin Creek watershed <p>Nooksack Dace was found to be present at 40% of sampled critical habitat reaches in all four occupied watersheds in BC.</p>

Table 9. Progress and details of the progress made toward meeting the performance indicators outlined in the Salish Sucker recovery strategy.

Performance indicator	Status ¹⁰	Details
<p>Performance indicator for population objective: Salish Sucker is found at abundance levels corresponding with population targets, where the population target for each watershed is met or exceeded, which indicates recovery of that watershed’s population abundance</p>	<p>Not met</p>	<p>Population abundances are below target population levels at all watersheds¹⁶:</p> <ul style="list-style-type: none"> - The population at Agassiz Slough was last estimated in 2012 at 203 to 354¹⁷ breeding adults. The recovery target is 1,500 breeding adults - The population at Miami River was last estimated in 2012 at 67 to 193 breeding adults. The recovery target is 1,500 breeding adults - The population at Chilliwack Delta (Luckakuck, Semmihault, Atchelitz, and Little Chilliwack creeks and Interception Ditch) was last estimated in 2015 at a total population of 2,254 breeding adults. The recovery target is 5,500 breeding adults - The population at Salwein Creek was estimated in 2020 at 108 to 342 breeding adults. The previous abundance estimate was conducted in 2012 at 191 to 635 breeding adults. The population at Hopedale Slough was last estimated in 2012 at 346 to 712 breeding adults. An updated mark-recapture survey was attempted in 2019 with insufficient numbers to estimate abundance. The recovery target for Salwein Creek/ Hopedale Slough is 2,500 breeding adults - The recovery target for the entire population at Bertrand Creek watershed is 4,000 breeding adults. Based on updated mark-recapture studies that were conducted at all sub-populations in the last five years: <ul style="list-style-type: none"> o sub-population abundances could not be estimated at Bertrand mainstem and Howe’s Creek due to insufficient mark-recapture numbers from 2020

¹⁶ Recovery targets do not exist for the Freytag Creek population at Chawathil First Nation

¹⁷ Population ranges provided in this cell are based on 95% confidence intervals

Performance indicator	Status ¹⁰	Details
		<p>surveys. The previous abundance estimate at Bertrand mainstem was 638 to 862 breeding adults in 2013. The previous abundance estimate at Howe's Creek was 206 to 711 breeding adults in 2012</p> <ul style="list-style-type: none"> ○ the sub-population at Perry Homestead Creek was estimated in 2017 at 341 to 1082 breeding adults ○ the sub-population at Cave Creek was estimated in 2019 at 260 to 400 breeding adults <ul style="list-style-type: none"> - The population at Pepin Creek was last estimated in 2012 at 1,318 to 2,900 breeding adults. The recovery target is 2,500 breeding adults - The last available population estimate at upper Salmon River watershed was 649 to 915 breeding adults in 2013. An updated mark-recapture survey was attempted in 2019 but insufficient numbers to estimate abundance, possibly because sampling did not take place at SLN 42 reach where the majority of Salish Suckers in this watershed were previously captured. Limited surveys in the Lower Salmon River yielded zero captures in 2020. The recovery target is 2,000 breeding adults - The population in the entire Little Campbell River watershed is estimated to be in the low hundreds based on population estimates conducted in the reach at Red Willow ranch from 2017 to 2020. The recovery target is 5,000 breeding adults - The population at Freytag Creek was estimated in 2019 at 47 to 93 breeding adults. There is no recovery target established for this population - Population abundance estimates are not available at Mountain Slough, Elk Creek/Hope Slough, and Fishtrap Creek due to insufficient mark-recapture numbers. Population surveys were last conducted in 2016 at Mountain Slough (recovery target is 3,000 breeding adults), 2015 at Elk Creek/Hope Slough (recovery target is 2,500 breeding adults), and 2019 at Fishtrap Creek (recovery target is 1,500 breeding adults)
<p>Performance indicator for population objective: Salish Sucker is found at abundance levels corresponding with population targets, where the population targets across all 11 occupied watersheds in British Columbia (BC) are met or exceeded, which indicates recovery of Salish Sucker in Canada</p>	<p>Not met</p>	<p>Population abundance targets have not been met across all occupied watersheds.</p>

Performance indicator	Status ¹⁰	Details
<p>Performance indicator for distribution objectives: Salish Sucker is present in all reaches that have been identified as critical habitat in each watershed, which indicates recovery of a watershed's population distribution</p>	<p>Not met</p>	<p>There are no watersheds in which presence of Salish Sucker has been confirmed in all critical habitat reaches:</p> <ul style="list-style-type: none"> - Salish Suckers were present in a portion of critical habitat reaches at Mountain Slough, Salwein/Hopedale, Bertrand Creek, Fishtrap Creek, Salmon River, and Little Campbell River in the last 5 years - No Salish Suckers were captured at Elk Creek/Hope Slough during 2017 to 2019 surveys - No surveys at Agassiz Slough, Miami River, Pepin Creek, and Chilliwack Delta were completed during this reporting period
<p>Performance indicator for distribution objectives: Salish Sucker is present in all reaches that have been identified as critical habitat across all 11 occupied watersheds in BC, which indicates recovery of the Salish Sucker distribution in Canada</p>	<p>Not met</p>	<p>Salish Sucker presence has not been confirmed in all critical habitat reaches across all occupied watersheds.</p>

3.3.2 Critical habitat identification and protection

Critical habitat for Nooksack Dace and Salish Sucker was identified to the extent possible in the recovery strategies using best available information, and provides the functions, features, and attributes necessary to support the species' life-cycle processes and to achieve the species' population and distribution objectives. A critical habitat order was established in 2016 and amended in 2020 to protect the Nooksack Dace's critical habitat from destruction. A critical habitat order was established in 2019 to protect the Salish Sucker's critical habitat from destruction. SARA critical habitat orders are made under subsections 58(4) and (5) and invoke the prohibition in subsection 58(1) against the destruction of identified critical habitat.

The schedule of studies provided in section 8 of the recovery strategies outline further research required to identify additional critical habitat and refine the understanding of the functions, features and attributes of the currently identified critical habitat necessary to support the species' population and distribution objectives and protect critical habitat from destruction.

3.3.3 Socio-economic impact

Under section 55 of SARA, the responsible federal minister is required to undertake an evaluation of the socio-economic costs of the action plan and benefits to be derived from its implementation. This section updates the socio-economic impacts associated with implementation of the action plan.

As per section 49(1)(e) of SARA, the action plan included a socio-economic evaluation of costs of the action plan and benefits to be derived from its implementation (section 2 of the 2017 action plan and section 3 of the 2020 amended action plan). Many of the economic costs associated with implementation of recovery actions have been, and will continue to be, borne by government agencies such as DFO. These were evaluated as a reallocation of existing government funds and are not considered additional costs to society. There have also been opportunity costs associated with these government funded actions; however, these are not easily quantified. This evaluation considers the economic costs and benefits of recovery activities that have taken place over the reporting period.

A large part of the economic costs borne by the federal government for Nooksack Dace and Salish Sucker recovery are provided via the Aboriginal Fund for Species at Risk (AFSAR), Habitat Stewardship Program for Species at Risk (HSP), and Canada Nature Fund for Aquatic Species at Risk (CNFASAR) funding programs. Between 2016 and 2021, nine projects that included Nooksack Dace and/or Salish Sucker received funding through these programs. Projects funded by HSP, AFSAR, and CNFASAR must have dollar and in-kind costs fully or partially matched by recipients receiving the funding. Furthermore, additional costs borne by the federal government for Nooksack Dace and Salish Sucker recovery are incurred through collaborative agreements between DFO and BC. These projects are vital to the recovery of the two species and fulfilling the performance indicators from the action plan.

There are also socio-economic benefits that have come from implementation of the action plan, including positive impacts on biodiversity and the value individuals place on preserving biodiversity (Federal, Provincial, Territorial Governments of Canada, 2014). These recovery actions have provided broader ecosystem and non-market benefits.

3.3.4 Recovery feasibility

Based on the best current available information, recovery of Nooksack Dace and Salish Sucker is determined to be feasible ([DFO 2020a, b](#)). No new information has been gathered that would suggest that Nooksack Dace or Salish Sucker populations no longer meet the feasibility criteria laid out in the recovery strategy.

4. Concluding statement

Within the reporting period of this progress report (2016 to 2021), through the implementation of activities identified in the recovery documents (the recovery strategies and action plan), a foundation has been built towards the successful recovery of Nooksack Dace and Salish Sucker.

Many studies have been completed and are underway to assess population abundance and distribution, monitor habitat quality, and identify and refine critical habitat. Many habitat restoration activities have been implemented in partnership with landowners and community members, as a significant portion of critical habitat for these species is located on or adjacent to private properties. Public outreach has been conducted to foster species awareness and community stewardship.

Despite advances in knowledge about both species, as well as advances in understanding and addressing threats to the species survival and recovery, none of the performance indicators identified in the recovery strategies have been met. These two species continue to face severe threats that will require large-scale mitigation efforts in order to achieve recovery.

While progress has been made towards implementing recovery measures, continued efforts will be necessary to ensure long-term viability and recovery of Nooksack Dace and Salish Sucker in British Columbia. These include, but are not limited to:

- ongoing surveys to determine population abundance estimates and trends as well as distribution of both species
- ongoing habitat restoration and enhancement to improve habitat access and habitat quality
- continued public outreach and watershed stewardship, particularly within the agricultural community
- exploration of short-term and long-term options to address cumulative effects of local and watershed-scale threats, such as nutrient loading, sedimentation and seasonal water availability, in areas with known Nooksack Dace and Salish Sucker presence and critical habitat
- engagement with interested agencies, groups and individuals to develop and negotiate stewardship agreements under SARA or other conservation agreements that support recovery of Nooksack Dace and Salish Sucker

DFO remains committed to the survival and recovery of the Nooksack Dace and the Salish Sucker. The work underway and completed to date has built a strong foundation for continued research, recovery, and management of these species over the next reporting period.

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