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RECOVERY POTENTIAL ASSESSMENT FOR EULACHON – FRASER RIVER DESIGNATABLE UNIT

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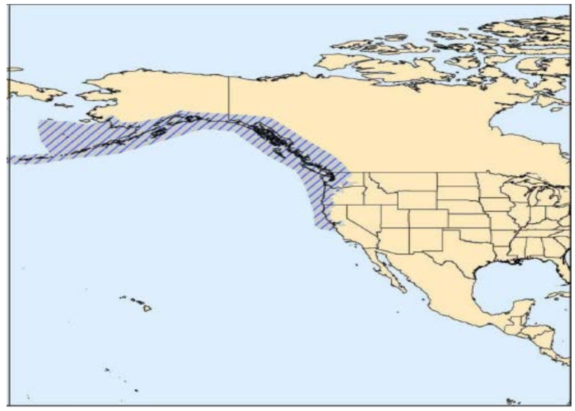

Figure 1: Global distribution of Eulachon.

Context:

The Committee on the Status of Endangered Wildlife in Canada has assessed three populations (or Designatable Units) in Canada: Fraser River as Endangered, Central Pacific Coast as Endangered and Nass/Skeena Rivers as a species of Special Concern. A Recovery Potential Assessment was undertaken to assess the possibilities of recovery of the species, recommend population targets, assess threats and propose mitigations for activities that may be causing harm to the species.

This Science Advisory Report is from the January 25-26, 2012 meeting on the Recovery Potential Assessment for Eulachon (Thaleichthys pacificus) Nass/Skeena, Central Pacific Coast and Fraser River Designatable Units. Additional publications from this process will be posted on the Fisheries and Oceans Fisheries and Oceans Canada (DFO) Science Advisory Schedule *as they become available.*

SUMMARY

- Eulachon (*Thaleichthys pacificus*) is a semelparous smelt that ranges from California to the Bering Sea.
- The species has experienced range-wide declines and possible local extirpation in some river systems.
- The Committee on the Status of Endangered Wildlife in Canada has assessed three populations (or Designatable Units) in Canada: Fraser River as Endangered, Central Pacific Coast as Endangered and Nass/Skeena Rivers as species of Special Concern.
- A Recovery Potential Assessment was undertaken to assess the possibilities of recovery of the designatable units to recommend population targets, assess threats and propose mitigations for activities that may be causing harm to the species.

- Eulachon are extremely important culturally to coastal First Nations and their traditional knowledge of the species and its biology played an important role in contributing to this report. However, there are many knowledge gaps about basic biology and life history parameters that limit the scope in predicting recovery times and giving recommendations on allowable harm.

INTRODUCTION

Eulachon (*Thaleichthys pacificus*) is an anadromous, semelparous species of smelt that spawn only in a limited number of rivers in Western North America ranging from California to the Bering Sea. Eulachon spend most of their three-year life cycle in the marine environment, are demersal and feed primarily on euphausiids. They have high lipid content and are an important prey item for a variety of fish, mammal, and avian predators.

A Recovery Potential Assessment (RPA) for Eulachon (Fraser River and Central Pacific Coast Designatable Units (DU)) was undertaken (Schweigert et al. 2012). The completion of a RPA is required to inform the listing decision and recovery planning processes by Fisheries and Oceans Canada (DFO) for species designated Endangered or Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This document was requested to provide scientific advice on a number of unresolved issues that are conceptually fundamental to recovery planning.

Information on the stock composition of marine samples was used to estimate the magnitude and trend in exposure to trawl fishing effort, and to refine indices of immature (marine) abundance. Differences between trends in marine and spawning indices were re-examined and provide insight about the most probable cause of Eulachon decline. Potential causes of population declines were examined and assessed in terms of their ability to explain the timing of declines in spawning abundance and to reconcile differences between the marine and spawning indices.

Some existing threats are unlikely to have been responsible for recent declines (e.g., food, social and ceremonial (FSC) fisheries, marine mammal predation, and degradation of freshwater habitat) but may now be preventing recovery from low population abundance. Threats were examined to provide advice on plausible recovery scenarios, and corresponding levels of allowable harm.

ASSESSMENT

Population status, trends and trajectories

Abundance of Eulachon in the Fraser River is at an historic low based on the results of recent egg and larval surveys.

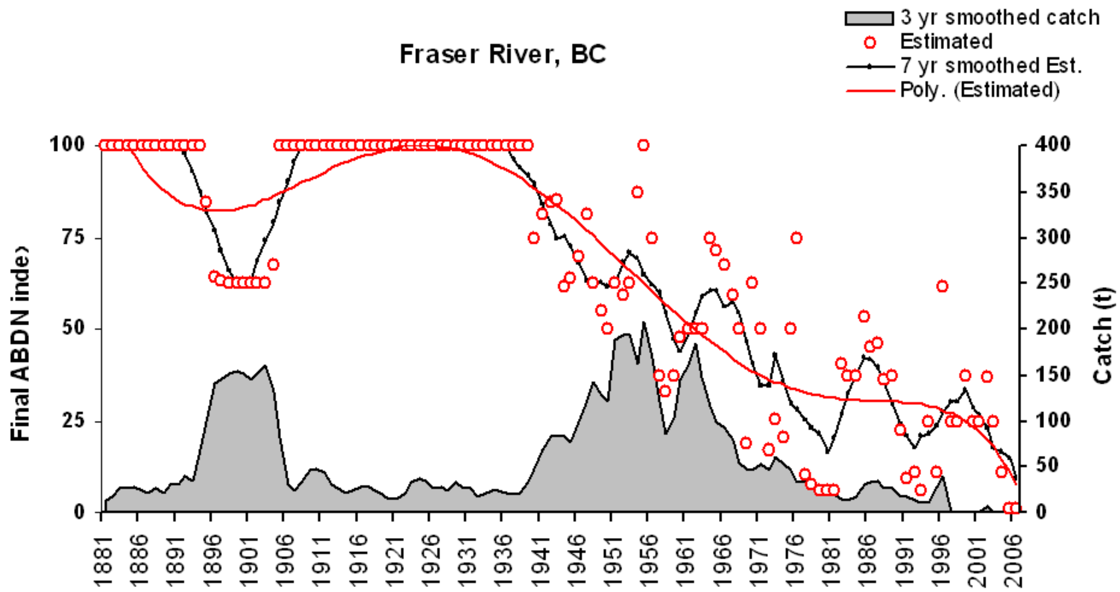

Figure 2. Fraser River estimated Eulachon abundance status (circles), seven year smoothed abundance status estimations (black line), three year smoothed catch (grey fill) and a polynomial fitted trend line (red line) from Moody (2008).

Fraser River specific abundance targets have not been established but it may be possible to estimate population sizes that would support sustainable catches that approximate the combined First Nations, commercial and recreational catches of Eulachon taken from the Fraser River. Levesque and Therriault (2011) propose a recovery target or lower stock reference level of 382t. Appendix 3 of the RPA (Schweigert et al 2012) estimated that the Maximum Sustainable Yield for this population is 112mt (90% C.I. 34-309).

The population dynamics model developed in Appendix 3 of the RPA indicates that the population should rebuild to 20% of the unfished abundance level with a 50% probability that it will exceed this level.

Species Residence

The concept of residence under SARA does not apply to Eulachon.

Habitat Use and Associated Threats of Fraser River Eulachon

Fraser River Eulachon are known to spawn in the lower reaches of the North and South Arms of the Fraser River, and have extended upstream as far as Chilliwack in previous years.

Pickard and Marmorek (2007) describe a wide variety of activities that could threaten Eulachon within freshwater habitats. These include pollution (industrial effluents, sewage, and agricultural runoff), dredging activity, changes to the discharge patterns of rivers affecting the availability of suitable spawning substrates, debris from log handling and booming in rivers, shoreline construction (roads, dykes changing available spawning habitat), diversion and dams affecting water volume, temperature and sediment levels. However, there is limited information on the extent of these activities within the Fraser DU.

Activities that threaten Eulachon habitat within the marine environment are primarily associated with bottom trawling and estuary alteration or development. Other activities would include marine transportation of oil, natural gas, or toxic chemicals.

It is not possible to quantify the biological functions of habitat features or carrying capacity limits with existing information, and constraints to the species for spawning within the Fraser River are unknown. Available information does not permit an estimate of the overall change in the Fraser River through dredging, foreshore alteration, or habitat degradation since pre-contact. The extent of habitat reduction within the marine environment is unknown, and available data on hypoxia within the area normally occupied by Eulachon is incomplete. It is not possible to quantify the habitat requirements at the upper stock reference level with existing information.

It is not possible to provide advice on restoring habitat to higher values at this time, due to lack of existing information and knowledge about the specific micro-habitat needs of the Eulachon at different life stages.

Pickard and Marmorek (2007), Gustafson et al (2010) and Levesque and Therriault (2011) identify and comment on the impact of various threats to the quality of available habitat in a qualitative manner. It is not possible to advise specifically on the extent of these impacts except in a speculative sense.

Although there are instances of habitat loss it does not appear that habitat loss is a limiting factor causing widespread population declines at this time. There is no evidence that available spawning habitat within the Fraser River has been reduced to the extent that it would limit population increases from the present low levels. Similarly, there is no evidence that the range of Eulachon in the marine environment has been reduced as determined from their presence in DFO trawl surveys. However, as Eulachon populations recover there may be instances where habitat loss could inhibit or slow further recovery.

Assess the Scope for Recovery of Eulachon

Bayesian modeling predicts that there is a high probability that the Fraser Eulachon population will increase over 4, 8, and 17 year time horizons but the extent of the increase decreases as the extent of in-river catch increases from 0.1 to 30 tonnes.

The offshore survey usually occurs between April and May and encounter Eulachon that are too large to represent progeny hatched in the same year as the survey. Instead the Eulachon captured at sea are at least one year old (probably about 14-16 months) or two years old (probably 26-28 months). The two-year-old Eulachon constitute the majority of Eulachon (by weight) and represent fish that will probably spawn in the next 8-10 months when they reach an age of 36 months. Therefore, given that both marine and freshwater indices of abundance were correct, then there must be a major source of mortality on Eulachon between the ages of 26 and 36 months of age.

Scenarios for Threats Mitigation and/or Recovery

The following is an inventory of all feasible measures that could be taken to mitigate the impacts of activities that are threats to the species and its habitat. These potential mitigations fall broadly under the areas of in-river impacts and offshore fishery impacts, and may be considered by management in developing mitigation and recovery actions.

1) Log booming in rivers and estuaries at the time of Eulachon spawning

Suspend booming or re-locate or re-schedule the activity so that potential impacts are eliminated. Monitor the temperature, pH and dissolved oxygen of bottom sediments of booming areas used prior to- and after spawning, to determine if impacts are sustained after booming operations are adjusted.

2) Dredging in Eulachon spawning rivers

Dredging at spawning time could negatively impact spawning success. Suspend dredging operations in all parts of rivers at the time of spawning. Re-examine and confirm spawning time(s) in rivers to ensure that spawning time is not changing.

3) First Nations fishing in rivers and estuaries

Suspend all fishing operations on spawning Eulachon.

4) Commercial fishing in rivers and estuaries

Suspend all commercial fishing on spawning Eulachon.

5) Sport fishing for Eulachon in the Fraser River

Suspend all sport fishing catches of Eulachon. Prohibit the use of Eulachon as bait in any other sport fishery. Prohibit cross border (USA-Canada) shipment of Eulachon, live or dead, for any purpose other than non-profit academic use or scientific research.

6) Wastewater disposal in rivers

Develop alternatives to disposal of human sewage into the river during spawning times.

7) Industrial pollution and agricultural chemical runoff in rivers

Consider attempts to withhold chemical disposal in rivers, especially during the periods of Eulachon spawning runs to avoid interfering with Eulachon migration and egg incubation to avoid deleterious impacts on egg development and survival.

8) Stream flow alteration from banking/road building

Avoid any changes that alter stream flow attributes without first determining if such changes could be deleterious to Eulachon. Such mitigation might be achieved by imposing a requirement that, on any Eulachon-bearing river identified in this report, that any proposed changes would have to be approved by a qualified hydrologist who was deemed to be cognizant of issues facing Eulachon.

9) Stream flow alteration by water withdrawal

Avoid removal of water during Eulachon spawning periods. Such an activity may not be occurring at the present time but potential future industrial developments (or agriculture) may be interested in using freshwater for cooling or other purposes.

10) Stream flow alteration from logging in watershed

Logging operations that could affect the quality or quantity of stream-flow in any Eulachon-bearing river should be suspended at the time of Eulachon spawning. Exemption from this restriction could be provided by a review by qualified habitat biologists, hydrologists and foresters.

11) Disposal of animal mammal carcasses in Eulachon rivers

Like salmonids, Eulachon change swimming habits and may exit rivers where odors of mammals (marine or terrestrial) exist. The mitigation of this concern is to simply prohibit disposal of any waste of material of mammalian origin (marine mammals, wild game or agriculture carcasses) in Eulachon bearing rivers during Eulachon spawning times. A related suggestion would be the suspension of any hunting of any mammal within a fixed distance (e.g. 200 m) of an Eulachon-bearing river during the spawning season.

12) Trawl fisheries in areas adjacent to Eulachon spawning rivers

Suspend fishing activity in the vicinity of the mouths of known or suspected Eulachon spawning rivers during the spawning period.

The following is an inventory of all reasonable alternatives to the activities that are threats to the species and its habitat

1) First Nations fisheries in-river or estuaries

No alternatives for acquiring traditional Eulachon for First Nations.

2) Commercial fishing for Eulachon in rivers

The alternative might be a license buy back for commercial fishers in the Fraser River.

3) Sport fishery for Eulachon in the Fraser River – and other rivers

No alternative.

4) Wastewater disposal in rivers

The alternative is to upgrade waste disposal and improve sewage treatment.

5) Industrial pollution in rivers and from agricultural chemical runoff

The alternative is to develop different disposal methods and sites and change the practice, materials and timing for agricultural fertilizing.

6) Stream flow alteration from banking/road building

The alternative is to explore alternative routes or activities to minimize impacts in-river.

7) Stream flow alteration from water withdrawal

The alternative would be to consider different sites for future projects that have large water requirements.

8) Stream flow alteration from logging in watershed

An alternative is to change the timing or logging activity during the Eulachon spawning period.

9) Pinniped or cetacean predation in rivers at the time of spawning

Potential alternatives include noise deterrents or culls.

10) Log booming in estuaries where Eulachon larvae and juveniles migrate or reside

An alternative is using different methods and locations of log storage and handling.

11) Industrial and wastewater pollution of estuaries

The alternative would be to develop different waste disposal procedures and timing.

12) Groundfish trawl fisheries

Eulachon can be entrained in mid-water and bottom trawl gear but the level of observer coverage in these fisheries is effectively 100%. Therefore, it seems reasonable to expect that these fisheries could be conducted in a way that could minimize Eulachon interception and capture. Observers could be required to respond to pre-determined standards of bycatch that were deemed to be acceptable (very low rates of interception) or unacceptable. If fishing activity in particular areas or times had unacceptable Eulachon interception rates then the vessel would be required to move or suspend operations.

13) Shrimp trawl fisheries

Eulachon can be entrained in mid-water and bottom trawls. They can escape through the nets or be retained in nets and landed on the decks of vessels. Virtually all Eulachon brought aboard vessels from trawl gear are dead or moribund. It is not clear if Eulachon that pass through nets are injured or killed (a form of 'collateral mortality') but evidence from studies in the Baltic and elsewhere on small pelagic fishes indicates that collateral mortality may be high, perhaps exceeding 60-70 percent of the fish that enter a net.

Probably these estimates vary with species and types of gear but there is no reason to expect that collateral mortality of Eulachon would be lower than that of other species. Complete mitigation could be achieved by suspending all trawl fisheries that intercept Eulachon so there would be no Eulachon bycatch but there may be a range of much less drastic, incremental alternatives that could be considered and perhaps implemented. Some suggestions may be impractical and could be refined. All would require the cooperation of the fishing industry to be effective.

i. Alter fishing gear: Of the two main types of shrimp fishing gear (otter trawls and beam trawls) beam trawls have substantially lower Eulachon bycatch. Therefore a simple form of mitigation would be to encourage the industry to adopt beam trawl gear, or use gear that mimics the catch characteristic of beam trawls. It could involve towing nets at slower speed and perhaps configuring the gear so that the vertical opening of the mouth of the net was reduced. Comparisons of Eulachon catch rates from slightly different configurations of beam-trawls (low-rise versus high rise) indicate that low-rise nets, with smaller vertical openings than high rise beam trawls appear to catch fewer Eulachon.

ii. Investigate the efficacy of bycatch reduction devices (BRDs): Eulachon catch rates of otter trawls with BRD's are lower than those without BRD's. Although theoretically effective, it is not clear if the Eulachon that escape through BRD's survive. If they do not survive then BRD's serve no useful purpose related to mitigation of Eulachon bycatch mortality. If BRDs are effective then there may be scope for improvements in their design and operation.

iii. Bycatch rate communication – pre-fishery testing: As a possible condition for initiation of fishing by the fleet, test fishing vessels could be employed to determine bycatch rates in various locations. In instances where bycatch was determined to be too high (a rate that would need to be established) then fishing activity could be delayed or suspended or re-located. (Similar pre-fishing activities occur in the herring roe fishery where a few select vessels determine if the herring are sufficiently ripe prior to fishery openings).

iv. Eulachon-free zone: investigate different potential temporal and spatial options for openings. Although it is known that Eulachon bycatch varies among years it is not clear if there are possible –'within-year' or seasonal patterns of Eulachon bycatch. For example, if it could be established that Eulachon abundance was zero, or negligible, in some areas then there may be potential for definition of fishing areas that could be defined as 'Eulachon free zones – or EFZ) where fishing could occur without putting Eulachon at risk. If this were possible such EFZ's could be defined annually, or as required, by test fishing or other methods.

v. Standardization of fishing practices such as tow duration. Some commercial shrimp vessel make tows of exceptionally long duration (>4 hours). Such long tows do not provide operators any opportunity to examine catch composition – and avoid fishing in locations where Eulachon bycatch is high. Therefore a recommendation is to limit tow duration to some shorter time that would allow operators to better monitor bycatch.

vi. Land all bycatch – an alternative to observers. The degree of observer coverage for shrimp fishing is low and mainly this is because of the cost of hiring observers. Also, it can be inconvenient for operators of small vessels to provide for an extra person on board. A potential alternative is to have the bycatch component of catches retained and stored separately, in labelled bags that would be landed at the same time and place as shrimp catches. Instead of having on-board observers, the bags would be collected by onshore samplers. The species composition of the catches could then be determined with accuracy and precision by later analysis in a laboratory. Other aspects of this alternative could be:

   a. The information and data from such landed bycatch would be retained as confidential and not be used for negative feedback to vessel operators;

   b. The data from bycatch retention could be useful for some DFO ecosystem analyses and therefore there might be option(s) for some DFO support for this:

   c. Detailed analyses of every bag of bycatch would not necessarily need to be examined. Instead laboratory analyses would be done only on a predetermined sub-set of all the bycatch samples. Also, by agreement, some bycatch species could be returned to the sea, especially those that were not killed by the gear (e.g., dogfish, skates, some large rockfish, etc.).

   d. There may be options for some limited marketing of bycatch, perhaps in the form of fish protein for specialty markets, aquarium food or for fertilizer. The total proportion of bycatch could be specified at <5% of total landings as in some other jurisdictions (Alaska).

vii. Electronic monitoring. A variety of video monitoring techniques are being used in other fisheries and could be adapted for the shrimp and/or groundfish fisheries to assess the levels of bycatch and assist managers with decisions regarding fishing times and areas. The cost of this approach may be prohibitive in the lower value fisheries.

14) Marine aquaculture of shellfish or finfish

i. Salmon (and other finfish) netpens: Marine aquaculture of finfish floating netpens may use bright lights to promote growth and may also attract marine mammals to the vicinity of netpens. It is uncertain whether these conditions could interfere with Eulachon migrations, or any other aspect of Eulachon biology, but until it can be shown that there are no effects, then a recommendation is to avoid location of major net pen operations in the vicinity of Eulachon-bearing rivers (a distance of several km away from the river mouth would be appropriate). In cases where net pen operations are located in fjords with major Eulachon rivers, develop a set of regulatory protocols to guide activity during Eulachon spawning periods.

ii. Shellfish operations: Although shellfish aquaculture (except for oysters) is still in the early stages of development, the suspension of intense shellfish rearing lines and other equipment could interfere with fish passage in some situations. Therefore it would be preferable if such potential shellfish sites could avoid being established in estuarine areas known to be Eulachon passage areas.

iii. Herring roe-on-kelp operations usually occur in March and April, approximately similar to Eulachon spawning times. Roe-on-kelp operations are now known to be potential sources of disease for some marine species (Hershberger et al 2001). Therefore these operations should not be located in inshore waters, such as fjords, that support Eulachon bearing rivers.

iv. Disease transmission: Recent research indicates that crowding of organisms in netpens leads to higher levels of disease that can be transmitted to other species in the adjacent ecosystem. Restricting the location and timing of active farms to avoid Eulachon spawning times would provide mitigation

Aside from the aforementioned activities the only other approach to increase productivity would be the artificial rearing of Eulachon. Although technically feasible this would require expensive and time consuming research to devise a method of establishing the success of a hatchery approach. A method to identify the progeny reared and released from a hatchery would also be required. In effect, the only available methods involve marking (or tagging) the larvae and juveniles prior to release. Chemical tags/marks are available but the technology to apply and recover marks has not yet been developed for Eulachon, and the potential for success is untested and unknown. In addition, the issue of disease in intensely reared marine fish would need to be addressed and solved.

Given that the majority of these recommendations are speculative in nature, it is not possible to determine the reductions in mortality or increases in productivity that might be expected from these proposed alternatives at this time.

Allowable Harm

A population dynamics model for the Fraser DU indicates that even a small removal or increased mortality rate (5t of the weakest cycle line) would substantially slow the recovery rate of the population. However, an increasing population trend is expected if productivity returns to the longer term average (i.e., prior to brood year 2002), but it is not possible to predict when, or if, this will happen. Given the large uncertainty regarding magnitude of threats to the Eulachon, minimal allowable harm should be permitted at this time, and be reduced below current levels as much as possible. This level of harm may allow for some activities to be undertaken while working towards population recovery.

Data and Knowledge Gaps & Sources of Uncertainty

Assessing the recovery potential for any species requires a good understanding of its biology and the factors that determine its survival and reproduction and those that are inducing mortality. There are substantial gaps in our knowledge of Eulachon biology and ecology, including life history parameters, population size, population structure and genetics, and habitat use and requirements, particularly outside of the Fraser DU. Additional Aboriginal Traditional Knowledge may exist within the First Nations communities.

There currently is no validated ageing technique for Eulachon. The available evidence, from a variety of sources, indicates that most Eulachon in BC spawn at age three, although this has yet to be confirmed.

Estimates of mortality from associated threats could not be derived; however, estimates for recruitment, carrying capacity, and sustainable harvest were determined for the Fraser River DU.

Genetic samples of Eulachon have been collected for some but not all known spawning rivers. It is recommended that additional samples should be collected from any unsampled systems to broaden the baseline and more accurately characterize river affinity for mixed stock samples from the offshore areas. Also, additional samples should be taken from rivers that have been previously sampled to examine any potential temporal changes.

More detailed analysis of the commercial and research catches of offshore Eulachon and of the potential effects of oceanographic factors on seasonal catches would provide a better understanding of Eulachon habitat requirements in the marine environment, and thereby provide a more scientific basis for developing management strategies to minimize fishery impacts on the species.

A more thorough cataloguing of the range and type of habitat impacts that have occurred within the freshwater spawning rivers would help to understand and better manage these impacts to foster recovery.

A long-term monitoring program of marine fish stomachs would assist in better understanding the impacts of predators on Eulachon survival and mortality.

SOURCES OF INFORMATION

This Science Advisory Report is from the January 25-26, 2012 meeting on the Recovery Potential Assessment for Eulachon *(Thaleichthys pacificus)* Nass/Skeena, Central Pacific Coast and Fraser River Designatable Units. Additional publications from this process will be posted on the Fisheries and Oceans Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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Centre for Science Advice (CSA)
Pacific Region
Fisheries and Oceans Canada
3190 Hammond Bay Road
Nanaimo, BC V9T 6N7

Telephone: 250-756-7208
E-Mail: csap@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

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