Species of Concern in the Georgia Basin/Puget Sound Marine Ecosystem: More Support for a Transboundary Ecosystem Approach to Marine Conservation

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Abstract
Species of concern are native species and sub-species that warrant special attention to ensure their conservation. Within the Georgia Basin / Puget Sound marine ecosystem, the Canadian Federal Government, the United States Federal Government, the State of Washington, and the Province of British Columbia all have different processes for assessing which species require special initiatives to ensure protection and survival of the population. We reviewed listings from all four jurisdictions and identified a total of 60 species or sub-species from the shared inland marine waters that were listed as species of concern (current on September 1, 2002). Each jurisdiction underestimated the number of species of concern within the entire marine ecosystem: Washington State identified 73%, the Province of British Columbia identified 47%, the U.S. Federal Government identified 30%, and the Canadian Federal Government identified 28%. While acknowledging that species abundance and distribution differ within the Georgia Basin / Puget Sound marine ecosystem and listing criteria differ by jurisdiction, recognition of species of concern on an ecosystem basis gives a more complete perspective on the health of our shared marine ecosystem. We propose that the identification of 60 species of concern could be indicative of ecosystem decay. Continued efforts need to be made to identify shared species of concern and plans for their recovery should occur across jurisdictional boundaries on an ecosystem basis.

Introduction
Species of concern are native species and subspecies that warrant special attention to ensure their conservation. Within the Georgia Basin / Puget Sound marine ecosystem, the Canadian Federal Government, the United States Federal Government, the State of Washington, and the Province of British Columbia all have different processes for assessing which species require special initiatives to ensure protection and survival of the population. Because species within the transboundary marine ecosystem do not recognize state, provincial, or international boundaries, we sought to enumerate the actual total number of species of concern within the ecosystem using listings produced by each jurisdiction.

Methods
Four jurisdictions evaluate and list species of concern within the shared inland waters of Washington and British Columbia: the federal governments of Canada and the United States; Washington State; and the Province of British Columbia. Using lists produced by each jurisdiction, we identified species that are found within the shared inland marine waters (Puget Sound, Northwest Straits, and Georgia Basin) and compared listings between jurisdictions. Data presented is current as of September 1, 2002. The processes for listing for each jurisdiction are as follows:

Canada
In Canada, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) creates a federal listing of species at risk using an international ranking system adapted from the World Conservation Union in Switzerland. This independent organization 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 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 the COSEWIC 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 commission's status reports

for these species so that an assessment can be undertaken. Currently, species listed by COSEWIC as "endangered," "threatened," or of "special concern" do not receive legal recognition from the federal government. Under the new federal Species at Risk Act, COSEWIC will act as an advisory body to the federal government, who will ultimately be responsible for turning the list into law.

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 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.
(5) Other natural or anthropogenic factors significantly impeding the species' survival.

The process for listing as species begins in one of two ways: either the Agencies initiate the process by publishing a "notice of review" that identifies as 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. Alternatively, the Agencies may receive a petition for listing a species from any citizen or group in the United States, and after a 90-day review of the petition, determine whether there is or is not 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 whether or not to propose listing for the species. During this review period, the Agencies seek biological information to help complete the status review. By the end of the one-year review period, 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 input and comment period. Information received during this time period 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 does not support the listing.
(3) The proposal review period is extended for an additional 6 months because there is substantial disagreement within the scientific community concerning the listing.

Once a species is listed under the ESA, all protective measures authorized under the ESA are applicable to the species, e.g. restrictions on take, transport and sale; authority to draft and implement recovery plans, and/or authority to purchase important habitat. The status of a listed species is reviewed at least every five years to determine if federal protection is still warranted.

British Columbia

In the Province of British Columbia, species are assigned a risk of extinction. This process is based on a standard set of international criteria developed by NatureServe. 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. These provincial ranks are updated annually. Currently, British Columbia assesses only mammals, birds, amphibians, reptiles, freshwater fish, freshwater mollusks, butterflies, dragonflies, vascular plants, and mosses. Important to this study and 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. To simplify interpretation of species ranks in British Columbia, species are placed on Red, Blue, and 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 of concern because of characteristics that make them particularly sensitive to human activities or natural events. Yellow-listed species, not considered species of concern for the purposes of this study, includes all species not included on the Red or Blue lists. The provincial listing of species with similar conservation risks (Red, Blue, and Yellow) helps provide the foundation for establishing legal protection for endangered or threatened species. Legal designation of species as threatened or endangered (Red List species) under the provincial Wildlife Act increases penalties for harming a species and enables the protection of habitat in a Critical Wildlife Management Area.

Washington State

In Washington State, species of concern are listed by the Washington Fish and Wildlife Commission (Commission) 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. A species is 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 is initiated either when the Washington Department of Fish and Wildlife (WDFW) determines that a species is in danger, when 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 when the Commission requests the WDFW 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. Once a species is identified as a candidate for listing, WDFW then publishes a public notice in the Washington Register and calls for scientific information relevant to the species status. WDFW prepares a preliminary species status report, which reviews relevant information on the status of the species in Washington, and addresses factors affecting its status. The public and the scientific community is given 90 days to review and comment on WDFW's preliminary status report, and WDFW holds at least one public meeting in each of its administrative regions during this public review period. Once WDFW has incorporated public comment, the status report is completed, and the WDFW makes a recommendation for species classification to the Commission. The final species status report and agency classification recommendation is 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 the threatened or endangered species, or a management plan for a sensitive species. A review of the species' status is conducted by WDFW at least once every five years.

Results

We identified 60 species from the Georgia Basin / Puget Sound marine ecosystem that were listed by one or more jurisdiction as species of concern (Table 1: current on September 1, 2002). Three of these were invertebrates (Table 2), 24 were fishes (Table 3), 25 were birds (Table 4), and 8 were mammals (Table 5). Each jurisdiction underestimated the number of species of concern within the entire marine ecosystem. Of the 60 species listed by one or more jurisdiction, Washington State identified 73%, the Province of British Columbia listed 47%, the U.S. Federal Government identified 30%, and the Canadian Federal Government identified 28%.

Table 1. Marine ecosystem species identified as species of concern by jurisdiction.

	BRITISH COLUMBIA	WASHINGTON STATE	CANADA	U.S.A.	TOTAL
INVERTEBRATES	0	3	2	1	3
FISHES	1	21	2	6	24
BIRDS	20	13	7	8	25
MAMMALS	7	7	6	3	8
TOTAL	28	44	17	18	60

Table 2. Invertebrate Species of Concern in the Georgia Basin / Puget Sound Marine Ecosystem.

SPECIES	BRITISH COLUMBIA	WASHINGTON STATE	CANADA	U.S.A.
Newcomb's littorine snail (*Algamorda subrotundata*)		Candidate		Species of Concern
Olympia oyster (*Ostrea lurida*)		Candidate	Special Concern	
Pinto (Northern) Abalone (*Haliotis kamtschatkana*)		Candidate	Threatened	

Table 3. Fish Species of Concern in the Georgia Basin / Puget Sound Marine Ecosystem.

SPECIES	BRITISH COLUMBIA	WASHINGTON STATE	CANADA	U.S. A.
Eulachon, (*Thaleichthys pacificus*)	Blue List	Candidate		
Pacific cod, S. & C. Puget Sound (*Gadus macrocephalus*)		Candidate		
Pacific hake, C. Puget Sound (*Merluccius productus*)		Candidate		Candidate
Pacific herring, Cherry Point (*Clupea pallasi*)		Candidate		Candidate
Pacific herring, Discovery Bay (*Clupea pallasi*)		Candidate		Candidate
Rockfish, Black (*Sebastes melanops*)		Candidate		
Rockfish, Bocaccio (*Sebastes paucispinis*)		Candidate		
Rockfish, Brown (*Sebastes auriculatus*)		Candidate		
Rockfish, Canary (*Sebastes pinniger*)		Candidate		
Rockfish, China (*Sebastes nebulosus*)		Candidate		
Rockfish, Copper (*Sebastes caurinus*)		Candidate		
Rockfish, Greenstriped (*Sebastes longates*)		Candidate		
Rockfish, Quillback (*Sebastes maliger*)		Candidate		
Rockfish, Redstripe (*Sebastes proriger*)		Candidate		
Rockfish, Tiger (*Sebastes nigrocinctus*)		Candidate		
Rockfish, Widow (*Sebastes entomelas*)		Candidate		
Rockfish, Yelloweye (*Sebastes ruberrimus*)		Candidate		
Rockfish, Yellowtail (*Sebastes flavidus*)		Candidate		
Salmon, Chinook (*Oncorhynchus tshawytscha*) (Puget Sound)		Candidate		Threatened
Salmon, Chum (*Oncorhynchus keta*) (summer-run Hood Canal)		Candidate		Threatened
Salmon, Coho (*Oncorhynchus kisutch*) Interior Fraser River			Endangered	
Salmon, Coho (*Oncorhynchus kisutch*) Puget Sound/ Strait of Georgia				Candidate
Spinynose Sculpin (*Asemichthys taylori*)			Data Deficient	
Walleye pollock, S. Puget Sound (*Theragra chalcogramma*)		Candidate		

Table 4. Avian Species of Concern in the Georgia Basin / Puget Sound Marine Ecosystem.

SPECIES	BRITISH COLUMBIA	WASHINGTON STATE	CANADA	U.S. A.
American Golden Plover (*Pluvialis dominica*)	Blue List			
Ancient Murrelet (*Synthliboramphus antiquus*)	Blue List		Special Concern	
Bald Eagle (*Haliaeetus leucocephalus*)		Threatened		Threatened
Canada Goose, Aleutian (*Branta canadensis leucopareia*)		Threatened		Threatened
Caspian Tern (*Sterna caspia*)	Blue List			
Cassin's Auklet (*Ptychoramphus aleuticus*)	Blue List	Candidate		Species of Concern
Common Loon (*Gavia immer*)		Sensitive		
Common Murre (*Uria aalge*)	Red List	Candidate		
Cormorant, Brandt's (*Phalocrocorax penicillatus*)	Red List	Candidate		
Cormorant, Double-crested (*Phalocrocorax auritis*)	Red List			
Cormorant, Pelagic (*Phalocrocorax pelagicus pelagicus*)	Red List			
Forster's Tern (*Sterna foresteri*)	Red List		Data Deficient	
Golden Eagle (*Aquiula chrysaetos*)		Candidate		
Great Blue Heron, Pacific (*Ardea herodias fannini*)	Blue List	Monitored	Special Concern	
Harlequin Duck (*Histrionicus histrionicus*)		Species of Concern		Species of Concern
Long-billed Curlew (*Numenius americanus*)	Blue List		Special Concern	
Long-tailed duck / Oldsquaw (*Clangula hyemalis*)	Blue List			
Marbled Murrelet (*Brachyramphus marmoratus marmoratus*)	Red List	Threatened	Threatened	Threatened
Peregrine Falcon, American (*Falco peregrinus anatum*)	Red List	Sensitive	Threatened	Species of Concern
Peregrine Falcon, Peale's (*Falco peregrinus pealei*)	Blue List	Sensitive	Special Concern	Species of Concern
Phalarope, Northern / Red-necked (*Phalaropus lobatus*)	Blue List			
Short-billed Dowitcher (*Limnodromus griseus*)	Blue List			
Surf Scoter (*Melanitta perspicillata*)	Blue List			
Tufted Puffin (*Fratercula cirrhata*)	Blue List	Candidate		Species of Concern
Western Grebe (*Aechmophorus occidentalis*)	Red List	Candidate		

Table 5. Mammalian Species of Concern in the Georgia Basin / Puget Sound Marine Ecosystem.

SPECIES	BRITISH COLUMBIA	WASHINGTON STATE	CANADA	U.S.A.
Gray Whale (*Eschrichtius robustus*)	Blue List	Sensitive		Sensitive
Harbor Porpoise (*Phocoena phocoena*)	Blue List	Candidate	Data Deficient	
Humpback whale, N. Pacific (*Megaptera novaeangliae*)		Endangered	Threatened	Endangered
Killer Whales, S. Residents (*Orcinus orca*)	Red List	Candidate*	Endangered	
Killer Whales, N. Residents (*Orcinus orca*)	Blue List		Threatened	
Killer Whales, Transients (*Orcinus orca*)	Red List	Candidate*	Threatened	
Sea Otter, northern (*Enhydra lutris*):	Red List	Endangered	Threatened	
Steller Sea-lion (eastern population) (*Eumetopias jubatus*)	Red List	Threatened		Threatened

*Washington State does not differentiate Resident and Transient Killer Whale Populations

Discussion

Due to differences in species abundance and distribution within the ecosystem as well as differences in listing criteria by jurisdiction, it is not surprising that each jurisdiction underestimated the true number of species of concern for the ecosystem. For example, the Province of British Columbia does not assess marine fishes and invertebrates in their species rankings. Consequently, developing a trans-jurisdictional list appears to be a more accurate way to create a list of species of concern for the shared marine waters. Each jurisdiction's method for evaluating and listing species of concern is crucial for the operations of that governing body and we do not recommend changing the way that any of the four jurisdictions evaluate species of concern. Instead we propose evaluating all four lists and creating an annual trans-jurisdictional list that is limited to species found in the marine ecosystem. Such a list would have many values:

A crude indicator of ecosystem health

The total number of species listed within an ecosystem can be used as a crude indicator of ecosystem health. Keeping in mind that listings of species of concern are human constructs, which often are driven by time, money, and legal considerations, a trans-jurisdictional list of species of concern within the shared inland waters of the Georgia Basin / Puget Sound marine ecosystem that is updated annually also could be used as a gross index of changes in ecosystem health. We propose that the current identification of 60 species of concern within the shared inland waters of the Georgia Basin / Puget Sound marine ecosystem is indicative of ecosystem decay (Bierregard *et al*. 2001). This gradual loss of species complexity and resulting loss in biodiversity can be likened to the insidious loss of radioactivity from a source: gradual losses are difficult to notice, but its cumulative effects are dramatic over time. It is only through recognizing the process and reversing the trend that ecosystem integrity can be maintained. Sixty species of concern within the Georgia Basin / Puget Sound marine ecosystem is a wake-up call to reverse ecosystem decay.

A method of cross checking between jurisdictions

A trans-jurisdictional list of species of concern within the shared inland waters of the Georgia Basin / Puget Sound marine ecosystem permits other jurisdictions to stay aware of the species being recognized by other jurisdictions within the ecosystem. While species abundance and distribution can differ within the ecosystem, it still is helpful to know when other jurisdictions are recognizing species declines. For example, we identified that Washington State listed 88% of the 44 fish species or fish stocks of concern, whereas British Columbia does not list marine fishes (with the exception of the eulachon, an anadromous fish). This is an opportunity for British Columbia to evaluate listings by Washington State

to identify potential species of concern within its jurisdiction. If declines in certain species or groups of fish (such as *Sebastes* spp.) are more significant in Washington State than in British Columbia, this could be an opportunity for British Columbia to try and learn why these fish species or stocks are in decline in Washington State and work to prevent those conditions from occurring in its jurisdiction. Also, we identified that British Columbia listed 80% of the 25 bird species or subspecies of concern, whereas Washington State listed only 52% (Table 4). Once aware of this, Washington State could look to see which of the bird species listed by British Columbia and not Washington also occur in Washington State and warrant investigation of population status in Washington.

Suggests where more research is needed

Ecosystem-based lists of species of concern could suggest where more research is needed to identify true species of concern or to plan their recovery. The number of invertebrate species far outnumbers vertebrate species in the shared inland waters of the Georgia Basin / Puget Sound marine ecosystem. Despite this, invertebrates comprised only 5% (3/60) of the species listed. While it is possible that this is a true representation of invertebrate species of concern within the ecosystem, it more likely represents a need for more research on the status of invertebrate populations throughout the shared marine ecosystem.

Suggests need for a transboundary approach to species recovery

Species, their prey, and their diseases do not recognize jurisdictional boundaries and consequently, efforts to recover most species of concern should be transboundary in scope. For example, larvae that could be critical in repopulating some declining populations of demersal rockfish in Washington State might originate in British Columbia. If this is found to be true and Washington State does not work with British Columbia to ensure adequate protection of older spawning females in British Columbia, rockfish recovery efforts in those parts of Washington will be stifled.

Implies new management strategies could be warranted

Some may say that traditional single-species management has failed or is failing in the case of many of the 60 species or sub-species of concern recognized in the Georgia Basin / Puget Sound marine ecosystem. This begs the question, "Are there ecosystem-level management approaches that could do a better job of keeping common species common?" New strategies warrant investigation.

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