Marine Species at Risk: A Salish Sea Transboundary Indicator with More Potential

Michelle Wainstein and Joseph K. Gaydos
The SeaDoc Society, Karen C. Drayer Wildlife Health Center – Orcas Island Office, UC Davis School of Veterinary Medicine, 942 Deer Harbor Road, Eastsound, WA 98245, www.seadocsociety.org

Abstract
Species at risk are native species, sub-species or ecologically significant units that warrant special attention to ensure their conservation. The number of marine species at risk within the Salish Sea is used by the US Environmental Protection Agency and Environment and Climate Change Canada as one of ten transboundary ecosystem indicators. Four jurisdictions within the Salish Sea have formal listing processes for marine species: the Province of British Columbia, the State of Washington, the Canadian Federal Government, and the United States Federal Government. As of October 15, 2021, there were 135 species listed as at risk in the Salish Sea: 4 invertebrates, 66 fish, 2 reptiles, 50 birds and 13 mammals. The list has been compiled periodically since 2002 when only 60 species were listed, and it has grown at each assessment. A portion of the growth in the number of listed species can be attributed to better information on the species that use the ecosystem or greater effort to assess species status, but for some species, additions reflect actual population declines in the Salish Sea over the last two decades. The list was pivotal in highlighting the magnitude of marine bird declines and motivating a taxa-wide risk assessment to identify underlying causes for declines in so many species, but overall has had little apparent value in driving ecosystem recovery. Rather than documenting the continued decline of species within the Salish Sea, this indicator could be better formalized to embrace the Drivers-Pressures-State-Impact-Response (DPSIR) approach as an organizing principle, as it has been for other transboundary ecosystem indicators. More formally engaging listing agencies and Tribal and First Nation co-managers to help detail the drivers and pressures behind listings could create a better indicator that facilitates design and implementation of transboundary conservation efforts that supersede a species-by-species piecemeal approach.

Introduction

Species at risk are native species, sub-species or ecologically significant units that warrant special attention to ensure their conservation. Also known as species of concern, the number of marine species at risk in the Salish Sea is used by the United States Environmental Protection Agency and Environment and Climate Change Canada as a transboundary ecosystem indicator (Marine Species at Risk; http://www2.epa.gov/salish-sea/marine-species-risk). For ecosystems like the Salish Sea that span international boundaries and include multiple jurisdictions, an ecosystem-based list of species of concern acts as a crude indicator of ecosystem health, permits cross checking of species of concern between jurisdictions, suggests where more research is needed to assess species status or causes of decline, and highlights where transboundary approaches could benefit species recovery (Gaydos and Gilardi, 2003). Four jurisdictions within the Salish Sea have processes for assessing and listing species that require special initiatives to ensure protection and survival of the population. These include the Province of British Columbia, the State of Washington, the Canadian Federal Government, and the United States Federal Government. This work reviews invertebrates, fish, reptiles, birds, and mammals that use the Salish Sea marine ecosystem and are listed as species of concern by one or more jurisdiction.

Methods

Species that use the Salish Sea marine ecosystem and were listed by one or more jurisdiction as of October 15, 2021 were included. Listed fish, bird, and mammal species were included if they occurred on published lists of birds, mammals (Gaydos and Pearson, 2011) and fishes (Pietsch and Orr, 2015; Ashley et al., 2022) dependent upon the Salish Sea. Listed reptiles were included if the listing agency identified the Salish Sea as critical habitat for the species. Invertebrates were included if listing data indicated their distribution included the Salish Sea. Listing classifications and the processes for listing in each jurisdiction are described below.

British Columbia

In the Province of British Columbia, species are assigned a risk of extinction. Species are placed on Red, Blue, or Yellow lists. Red-listed species are those that have been legally designated as Endangered or Threatened under the provincial Wildlife Act, are extirpated, or are candidates for such designation. Blue-listed species are those not immediately threatened but are of concern because of characteristics that make them particularly sensitive to human activities or natural events. Yellow-listed species are all species not included on the Red or Blue lists. When British Columbia ranks species, each species is assigned a global rank (applies across its range), a national rank (for each

nation within its range, such as Canada), and a sub-national rank (for each province). In British Columbia, the Conservation Data Centre within the Ministry of Sustainable Resource Management assigns the provincial rank. Within the marine ecosystem, British Columbia currently only assesses mammals, birds, reptiles, and freshwater fishes that also use marine habitat. Important to this study, conspicuously absent are marine fishes and marine invertebrates. All credible sources of information concerning species distribution, abundance, trends, and threats are considered in provincially ranking species in British Columbia. Red- and Blue-listed species were considered species of concern for this study (http://speciesatriskbc.ca/).

Washington State

In Washington State, the Washington Fish and Wildlife Commission (Commission) lists species at risk under the provisions of Washington Administrative Code (WAC) 232-12-297 (Endangered, Threatened, and Sensitive Wildlife Species Classification). Listing occurs in much the same stepwise procedure as occurs at the U.S. federal level. Species can be listed as either endangered (seriously threatened with extinction throughout all or a significant portion of its range within the state), threatened (likely to become an endangered species within the foreseeable future throughout a significant portion of it range within the state) or sensitive (vulnerable or declining and likely to become endangered or threatened in a significant portion of its range within the state). Listing can be initiated in one of three ways: (1) the Washington Department of Fish and Wildlife (WDFW) initiates a species status review; (2) the WDFW receives a petition from a citizen (at which point the agency has 60 days to either initiate the classification process or deny the petition, based on the best available scientific data); or (3) the Commission requests the WDFW to review a species of concern. Listings are based solely on the biological status of the species in the wild, as indicated by the preponderance of scientific data available. When the listing process is initiated, the WDFW publishes a public notice in the Washington State Register and calls for scientific information relevant to the species' status. Then WDFW prepares a draft species status report, which reviews relevant information on the status of the species in Washington, addresses factors affecting its status, and makes a preliminary listing recommendation. The public and the scientific community is given 90 days to review and comment on the draft status report and listing recommendation, and the WDFW can hold one or more public meetings during the public review period. At the close of the public comment period, WDFW addresses comments, completes the final status report and listing recommendation and submits them to the Commission. The final species status report, agency classification recommendation, and State Environmental Policy Act (SEPA) documents are made available to the public at least 30 days prior to the Commission meeting. Once a species is listed, WDFW writes and implements a recovery plan for threatened or endangered species, or a management plan for sensitive species. A review of the species' status is conducted by the WDFW at least once every five years. The WDFW maintains a list of candidate species, which are those species that will be reviewed for possible listing as endangered, threatened, or sensitive. Important to this study, marine invertebrates and fishes can only receive candidate status in Washington State as (WAC) 232-12-297 does not permit State listing of marine invertebrates and fishes. Species listed as candidate, sensitive, threatened, or endangered are included in this study (http://wdfw.wa.gov/conservation/endangered/).

Canada

In Canada, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) creates a federal assessment of species at risk using an international ranking system adapted from the World Conservation Union in Switzerland. COSEWIC is composed of government and non-government members, members from academic institutions, and one member with expertise in Aboriginal traditional knowledge. Species designations are made using a formal status report review process. Experts are commissioned to write status reports on the biology, population status, range, and possible threats facing the species or subspecies in question using the best available scientific, community, and Aboriginal traditional knowledge. COSEWIC meets at least once annually to consider new and updated status reports and to make status determinations. If deemed necessary and appropriate, emergency listing can be made ahead of COSEWIC's regular general meeting and decisions made are later ratified based upon a full report. As listed by COSEWIC, risk categories for species include extinct (a species that no longer exists), extirpated (no longer exists in the wild in Canada, but exists elsewhere), endangered (facing imminent extinction or extirpation), threatened (likely to become endangered if limiting factors are not reversed), special concern (characteristics make species particularly sensitive to human activities or natural events), not at risk, or data deficient (insufficient information to support status designation). Species that are suspected of being at some risk of extinction or extirpation but have not yet been reviewed by COSEWIC are placed on a Candidate List and as time and resources permit, COSEWIC commissions status reports for these species so that an assessment can be undertaken. Currently, species listed by COSEWIC as "endangered," "threatened," or "special concern" do not receive legal recognition from the federal government. Under the Canadian federal Species at Risk Act (SARA), the federal Cabinet

ultimately decides whether COSEWIC-designated species should get legal protection. These decisions are made after consultations with affected stakeholders and other groups. In this study, species listed under COSEWIC (http://www.cosewic.gc.ca/) or SARA (http://www.registrelep-sararegistry.gc.ca/) as Candidate, Special Concern, Threatened, or Endangered are included as species of concern.

United States

In the United States, the U.S. Fish and Wildlife Service (USFWS, Department of the Interior) and the National Oceanic and Atmospheric Administration (NOAA-Fisheries, Department of Commerce) (hereinafter referred to as "the Agencies") share responsibility for identifying species of concern under the provisions of the Federal Endangered Species Act (ESA), enacted in 1973. A species is listed either as endangered (a species that is in danger of extinction throughout all of or a significant portion of its range) or threatened (one that is likely to become endangered in the foreseeable future) when it is determined to be negatively impacted by any or all of the following factors: 1) current or imminent destruction or degradation of its habitat or range; 2) over-extraction for any purpose or by any means; 3) population-level impacts of disease or predation; 4) existing regulatory mechanisms that are inadequate to protect the species; or 5) other natural or anthropogenic factors significantly impeding the species' survival. The process for listing a species can be initiated by the Agencies or by a petition from the public. The Agencies initiate the process by publishing a "notice of review" that identifies a "candidate for listing" any species in the United States that it believes meets the definition of threatened or endangered, or for which its status in the wild warrants review and consideration under the ESA. If the Agencies receive a petition for listing a species from the public, they have 90 days to review the petition and determine if there is substantial information indicating that the listing may be warranted. At this point, the species is called a "Candidate for Listing," and the Agencies then have one year to decide to propose listing for the species. During this review period, the Agencies seek biological information to help complete the status review. If the Agencies decide that a species warrants listing under the ESA, a proposed rule is published in the Federal Register for a 60-day public comment period. Information received is analyzed and considered, and within one year of a listing proposal, one of three possible actions is taken: 1) a species is listed as threatened or endangered because the best available scientific data supports the listing; 2) the proposal is withdrawn because the best available scientific data do not support the listing; or 3) the proposal review period is extended for an additional six months if there is substantial disagreement within the scientific community concerning the listing. The status of a listed species is reviewed at least every five years to determine if federal protection is still warranted. This project includes candidate species, species of concern and those listed as threatened or endangered (http://www.fws.gov/endangered/ and http://www.nmfs.noaa.gov/pr/species/esa/).

Results

As of October 15, 2021, 135 native species, sub-species or ecologically significant units that depend on the Salish Sea marine ecosystem were listed by one or more jurisdiction as species at risk (Table 1). These included four invertebrates (Table 2), 66 fishes (Table 3), two reptiles (Table 4), 50 birds (Table 5), and 13 mammals (Table 6). Of the 135 species listed, no one jurisdiction listed them all (Table 1). The number of species listed in the Salish Sea has grown from 60 in 2002 (Gaydos and Gilardi, 2003) to 135 in 2021 (Fig. 1), partly due to an expanded understanding of species that use the Salish Sea, but also due to increases in newly listed species.

Discussion

As expected, no jurisdiction lists 100% of the total number of species of concern within the Salish Sea, supporting the concept that a comprehensive jurisdiction-wide list helps portray a more complete view of the actual number of species at risk within the ecosystem. While it is a crude indicator of ecosystem health, the increasing number of listed species within the Salish Sea suggests ecosystem decay (Bierregard et al., 2001) is outpacing ecosystem recovery.

At times, this list has been helpful in pushing forward novel recovery efforts. For example, recognition of the number of listed bird species was pivotal in gathering bird biologists from Canada and the United States to conduct a taxa-wide risk assessment to identify underlying causes for declines in so many bird species (Vilchis et al., 2014). Unfortunately, overall, the indicator has had little apparent value in driving ecosystem recovery. Lindenmayer et al. (2013) suggest that for monitoring programs to help conservation they need to explicitly articulate how monitoring data will inform conservation actions, identify trigger points at which strategic interventions will be implemented, and rigorously quantify the program's ability to detect change early. The Marine Species at Risk indicator currently has none of these qualities.

Rather than merely documenting the continued decline of species within the Salish Sea, this indicator could be formalized to embrace the Drivers-Pressures-State-Impact-Response (DPSIR) approach as an organizing principle, as it has been for other transboundary ecosystem indicators. More formally engaging listing agencies and Tribal and First Nation co-managers to help detail the drivers and pressures behind listings could create a better indicator that facilitates design and implementation of transboundary conservation efforts that supersede a species-by-species piecemeal approach.

Acknowledgements
This work was supported by the SeaDoc Society, a program of the Karen C. Drayer Wildlife Health Center, a Center of Excellence at the UC Davis School of Veterinary Medicine (www.seadocsociety.org). We thank Hannah Anderson, Sarah Bartnik, Nick Georgiadis, Michael Rylko, and Jo Smith for helping us think about this ecosystem indicator and how we could improve it. We also thank Sarah Teman for editing assistance.

Literature Cited

Ashley, E.A., C.V. Pattengill-Semmens, J.W. Orr, J. Nichols, and J.K. Gaydos. 2022. Documenting fishes in an inland sea with citizen scientist diver surveys: using taxonomic expertise to inform the observation potential of fish species. *Environmental Monitoring and Assessment* 194:227. https://doi.org/10.1007/s10661-022-09857-1

Bierregard, R.O., T.E. Lovejoy, C. Gascon, and R. Mesquita (eds). 2001. *Lessons from Amazonia: The Ecology and Conservation of a Fragmented Forest.* Yale University Press. 544 pp.

Brown, N. A. and J. K. Gaydos. 2005. Species of concern in the Puget Sound Georgia Basin: changes between 2002 and 2004. *In* Proceedings of the 2005 Puget Sound Georgia Basin Research Conference, Seattle, Washington, March 2005.

Brown, N. A. and J. K. Gaydos. 2007. Species of concern within the Georgia Basin Puget Sound Marine Ecosystem: changes between 2002 and 2006. *In* Proceedings of the 2007 Georgia Basin Puget Sound Research Conference, Vancouver, British Columbia, March 2007.

Gaydos, J. K. and N. Brown. 2009. Species of concern within the Salish Sea Marine Ecosystem: changes between 2002 and 2008. *In* Proceedings of the 2009 Puget Sound Georgia Basin Ecosystem Conference, Seattle, WA, February 2009.

Gaydos, J. K. and N. Brown. 2011. Species of Concern within the Salish Sea: changes from 2002 to 2011. *In* Proceedings of the 2011 Salish Sea Ecosystem Conference, Vancouver, British Columbia, October 2011.

Gaydos, J. K. and S. Pearson. 2011. Bird and Mammals that Depend on the Salish Sea: a compilation. *Northwestern Naturalist* 92:79−89.

Gaydos, J. K. and K. V.K. Gilardi. 2003. Species of Concern in the Georgia Basin / Puget Sound Marine Ecosystem: more support for a transboundary ecosystem approach to marine conservation. *In* Droscher, Toni and David A. Fraser (eds.) Proceedings of the 2003 Georgia Basin/Puget Sound Research Conference, March 31-April 3, 2003, Vancouver, British Columbia.

Gaydos, J. K. and J. Zier. 2014. Species of Concern within the Salish Sea nearly double between 2002 and 2013. Proceedings of the Salish Sea Conference, Seattle, Washington, April 2014.

Lindenmayer, D. B., M. P. Piggott, and B. A. Wintle. 2013. Counting the books while the library burns: why conservation monitoring programs need a plan for action. *Frontiers in Ecology and the Environment* doi: https://doi.org/10.1890/120220

Pietsch, T. W. and J. W. Orr. 2015. Fishes of the Salish Sea: A Compilation and Distributional Analysis. NOAA Professional Paper NMFS 18, U.S. Department of Commerce, 106 pp.

Vilchis, I. L., C. Kreuder Johnson, J. R. Evenson, S. F. Pearson, K. Barry, P. Davidson, M. Raphael and J. K. Gaydos. 2014. Assessing ecological correlates of marine bird declines to inform marine conservation. Conservation Biology. https://doi.org/10.1111/cobi.12378

Zier, J. and J. K. Gaydos. 2016. The growing number of species of concern in the Salish Sea suggests ecosystem decay is outpacing recovery. Proceedings of the Salish Sea Ecosystem Conference. Vancouver, BC, April 2016.

Table 1: Marine species at risk in the Salish Sea in 2021 by listing jurisdiction

	British Columbia	**Washington State**	**CANADA**	**U.S.A.**	**TOTAL # species on list**
INVERTEBRATES	4	3	4	1	4
FISHES	8	22	46	8	66
REPTILES	1	2	2	2	2
BIRDS	45	8	18	1	50
MAMMALS	13	10	12	4	13
TOTAL	71	45	82	16	135

Table 2: Invertebrate species at risk in the Salish Sea in 2021
(Date of most recent review or listing provided when available)

Common Name	**Scientific Name**	**British Columbia**	**Washington State**	**Canada**	**U.S.A.**
Abalone, Pinto (Northern)	*Haliotis kamtschatkana*	Red List (2002)	**Candidate to Endangered (2019)**	Endangered (COSEWIC 2009, SARA)	Species of Concern (2014)
Moth, Edwards' Beach	*Anarta edwardsii*	Red List (2009)		Endangered (COSEWIC 2009, SARA 2011)	
Moth, Sand-verbena	*Copablepharon fuscum*	Red List (2006)	**Not listed to Candidate**	Endangered (COSEWIC 2013, SARA 2005)	
Olympia oyster	*Ostrea conchaphila*	Blue list (2003)	Candidate	Special Concern (COSEWIC 2011, SARA 2003)	

Items in bold represent legal status changes made between December 1, 2015 and October 15, 2021.

Table 3: Fish species at risk in the Salish Sea in 2021
(Date of most recent review or listing provided when available)

Common Name	Scientific Name	British Columbia	Washington State	Canada	U.S.A.
Dogfish, North Pacific Spiny	*Squalus suckleyi*			Special Concern (COSEWIC 2011)	
Eulachon (Central Pacific Coast)	*Thaleichthys pacificus*	Blue List (2004)		Endangered (COSEWIC 2011)	Threatened (2010)
Eulachon (Fraser River)	*Thaleichthys pacificus*			Endangered (COSEWIC 2011)	
Eulachon (Southern DPS)	*Thaleichthys pacificus*		Candidate		
Lamprey, River	*Lampetra ayresii*		Candidate		
Pacific Cod (South & Central Puget Sound)	*Gadus macrocephalus*		Candidate		
Pacific Hake (Georgia Basin)	*Merluccius productus*		Candidate		
Pacific Herring	*Clupea pallasi*		Candidate		
Rockfish, Black (Georgia Basin)	*Sebastes melanops*		Candidate		
Rockfish, Bocaccio (Georgia Basin)	*Sebastes paucispinis*		Candidate	Endangered (COSEWIC 2013)	Endangered (2010)
Rockfish, Brown	*Sebastes auriculatus*		Candidate		
Rockfish, Canary	*Sebastes pinniger*		Candidate	Threatened (COSEWIC 2007)	**Threatened to delisted***

Rockfish, China	*Sebastes nebulosus*		Candidate		
Rockfish, Copper (Georgia Basin)	*Sebastes caurinus*		Candidate		
Rockfish, Darkblotched	*Sebastes crameri*			Special Concern (COSEWIC 2009)	
Rockfish, Greenstriped (Georgia Basin)	*Sebastes elongatus*		Candidate		
Rockfish, Quillback (Georgia Basin)	*Sebastes maliger*		Candidate	Threatened (COSEWIC 2009)	
Rockfish, Redstripe (Puget Sound)	*Sebastes proriger*		Candidate		
Rockfish, Rougheye Type I & II	*Sebastes aleutianus, previously known as only one species*			Special Concern (COSEWIC 2007, SARA)	
Rockfish, Tiger (Georgia Basin)	*Sebastes nigrocinctus*		Candidate		
Rockfish, Widow (Georgia Basin)	*Sebastes entomelas*		Candidate		
Rockfish, Yelloweye (Georgia Basin)	*Sebastes ruberrimus*		Candidate	Special Concern (COSEWIC 2008, SARA)	Threatened (2010)
Rockfish, Yellowtail (Georgia Basin)	*Sebastes flavidus*		Candidate		
Salmon, Chinook (Puget Sound)	*Oncorhynchus tshawytscha*		Candidate		Threatened (1999)
Salmon, Chinook (Lower Fraser Summer)	*Oncorhynchus tshawytscha*			**Endangered (COSEWIC 2017/2018)**	
Salmon, Chinook (Middle Fraser Spring)	*Oncorhynchus tshawytscha*			**Endangered (COSEWIC 2017/2018)**	
Salmon, Chinook (Middle Fraser Fall)	*Oncorhynchus tshawytscha*			**Endangered (COSEWIC 2017/2018)**	
Salmon, Chinook (Upper Fraser Spring)	*Oncorhynchus tshawytscha*			**Endangered (COSEWIC 2017/2018)**	

Salmon, Chinook (South Thompson drains to Fraser Summer)	*Oncorhynchus tshawytscha*			**Endangered (COSEWIC 2017/2018)**	
Salmon, Chinook (North Thompson Spring)	*Oncorhynchus tshawytscha*			**Endangered (COSEWIC 2017/2018)**	
Salmon, Chinook (North Thompson Summer)	*Oncorhynchus tshawytscha*			**Endangered (COSEWIC 2017/2018)**	
Salmon, Chinook (East Vancouver Island Spring)	*Oncorhynchus tshawytscha*			**Endangered (COSEWIC 2017/2018)**	
Salmon, Chinook (Lower Fraser Fall)	*Oncorhynchus tshawytscha*			**Threatened (COSEWIC 2018)**	
Salmon, Chinook (Lower Fraser Summer)	*Oncorhynchus tshawytscha*			**Threatened (COSEWIC 2018)**	
Salmon, Chinook (Middle Fraser Spring)	*Oncorhynchus tshawytscha*			**Threatened (COSEWIC 2018)**	
Salmon, Chinook (Middle Fraser Summer)	*Oncorhynchus tshawytscha*			**Threatened (COSEWIC 2018)**	
Salmon, Chinook (Lower Fraser Spring)	*Oncorhynchus tshawytscha*			**Special Concern (COSEWIC 2018)**	
Salmon, Chum (Summer-Run Hood Canal)	*Oncorhynchus keta*		Candidate		Threatened (1999)
Salmon, Coho (Interior Fraser River)	*Oncorhynchus kisutch*			**Endangered to Threatened (COSEWIC 2016)**	
Salmon, Sockeye (Cutlus Lake)	*Oncorhynchus nerka*			Endangered (COSEWIC)	
Salmon, Sockeye (Sakinaw Lake)	*Oncorhynchus nerka*			Endangered (COSEWIC)	
Salmon, Sockeye (Bowron-ES)	*Oncorhynchus nerka*			**Endangered (COSEWIC 2017)**	
Salmon, Sockeye (Harrison (U/S)-L)	*Oncorhynchus nerka*			**Endangered (COSEWIC 2017)**	
Salmon, Sockeye (Quesnel-S)	*Oncorhynchus nerka*			**Endangered (COSEWIC 2017)**	
Salmon, Sockeye (Seton-L)	*Oncorhynchus nerka*			**Endangered (COSEWIC 2017)**	

Salmon, Sockeye (Takla-Trembleur-EStu)	*Oncorhynchus nerka*			**Endangered (COSEWIC 2017)**	
Salmon, Sockeye (Takla-Trembleur-Stuart-S)	*Oncorhynchus nerka*			**Endangered (COSEWIC 2017)**	
Salmon, Sockeye (Taseko-ES)	*Oncorhynchus nerka*			**Endangered (COSEWIC 2017)**	
Salmon, Sockeye (North Barriere-ES)	*Oncorhynchus nerka*			**Threatened (COSEWIC 2017)**	
Salmon, Sockeye (Widgeon (River-Type))	*Oncorhynchus nerka*			**Threatened (COSEWIC 2017)**	
Salmon, Sockeye (Francois-Fraser-S)	*Oncorhynchus nerka*			**Special Concern (COSEWIC 2017)**	
Salmon, Sockeye (Harrison (D/S)-L)	*Oncorhynchus nerka*			**Special Concern (COSEWIC 2017)**	
Salmon, Sockeye (Kamloops-ES)	*Oncorhynchus nerka*			**Special Concern (COSEWIC 2017)**	
Salmon, Sockeye (Lillooet-Harrison-L)	*Oncorhynchus nerka*			**Special Concern (COSEWIC 2017)**	
Salmon, Sockeye (Nahatlatch-ES)	*Oncorhynchus nerka*			**Special Concern (COSEWIC 2017)**	
Shark, Basking	*Cetorhinus maximus*			Endangered (COSEWIC 2018, SARA 2010)	
Shark, Bluntnose Sixgill	*Hexanchus griseus*			Special Concern (COSEWIC 2007, SARA 2009)	
Smelt, Longfin	*Spirinchus thaleichthys*	**Blue List (2019)**			
Sturgeon, Green	*Acipenser medirostris*	**Red to Blue List (2019)**		Special Concern (COSEWIC 2013, SARA 2006)	Threatened (2006)
Sturgeon, White (Lower Fraser River)	*Acipenser transmontanus*	Red List (2018)		Threatened (COSEWIC 2012)	
Sturgeon, White (Upper Fraser River)	*Acipenser transmontanus*	Red List (2018)		Endangered (COSEWIC 2012, SARA 2003)	
Trout, Bull (South Coast BC population)	*Salvelinus confluentus*	Blue List (2018)	Candidate	**Not Listed to Special Concern (SARA 2019)**, Special Concern (COSEWIC 2012)	Threatened
Trout, Bull (Pacific populations)	*Salvelinus confluentus*	Blue List (2018)			

Trout, Coastal Cutthroat	*Oncorhynchus clarkii clarkii*	Blue List (2004)			
Trout, Steelhead (Puget Sound / Georgia Basin)	*Oncorhynchus mykiss*			**Candidate to Endangered (COSEWIC 2018)**	Threatened (2007)
Walleye Pollock (South Puget Sound)	*Theragra chalcogramma*		Candidate		

Items in bold represent legal status changes made between December 1, 2015 and October 15, 2021. Common name in bold represents new species to the list.

*Not included in species count

Table 4: Reptile species at risk in the Salish Sea in 2021
(Date of most recent review or listing provided when available)

Common Name	Scientific Name	British Columbia	Washington State	Canada	U.S.A.
Green Sea Turtle	*Chelonia mydas*		Threatened	Candidate (COSEWIC)	Threatened (2016)
Leatherback Sea Turtle	*Dermochelys coriacea*	Red List (2018)	Endangered	Endangered (COSEWIC 2012, SARA 2017)	Endangered (1970)

Table 5: Avian species at risk in the Salish Sea in 2021
(Date of most recent review or listing provided when available)

Common Name	Scientific Name	British Columbia	Washington State	Canada	U.S.A.
American Avocet	*Recurvirostra americana*	Blue List (2015)			
American Bittern	*Botaurus lentiginosus*	Blue List (2015)			
Ancient Murrelet	*Synthliboramphus antiquus*	Blue List (2020)		Special Concern (COSEWIC 2014, SARA 2006)	
Band-tailed Pigeon	*Patagioenas fasciata*	Blue List (2015)		Special Concern (COSEWIC 2008, SARA 2011)	
Black-footed Albatross	*Phoebastria nigripes*	Blue List (2015)		Special Concern (COSEWIC 2007, SARA)	

Black-legged Kittiwake	*Rissa tridactyla*	Red List (2015)			
Brant	*Branta bernicla*	Blue List (2015)			
California Gull	*Larus californicus*	Blue List (2015)			
Canada Goose, Dusky	*Branta canadensis occidentalis*	Red List (2009)			
Cassin's Auklet	*Ptychoramphus aleuticus*	**Blue List to Red List (2018)**	Candidate	Special Concern (COSEWIC, 2014), **Special Concern (SARA, 2019)**	
Common Murre	*Uria aalge*	Red List (2015)	**Candidate to Not Listed***		
Cormorant, Brandt's	*Phalacrocorax penicillatus*	Red List (2015)	**Candidate to Not Listed***		
Cormorant, Double-crested	*Phalacrocorax auritis*	Blue List (2015)			
Cormorant, Pelagic	*Phalacrocorax pelagicus pelagicus*	Red List			
Forster's Tern	*Sterna foresteri*	Red List (2015)			
Great Blue Heron, Pacific	*Ardea herodias fannini*	Blue List (2018)		Special Concern (COSEWIC 2008, SARA 2010)	
Grebe, Clark's	*Aechmophorus clarkii*	Red List (2015)	Candidate		
Grebe, Eared	*Podiceps nigricollis*	Blue List (2015)			
Grebe, Horned	*Podiceps auritus*			Special Concern (COSEWIC 2009), **Not listed to Special Concern (SARA)**	
Grebe, Western	*Aechmophorus occidentalis*	Red List (2015)	Candidate	Special Concern (COSEWIC, 2014), **Not Listed to Special Concern (SARA, 2017)**	
Green Heron	*Butorides virescens*	Blue List (2015)			

Gyrfalcon	*Falco rusticolus*	Blue List (2015)			
Hudsonian Godwit	*Limosa haemastica*	Red List (2020)		**Candidate to Threatened (COSEWIC, 2019)**	
Long-billed Curlew	*Numenius americanus*	Blue List (2018)		Special Concern (COSEWIC 2011, SARA 2005)	
Long-tailed Duck	*Clangula hyemalis*	Blue List (2015)			
Loon, Common	*Gavia immer*		Sensitive		
Marbled Murrelet	*Brachyramphus marmoratus marmoratus*	Blue List (2015)	**Threatened to Endangered (2016)**	Threatened (COSEWIC 2012, SARA 2003)	Threatened
Northern Fulmar	*Fulmarus glacialis*	Red List (2015)			
Owl, Short-eared	*Asio flammeus*	Blue List (2015)		Special Concern (COSEWIC 2008, SARA 2012)	
Owl, Snowy	*Bubo scandiacus*	**Blue List to Unknown***		**Not At Risk to Candidate (COSEWIC)**	
Parasitic Jaeger	*Stercorarius parasiticus*	Red List (2015)			
Pelican, American White	*Pelecanus erythrorhynchos*	Red List (2015)	**Endangered to Threatened (2016)**		
Peregrine Falcon, American	*Falco peregrinus anatum*	Red List (2011)	**Sensitive to Not Listed***	**Special Concern to Not at Risk (COSEWIC 2017),** Special Concern (SARA 2012)	
Peregrine Falcon, Peale's	*Falco peregrinus pealei*	Blue List (2019)	**Sensitive to Not Listed***	Special Concern (COSEWIC 2017, SARA 2003)	
Phalarope, Red-necked	*Phalaropus lobatus*	Blue List (2015)		Special Concern (COSEWIC, 2014), **Not Listed to Special Concern (SARA, 2019)**	
Puffin, Horned	*Fratercula corniculata*	Red List (2015)			
Puffin, Tufted	*Fatercula cirrhata*	Blue List (2015)	Endangered		
Purple Martin	*Progne subis*	Blue List	**Candidate to Not Listed***		

Red Knot	*Calidris canutus roselaari*	Red List (2015)		Threatened (COSEWIC 2007, SARA 2010)	
Rough-legged Hawk	*Buteo lagopus*	Blue List			
Sandhill Crane	*Grus canadensis*		Endangered		
Sandpiper, Buff-breasted	*Tryngites subruficollis*			Special Concern (COSEWIC 2012), **Not Listed to Special Concern (SARA)**	
Scoter, Black	*Melanitta americana*	Blue List (2015)			
Scoter, Surf	*Melanitta perspicillata*	Blue List (2015)			
Shearwater, Buller's	*Puffinus bulleri*	Blue List (2015)			
Shearwater, Flesh-footed	*Puffinus carneipes*	Blue List (2015)			
Shearwater, Pink-footed	*Puffinus creatopus*	Blue List (2015)		**Threatened to Endangered (COSEWIC 2016, SARA 2016)**	
Tern, Caspian	*Hydroprogne caspia*	Blue List (2015)			
Tundra Swan	*Cygnus columbianus*	Blue List (2015)			
Whimbrel	*Numenius phaeopus*	**Red List (2019)**			

Items in bold represent legal status changes made between December 1, 2015 and October 15, 2021. Common name in bold represents new species to the list.
*Not included in species count

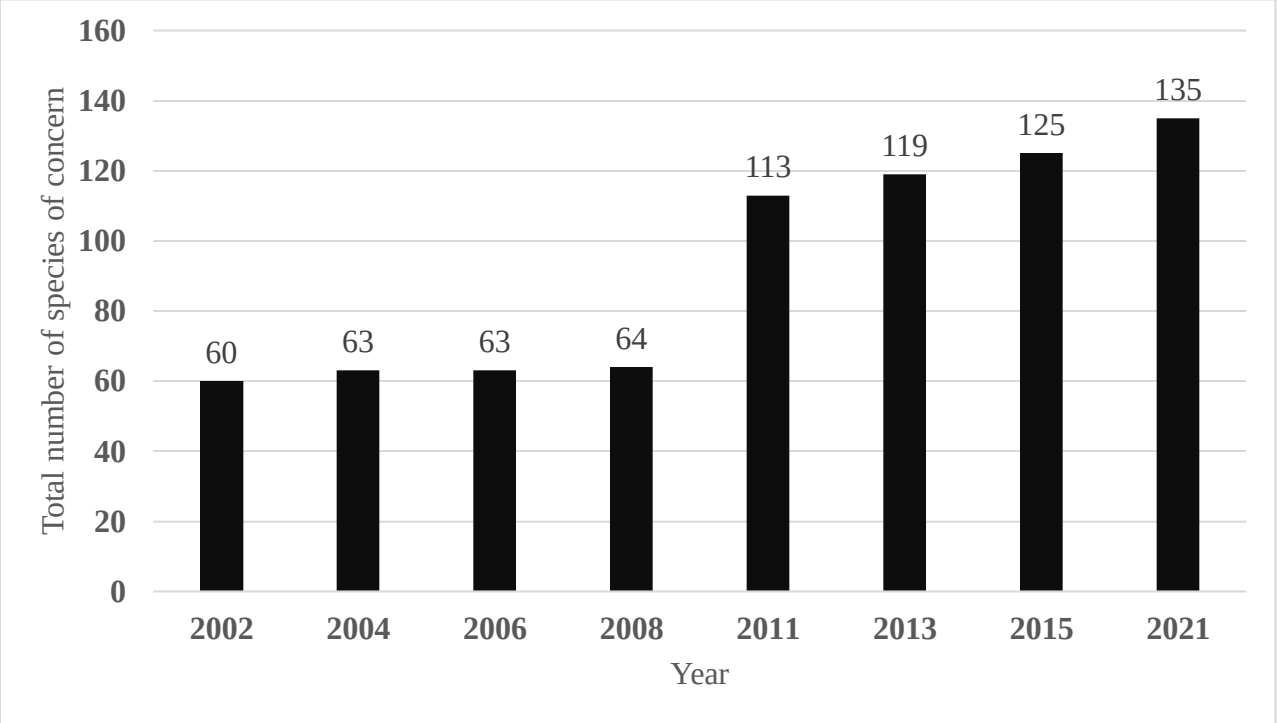
Table 6: Mammal species at risk in the Salish Sea in 2021
(Date of most recent review or listing provided when available)

Common Name	Scientific Name	British Columbia	Washington State	Canada	U.S.A.
Fin Whale	*Balaenoptera physalus*	Red List (2006)	Endangered	**Threatened to Special Concern (COSEWIC 2019)**, Threatened (SARA 2006)	Endangered (1970)
Gray Whale	*Eschrichtius robustus*	Blue List (2006)	Sensitive (E. North Pacific Stock)	**Not Listed to Endangered (COSEWIC 2017)**, Special Concern (SARA 2005)	

Grizzly bear	*Ursus arctos*	Blue List (2015)	Endangered	Special Concern (COSEWIC 2012), **Not Listed to Special Concern (SARA 2018)**	Threatened
Harbor Porpoise	*Phocoena phocoena*	Blue List (2006)	Candidate	Special Concern (COSEWIC 2016, SARA 2005)	
Humpback Whale (N. Pacific)	*Megaptera novaeangliae*	Blue List (2006)	Endangered	Special Concern (COSEWIC 2011), **Threatened to Special Concern (SARA 2017)**	Endangered (Central America DPS, 2016), Threatened (Mexico DPS, 2016)
Killer Whale (N. Residents)	*Orcinus orca*	Red List (2011)	Endangered	Threatened (COSEWIC 2008, SARA 2003)	
Killer Whale (Offshore)	*Orcinus orca*	Red List (2011)	Endangered	Threatened (COSEWIC 2008, SARA 2003)	
Killer Whale (S. Residents)	*Orcinus orca*	Red List (2021)	Endangered	Endangered (COSEWIC 2008, SARA 2003)	Endangered
Killer Whale (Transients)	*Orcinus orca*	Red List (2011)	Endangered	Threatened (COSEWIC 2008, SARA 2003)	
Northern Elephant Seal	*Mirounga angustirostris*	Red List (2006)			
Northern Fur Seal	*Callorhinus ursinus*	Red List (2006)		Threatened (COSEWIC 2010)	
Sea Otter, Northern	*Enhydra lutris kenyoni*	Blue List (2015)	**Endangered to Threatened**	Special Concern (COSEWIC 2011, SARA 2003)	
Steller Sea-lion (Eastern Population)	*Eumetopias jubatus*	Blue List (2013)		Special Concern (COSEWIC 2013, SARA 2005)	

Items in bold represent legal status changes made between December 1, 2015 and October 15, 2021.

Figure 1: Number of marine species at risk in the Salish Sea over time (year axis not to scale)



Note: citations for data
2002: Gaydos and Gilardi, 2003
2004: Brown and Gaydos, 2005
2006: Brown and Gaydos, 2007
2008: Gaydos and Brown, 2009
2011: Gaydos and Brown, 2011
2013: Gaydos and Zier, 2014
2015: Zier and Gaydos, 2016
2021: Current study