Supplementary Materials

Contents

Supplementary Table 1. Data used, sources, and other details

Type of data	Source(s) of data	Resolution of data	Rescaling of intensity values to low, medium, high intensity
Commercial fishing			
1. Groundfish Bottom trawling: effort	Fisheries and Oceans Canada (DFO)	4km by 4km*	Low=3-3449 hrs Medium=3450-11450 hrs High=11451-44851 hrs
2. Groundfish ZN 1993-2004: effort	DFO	4km by 4km*	Low=60-64200 hrs Medium=64201-218372 hrs High=218373-1095223 hrs
3. Schedule II 1996-2004: effort	DFO	4km by 4km*	Low=0-22050 min Medium=22051-81827 min High=81828-215318 min
4. Sablefish Trap 1996-2004: effort	DFO	4km by 4km*	Low=125-4591 traps Medium=4592-14750 traps High=14751-63531 traps
5. Sablefish Longline 1996-2004: effort	DFO	4km by 4km*	Low=800-94175 hooks Medium=94176-310818 hooks High=310819-763675 hooks
6. Prawn 2001-2004: effort	DFO	4km by 4km*	Low=51-5198 hrs Medium=5199-17467 hrs High=17468-54345 hrs
7. Shrimp Trawl 1996-2004: effort	DFO	4km by 4km*	Low=2-856 hrs Medium=857-3570 hrs High=3571-8499 hrs
8. Crab 2000-2004: effort	DFO	4km by 4km*	Low=72-49298 hrs Medium=49299-180408 hrs High=180409-451148 hrs
9. Red urchin: effort	DFO	10km by 10km*	Low=10-487 hrs Medium=488-1600 hrs High=1601-4104 hrs
10. Green urchin: effort	DFO, Parks Canada	10km by 10km*	Low=0-138 hrs Medium=139-410 hrs High=411-1405 hrs
11. Commercial sea cucumber: effort	DFO	10km by 10km*	Low=0-130 hr Medium=131-354 hrs High=355-982 hrs
12. Commercial krill: effort	DFO	10km by 10km*	Low=936-2055 hrs Medium=2056-12208 hrs High=12209-24166 hrs
13. Commercial geoduck: effort	DFO	10km by 10km*	Low=2-250 hrs Medium=251-1390 hrs High=1391-3743 hrs
14. Commercial scallop	Province of BC	Not specified in metadata**	Used existing relative importance index.
15. Commercial salmon troll	Province of BC, Parks Canada	Not specified in metadata**	Used existing relative importance index.
16. Commercial salmon net	Province of BC	Not specified in metadata**	Used existing relative importance index.
17. Commercial squid	Province of BC	Not specified in metadata**	Used existing relative importance index.
18. Commercial octopus	Province of BC	Not specified in metadata**	Used existing relative importance index.
19. Commercial herring	Province of BC	Not specified in metadata**	Used existing relative importance index.

20. Commercial herring roe	Province of BC, Parks Canada	Not specified in metadata**	Used existing relative importance index.
21. Commercial gooseneck barnacle	Province of BC	Not specified in metadata**	Used existing relative importance index.
22. Commercial dogfish	Parks Canada	Not specified in metadata**	Does not contain relative importance information
Recreational fishing			
23. Recreational trap fishing (crab and prawn)	Province of BC, DFO, Parks Canada	Not specified in metadata**	Used existing relative importance index.
24. Recreational diving (dive, diving, scallops)	Province of BC, and DFO	Not specified in metadata**	Does not contain relative importance information
25. Recreational fishing – unspecified (probably mostly hook and line fishing)	Province of BC, DFO, Parks Canada	Not specified in metadata**	Used existing relative importance index.
Marine tourism			
26. Fishing and other floating lodges	DFO	Not specified in metadata**	Used existing relative importance index.
Coastal marine-based industrial/commercial activities			
27. Finfish aquaculture	Province of BC	Not specified in metadata**	Does not contain relative importance information
28. Shellfish aquaculture	Province of BC	Not specified in metadata**	Does not contain relative importance information
29. Ports, moorage, ferry docks, marinas	Updated from Province of BC	1:20,000	Used existing relative importance index.
30. Marine disposal sites	Environment Canada	Not specified in metadata	Does not contain relative importance information
31. Logging-related	Province of BC	1:20,000	Used existing relative importance index.
32. Large vessel activity	DFO	4km by 4km	Low=100-1088 ships Medium=1089-3504 ships High=3505-12787 ships
Land-based activities			
33. Towns	Created from charts	1:20,000	Low=1-2 relative size Medium=3-5 relative size High=6-10 relative size
34. Pulp and paper	Province of BC	1:20,000	Used existing relative importance index.
35. Industry	Province of BC	1:20,000	Used existing relative importance index.
36. Agriculture	Province of British Columbia	Not specified in metadata	Does not contain relative importance information
37. Mining	Province of BC	1:20,000	Used existing relative importance index.
38. Forestry	Province of British Columbia	1:20,000	Used existing relative importance index.

* Data summarized into coarse grids by data provider to maintain confidentiality obligations.

** While many of the datasets do not indicate the specific resolution, we estimate that they are based on CHS charts of about 1:50,000.

Supplementary Table 2. Creating the habitat map

Methods: We created the habitat map to match the habitats used in the work by Halpern et al [1,2]. To create the map, we started with the coarsest data, which covers all of BC's marine waters: the Marine Ecological Classification (MEC) data [3]. In places where more detailed data were available, we then replaced the MEC data in those locations, starting with coarser data from Manson [4], followed by more detailed data (complexity analysis, Parks Canada terrain modeler mapping, and biogenic habitats (kelp, sponge reefs, seagrass) [5]. When assigning benthic habitat types, unknown habitats were given the most common habitat type designation for their location: soft shelf, soft slope, or soft deep

Category from Halpern data	**Data used for BC**
Subtidal coastal	*Subtidal coastal*
kelp forest	Prov. of BC: shorezone kelp
rocky reef	Complexity analysis (LOS, Ardron): categories 6,7 Strait of Georgia, Parks Canada benthic terrain modeler mapping
seagrass	Prov. of BC: shorezone eelgrass
shallow soft	MEC substrate type sand and mud, shelf
suspension reefs	Sponge reefs
Offshore	*Offshore*
soft shelf	MEC substrate type sand and mud, shelf
soft slope	MEC substrate type sand and mud, slope
soft deep	MEC substrate type sand and mud, deep
hard shelf	MEC substrate type hard, shelf
hard slope	MEC substrate type hard, slope
hard deep	MEC substrate type hard, deep
canyons	DFO (Manson 2007)
seamounts	DFO (Manson 2007)

Supplementary Table 3. Literature review of stressors and zone of influence by activity.

We used a literature review to identify the spatial extent of impacts from activities, and assigned one of six distance categories (Table 1). When mapping the distances, we used the upper limit of the values, with the exception of the very long category for which we used the minimum distance of 30 km because maximum distances vary widely. We took the conservative assumption that stressors beyond 30 km of an activity will attenuate to minimal impacts. We used ArcGIS (ESRI version 9.1, Redmond, California) to process and analyze the spatial data. To generate maps showing stressors associated with human uses, we employed linear density decay analyses for each activity with their associated stressor-distance [6]. We used the distance class as the maximum distance at which the activity still has an influence, with the relative intensity/importance field as the value. The table is an updated version of a table contained in Ban & Alder [7].

Anthropogenic activity	Type of impact	Observed distance of impact	Location of study	References
Coastal marine-based industrial/commercial activities				
Finfish aquaculture	Transmittance of furunculosis	24 km	Puget Sound	Quoted in [8]
	Sea lice infections exceeded ambient levels	30 km	B.C.	[9]
	Second generation of lice that re-infected juvenile salmon exceeded ambient levels	75 km	B.C.	[9]
	Escaped Atlantic Salmon	100s of kms	B.C.	[10]
	Dead zone created by accumulated organic matter	100 to 500 feet	B.C.	Quoted in [11]
	Changes in the macrobenthos observed from some salmon farms during peak production	225 m	B.C.	[12,13]
	Organic enrichment effects at newly established farm sites were localized, but ~ five years, changes were measurable over greater	> 200 m	New Brunswick	[13]
	Total discharge of N and P from pen-raised salmon has been estimated to be 20.5-30.0 g N and 6.7 g P per kg of Atlantic salmon produced.		B.C.	[14,15]
	Material directly attributable to a finfish aquaculture source	1.2 km	Denmark;	[13,16,17]
	Oxytetracycline resistance has been observed in bacteria cultured from sediments up to 100 m away from	100 m	Bay of Fundy	[14,18,19]

	salmon farm sites			
	Distances traveled by the dye patches	900 to 3000 m	Lower Bay of Fundy	[14,18,20]
	Large variations in copper concentrations in the sediments of farms using treated nets		Washington State; B.C.	[21,22]
	Use of acoustic harassment devices: dramatic decline in porpoise abundance at least several km of the source when the devices were activated. Audible zone for an Airmur AHD operating at 152 dB re 1pPa2 @ 1 m would extend to 2.8-12.2 km under high and low ambient noise levels.	AHD at 194 dB audible to extents between 25-42 km.	B.C.	[23,24]
Shellfish aquaculture	Introduction of exotic species	100s of kms	B.C.	[10]
	Vexar® fences, berm building and beach clearing alter the natural patterns of waves and currents resulting in impacts on the natural patterns of erosion and sedimentation in the intertidal zone	?	Baynes Sound, B.C.	[25,26]
	The extent to which beach cover (either predator exclusion netting or dense oyster beds) reduces shorebird and seaduck access to the underlying substrates is not known, but increase of birds energetic costs of foraging, or increase in risk of impact are potential problems	?	Baynes Sound, B.C.	[25,27,28]
	The manual removal and killing of macro invertebrate predators found on lease areas is a common practice in intertidal bivalve aquaculture.	?		[25,29]
	Channelization alters the temporal and spatial flow patterns in the intertidal zone			[25]
Log dumping, handling and storage	Bark and debris accumulations		Alaska, US	[30]
	Logs creating shade and chemical leachates; scouring from tugboat propellers; reduced dissolved oxygen in water and sediment resulting from log debris, resulting in changes to the infaunal community	300 m	B.C.	[31,32]
	Deposition of resin acids (ex:dehydroabietic acid) on the sea	2.8 km	North Island,	[33]

	floor due to storm runoff from close-by log handling areas		New Zealand	
	Build up of wood debris and soluble wastes in poorly flushed locations, creating significant local harm to benthic communities and bottom feeders	120 m	B.C.	[32,34]
Forestry – harvest	Forestry practices which generate suspended sediments include all operations that disturb soil surfaces such as site preparations, clear-cutting, log skidding, yarding, slash burns, heavy equipment operation and road construction and maintenance.		British Columbia	[35]
Ports, Marinas and harbors	Zinc concentrations in sediments were markedly higher in marinas than at the control sites.		UK	[36]
	Dredging for marina development and vessel navigation, water quality issues creating conditions for dinoflagellate blooms	At least extent of the marina and channels	Washington	[37]
	Large scale dredging to maintain sufficient depth for vessel passage can create sediment plumes	1.2 km		[31]
	Sedimentation and erosion due to ship traffic	Erosion areas at 56% of 1,149,000 m^2 mapped	Sweden	[38]
	Increased heavy metal contamination, differences in biological communities and settlement rates	1.4 km	New Zealand	[39]
	Heavy metal contaminations from residues of antifoulant released during sand blasting, high pressure water cleaning and paint scraping during ship repairs	5 km	UK	[40]
	Tributyltin (TBT) contamination; TBT was banned for ships smaller than 25 meters in 1989. Nontheless, it is still extremely widespread.		B.C.	[14,41]
	Wood preservatives; nitrogen heterocyclics make up 70% of the soluble fraction of creosote and are much more toxic and bioavailable to organisms in the water column	Localized to the port/harbour	B.C.	[14,31,42]
	Temporary but significant increase of turbidity from dredging to suspended sediments and the release of contaminants that	?	B.C.	[34,43]

	have previously accumulated in muds.			
	Trace metal contaminants found ~50 km distant from Vancouver harbor	~50 km	B.C.	[44]
	Anchor damage to benthos	Whole embayments	New Zealand	[45]
	Energy dissipating structures (breakwaters and jetties) possibly impacting nearshore hydrological processes, primary producer composition and juvenile fish	100-499m (estimation)	Washington, U.S.	[46]
	Photopollution from lighthouses can harmfully impact migrating birds	Localized	Lake Erie, Ontario	[47]
Small docks, ramps, wharves	Shading from the average dock adversely affects 87 m^2 marsh grass	87 m^2	South Carolina	[48]
	Light levels reduced 2-4 orders of magnitude	2400 feet	Seattle	[37,49]
	During construction, pile driving noise would be heard by salmonids within a radius of at least 600 m from the noise	600 m	Washington	[37]
	Effects of CCA (chromated copper arsenate) treated wood on benthic organisms was generally localized	Localized	Atlantic coast estuaries, US; B.C.	[50,51]
	Shading effects from dock structures decreased the stem density of the dominant salt marsh plant S. alterniflora.	Localized	South Carolina, US	[52-55]
Ocean dumping (designated sites for non-toxic materials)	The substances that may be permitted for disposal at sea include dredged material, inert/inorganic geological material, fish waste, uncontaminated organic material of natural origin, inert/bulky items and vessels (trace metal contaminants can potentially affect the resident benthic community).	500-1999 m	Pacific and Yukon Region	[56]
Large boat traffic (tankers, cruise ships, etc.)	Responses of feeding humpback whales to vessels	2-4 km	B.C. and Alaska	[57]
	Illegal dumping of oily wastes	80 km	California	[58]
	Boat noise could impair communication between killer whales over a range of 1 – 14 km	1-14 km	Washington and B.C.	[59]
	Cruise ships: Volume of greywater plume with detectable levels of tracer dye	6 – 45 billion litres	Florida	[60]
	Boat noise could impair communication between killer whales over a range of 1 – 14 km	1-14 km	Washington and B.C.	[59]

	Gray whales fled when Soviet catcher vessels approached within 350-550m	350-550 m	Chukotka, Russia;	[61,62]
	Oil spills: Detectable oil and affected seabirds were seen as far as 175 km to the north on Vancouver Island.	175 km	B.C.; Washington State (Nestucca spill)	[14,34,63-67]
	Dumping of floating plastic debris (can travel on currents for thousands of miles)	> 100000m	Worldwide; UN review	[68,69]
Land-based activities				
Onshore mining	Increased levels of mercury 40km from abandoned mercury mine	40 km	Slovenia and Italy	[70]
	Acid mine drainage had a deleterious effect on mussles at least 2.1 km north and 1.7 km south of the mine	At least 2.1 km	B.C.	[71]
	AMD appears to strongly influence algal community structure within the 1600-m zone	1.6 km	Britannia Mine, B.C.	[72]
	Submarine discharge of tailings (Cu): copper levels were elevated from the outfall to 16–20 km distant, particularly below the discharge depth (50 m).	16-20 km	Island Copper Mine (closed in 1995) B.C.	[34,73]
Agriculture	Runoff of silts from tilled land can smother nearshore benthic communities and coastal wetlands	?		[34]
	Pesticide pollution via run-off waters	10001-30000m	Mediterranean Sea	[74]
Smelters	PAH concentrations in indicator organisms of > 1000 times the background values within 1-2 km of the smelter outfalls. Nonetheless, elevated concentrations were traced for more than 35-40 km.	Up to 40 km	Norway	[75]
Pulp and paper	Traces of bark, fiber and wood chips were observed 12 km upcurrent from a pulp and paper mill.	12 km	Newfoundland	[76]
	Toxic substances released in effluent and by air been found in sediments as well as Dungeness crab as far as 60 km away and as late as 1995, indicating that the contaminants continued to be bioavailable.	60 km	B.C.	[77-79]
	Increase in total suspended solids	0.5 to 8 km	B.C.	[80,81] [82]

	Mill effluents reducing oxygen supply; the zone of potentially lethal (to salmon) dissolved oxygen concentrations (DO < 3 mg 1-1) extended over 5 km	5 km	Port Alice, B.C.	[34,83,84]
	High PCB levels in sediments around pulp mills are likely the result of leaks from PCB-containing electrical equipment. PCBs are a persistent environment contaminant	?	B.C.	[14,85]
Human settlements	Structural changes in benthic communities along a presumed pollution gradient	~20km	B.C.	[86]
	rockfish and flatfish in industrial parts of Puget Sound have high levels of contamination in comparison to less industrial and urban areas		Washington State	[87]
	Otters sampled close to towns were nearly twice as likely to be seropositive to *T. gondii* as expected	20 km	California coast	[88,89]
	Sewage-derived nitrogen traced to 24 km from outfall; sewage influence most pronounced within 10 km	10-24 km	Baltic Sea	[90]
	Distribution of steroidal estrogens in marine environments	?	Pacific, western Atlantic Ocean, and Caribbean.	[91]
	Nitrogen loading leading to eutrophication	5 km from river mouths	Moreton Bay, Australia	[92]
	Storm water discharges, combined sewer overflow, littering, disposal from landfills and industrial activities all contribute to land-based sources of marine debris (floating plastic debris can travel on currents for thousands of miles).	> 100000m	Worldwide; UN review; U.S.	[68,69,93]
Water diversions*	Localized increase of sediment loads and nutrients in estuaries	Vicinity of the estuary	Kitimat, B.C.	[94]
Marine tourism				
Motorized pleasure boating	Nutrient loading due to vessels that have minimal on-board waste retention	~ 1km ?		[34]
	After an exotic species initially invades a new bioregion and	?	Elkhorn	[95]

	becomes established, it may spread within the region by intraregional mechanisms including boat traffic		Slough, California, US	
	Most common source of marine oil pollution is from recreational vessels	~ 1 km ?	US	[96]
	Noise: Killer whales exhibited avoidance behaviors when approached by 'leapfrogging' vessels	100 m?		[97]
Kayaking	Marine mammals and birds can be disturbed	~ 50 m ?	PNCIMA, B.C.	[34]
SCUBA diving	Physical damage from fins or other contact is possible locally. Branching corals have also been shown to be most susceptible to mechanical injury.	Localized	B.C.; Caribbean	[34,98]
Whale watching	Negative reactions to sounds typically occurred when whales were within 100 m of the source, or when there were sudden increases in sound levels (> 12 dB)	100 m	Canada	[99].
	Killer whale (*Orcinus Orca*) disturbance: Whales tended to swim faster as boats got closer, and to slow down as number of boats increased.	400 m	Johnstone Strait, B.C.	[97,100]

Supplementary Table 4. Summary of stressors associated with activities.

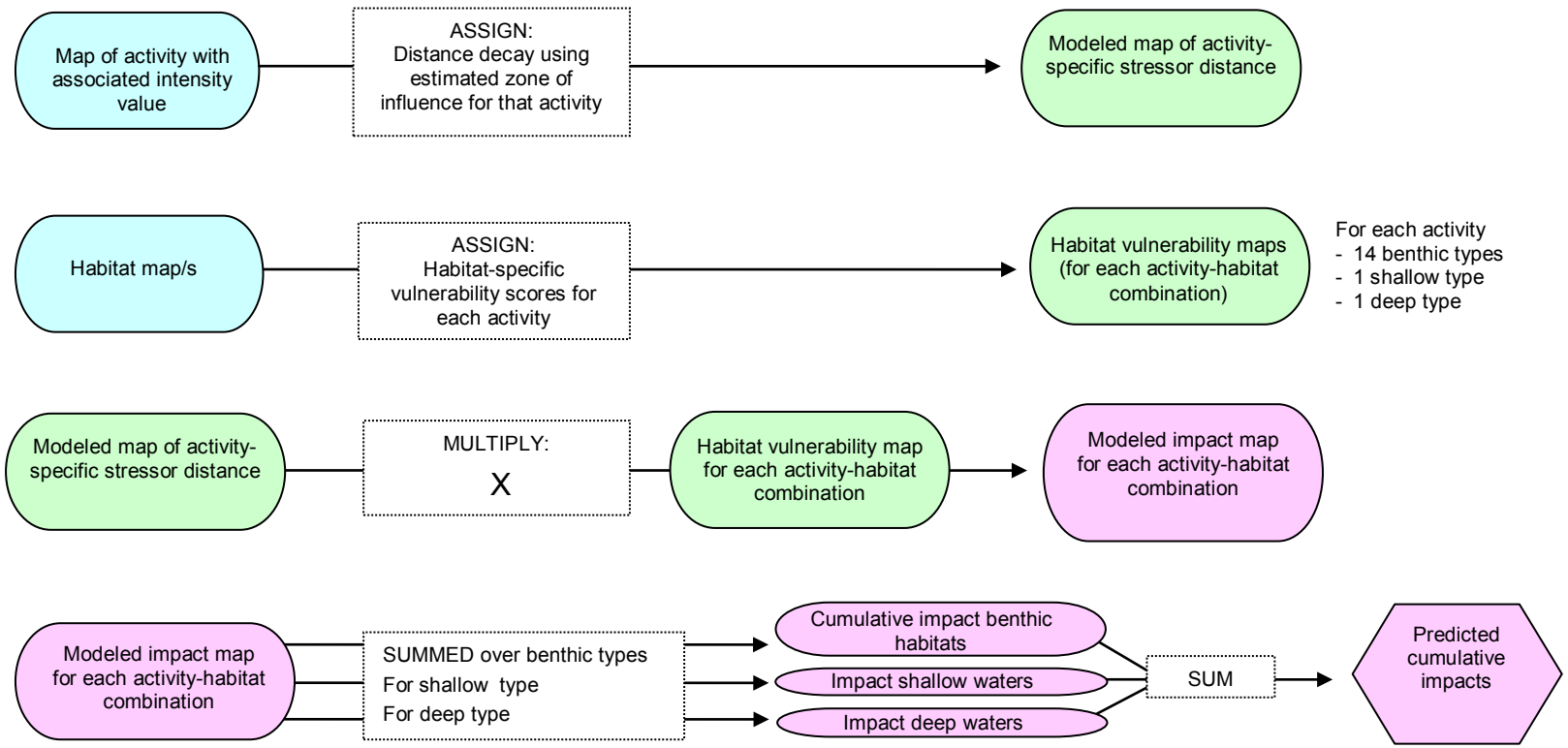
		Coastal marine-based industrial/commercial activities							Land-based activities							Marine tourism and recreation					Fishing - recreational			
Stressor ↓ / **Activity →**		Finfish aquaculture	Shellfish aquaculture	Log dumping, handling and	Ports, Marinas and harbors	Small docks, ramps, wharves	Ocean dumping	Large boat traffic	Forestry: recently logged	Industry	Onshore mining	Agriculture	Pulp and paper	Human settlements	Water diversions*	Pleasure boating*	Kayaking*	SCUBA diving*	Lodges	Whale watching*	Trap	Line	Dive	Unspecified
Water & sediment quality	Bacteria	✓		✓	✓	✓				✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Chemical contaminants	✓		✓	✓	✓				✓	✓		✓	✓		✓			✓		✓	✓	✓	✓
	Nutrients	✓	✓		✓	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	Oil waste	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓
	Organic waste	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Sediment transport / turbidity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓
Biological stressors	Behaviour	✓	✓	✓	✓	✓										✓		✓		✓				
	Biomass removal/incidental mortality	✓	✓	✓	✓			✓		✓	✓		✓		✓	✓		✓	✓		✓	✓	✓	✓
	Disease & parasites	✓													✓									
	Genetic contamination	✓																						
	Invasive species	✓	✓		✓			✓		✓	✓		✓		✓	✓		✓						
Physical stressors	Benthic disturbance	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			✓	✓		✓	✓		
	Change in temperature				✓								✓		✓									
	Collisions							✓		✓						✓		✓	✓	✓	✓	✓	✓	✓
	Freshwater input/decrease														✓									
	Hydrography (currents, wash)	✓	✓	✓	✓	✓									✓					✓				
	Light	✓			✓	✓		✓		✓														
	Marine debris		✓	✓							✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Noise	✓	✓	✓	✓	✓		✓		✓	✓		✓			✓		✓	✓	✓	✓	✓	✓	✓	✓

*No spatial data available; not included in analysis.

Supplementary Table 4 (cont'd)		Commercial fisheries																				
Stressor ↓ **Activity →**		Bottom trawling	Groundfish ZN	Schedule II	Sablefish trap	Sablefish longline	Prawn trap	Shrimp trawl	Crab	Red urchin	Green urchin	Sea cucumber	Krill	Geoduck	Scallop	Salmon troll	Salmon net	Squid	Octopus	Herring	Herring roe	Gooseneck barnacle
Water & sediment quality	Bacteria	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Chemical contaminants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nutrients	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Oil waste	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Organic waste	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Sediment transport	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Biological stressors	Behaviour																					
	Biomass removal/incidental mortality	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Disease & parasites																					
	Genetic contamination																					
	Invasive species																					
Physical stressors	Benthic disturbance	✓	✓	✓	✓	✓	✓	✓	✓					✓								✓
	Change in temperature																					
	Collisions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Freshwater input/decrease																					
	Hydrography (currents, wash)																					
	Light																					
	Marine debris	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Noise	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Supplementary Table 5. Matching activities to stressors from Halpern et al. [1,101]

Activity	Corresponding stressor
Agriculture	Nutrient input: into mesotrophic (non-upwelled) waters
Commercial fishing: Bottom trawling	Fishing: demersal destructive
Commercial fishing: Crab	Fishing: demersal destructive
Commercial fishing: Geoduck	Fishing: demersal non-destructive low bycatch
Commercial fishing: Gooseneck barnacle	Fishing: demersal non-destructive low bycatch
Commercial fishing: Green urchin	Fishing: demersal non-destructive low bycatch
Commercial fishing: Groundfish ZN	Fishing: demersal non-destructive low bycatch
Commercial fishing: Herring	Fishing: pelagic high bycatch
Commercial fishing: Herring roe	Fishing: demersal non-destructive low bycatch
Commercial fishing: Krill	Fishing: pelagic low bycatch
Commercial fishing: Octopus	Fishing: demersal non-destructive low bycatch
Commercial fishing: Prawn trap	Fishing: demersal destructive
Commercial fishing: Red urchin	Fishing: demersal non-destructive low bycatch
Commercial fishing: Sablefish longline	Fishing: demersal non-destructive low bycatch
Commercial fishing: Sablefish trap	Fishing: demersal destructive
Commercial fishing: Salmon net	Fishing: pelagic high bycatch
Commercial fishing: Salmon troll	Fishing: pelagic low bycatch
Commercial fishing: Scallop	Fishing: demersal destructive
Commercial fishing: Schedule II	Fishing: demersal non-destructive low bycatch
Commercial fishing: Sea cucumber	Fishing: demersal non-destructive low bycatch
Commercial fishing: Shrimp trawl	Fishing: demersal destructive
Commercial fishing: Squid	Fishing: pelagic high bycatch
Finfish aquaculture	Aquaculture: finfish
Human settlements	Pollution input: trash, etc. (urban runoff)
Industry	Pollution input: inorganic
Large boat traffic (tankers, cruise ships, etc.)	Shipping
Log dumping, handling and storage	Marine component of forestry operations
Ocean dumping (designated sites for non-toxic materials)	Ocean dumping: marine debris
Onshore mining	Pollution input: organic
Ports, Marinas and harbors	Ocean pollution
Pulp and paper	Ocean dumping: toxic materials
Recreational fishing: Dive	Fishing: recreational
Recreational fishing: Line	Fishing: recreational
Recreational fishing: Lodges	Fishing: recreational
Recreational fishing: Trap	Fishing: recreational
Recreational fishing: Unspecified	Fishing: recreational
Shellfish aquaculture	Aquaculture: shellfish
Small docks, ramps, wharves	Ocean pollution



Supplementary Figure 1. Flowchart of methods used to create the maps of predicted cumulative impacts.

References

[1]. Teck SJ, Halpern BS, Kappel CV, Micheli F, Selkoe KA, Crain CM, et al. Using expert judgment to estimate marine ecosystem vulnerability in the California Current. Ecol Appl. In Review.

[2]. Halpern BS, McLeod KL, Rosenberg AA, Crowder LB. Managing for cumulative impacts in ecosystem-based management through ocean zoning. Ocean & Coastal Management. 2008; 51: 203-11.

[3]. Zacharias MA, Howes DE, Harper JR, Wainwright. P. The British Columbia Marine Ecosystem Classification: Rationale, Development, and Verification. Coastal Management. 1998; 26: 105-24.

[4]. Manson M. Small Scale Delineation of Northeast Pacific Ocean Undersea Features Using Benthic Position Index. Vancouver: Fisheries and Oceans Canada2007.

[5]. Ardron J. A GIS recipe for determining benthic complexity: an indicator of species richness. In: Breman J, editor. Marine geography: GIS for the oceans and seas: ESRI Press; 2002.

[6]. Schill S, Raber G. Protected Area GAP Decision-Support System for ArcGIS 9.1 User Manual and Tutorial: The Nature Conservancy2006 September 2007.

[7]. Ban N, Alder J. How wild is the ocean? Assessing the intensity of anthropogenic marine activities in British Columbia, Canada
DOI: 10.1002/aqc.816. Aquatic conservation: marine and freshwater ecosystems. 2008; 18: 55-85.

[8]. EVS Environment Consultants. An evaluation of knowledge and gaps related to impacts of freshwater and marine aquaculture on the aquatic environment: a review of selected literature. North Vancouver: EVS Environment Consultants2000 December 2000.

[9]. Krkošek M, Lewis MA, Volpe JP. Transmission dynamics of parasitic sea lice from farm to wild salmon. Proceedings of the Royal Society B. 2005; 272: 689-96.

[10]. Naylor RL, Williams SL, Strong DR. Aquaculture - a gateway for exotic species. Science. 2001; 294: 1655-6.

[11]. Naylor RL, Eagle J, Smith WL. Salmon aquaculture in the Pacific Northwest: a global industry with local impacts. Environment. 2003; 45: 18-39.

[12]. Brooks K, Stierns A, Mahnken C, Blackburn D. Chemical and biological remediation of the benthos near Atlantic salmon farms. Aquaculture. 2003; 219: 355-77.

[13]. Hargrave B, Cranford P, Dowd M, Grant B, McGladdery S, Burridge L. A Scientific Review of the Potential Environmental Effects of Aquaculture in Aquatic Ecosystems. Ottawa, Ontario: Fisheries and Oceans Canada, Science Branch2003. Report No.: 2450.

[14]. Haggarty D, McCorquodale B, Johannessen D, Levings C, Ross P. Marine environmental quality in the central coast of British Columbia, Canada: a review of contaminant sources, types and risks. Can Tech Rep Fish Aquat Sci/Rapp Tech Can Sci Halieut Aquat. 2003: 163.

[15]. Nash C. The net-pen salmon farming industry in the Pacific Northwest: US Department of Commerce2001. Report No.: NMFS-NWFSC-49.

[16]. Haya K, Burridge L, Chang B. Environmental impact of chemical wastes produced by the salmon aquaculture industry. ICES Journal of Marine Science. 2001; 58: 492-6.

[17]. Holmer M. Impacts of aquaculture on surrounding sediments: generation of organic-rich sediments (p. 155-175 of Aquaculture and the environment). Depauw N, Joyce J, editors. Ghent, Belgium: European Aquaculture Society Spec. Publ. 16; 1991.

[18]. Burridge L. Chemical use in marine finfish aquaculture in Canada: a review of current practices and possible environmental effects. St-Andrews: St-Andrews Biological Station, Marine Environmental Sciences, Fisheries and Oceans Canada2005.

[19]. Friars F, Armstrong S. The examination of possible oxytetracycline resistance in microbes isolated from sediments under and around finfish aquaculture sea cage sites in Southwestern New Brunswick (p.79)2002. Report No.: 2411.

[20]. Ernst W, Jackman P, Doe K, Page F, Julien G, Mackay K, et al. Dispersion and toxicity to non-target aquatic organisms of pesticides used to treat sea lice on salmon in net pen enclosures. Mar Pollut Bull. 2001; 42: 433-44.
[21]. Gardner J, Peterson D. Making sense of the salmon aquaculture debate: Analysis of issues related to netcage salmon farming in British Columbia: Pacific Fisheries Resource Conservation Council2003.
[22]. Brooks K. An evaluation of the relationship between salmon farm biomass, organic inputs to sediment, physiochemical changes associated with those inputs and the infaunal response-with emphasis on total sediment sulfides, total volatile sulfides, and oxidation-reduction potential as surrogate endpoints for biological monitoring. Port Townsend, Washington: Aquatic Environmental Sciences2001.
[23]. Richardson W, Greene C, Malme C, Thomson D. Marine mammals and noise. San Diego, California: Academic Press; 1995.
[24]. Olesiuk P, Nichol L, Sowden M, Ford J. Effect of the sound generated by an acoustic harassment device on the relative abundance and distribution of harbor porpoises (*Phocoena phocoena)* in Retreat Passage, British Columbia. Marine Mammal Science. 2002; 18: 843-62.
[25]. Jamieson G, Chew L, Gillespie G, Robinson A, Bendell-Young L, Heath W, et al. Phase 0 Review of the Environmental Impacts of Intertidal Shellfish Aquaculture in Baynes Sound: Canadian Science Advisory Secretariat, Fisheries and Oceans Science, Fisheries and Oceans Canada2001. Report No.: 2001/125.
[26]. Pillay T. Aquaculture and the Environment. New York, NY: John Wiley & Sons, Inc.; 1992.
[27]. Spencer B, Kaiser M, Edwards D. The effects of Manila clam cultivation on an intertidal benthic community: the early cultivation phase. Aquaculture Research. 1996; 27: 261-76.
[28]. Spencer B, Kaiser M, Edwards D. Ecological Effects of Intertidal Manila Clam Cultivation: Observations at the End of the Cultivation Phase. The Journal of Applied Ecology. 1997; 34: 444-52.
[29]. Pillay T. Aquaculture: Principles and Practices. Oxford, UK: Fishing New Books; 1990.
[30]. Kirkpatrick B, Shirley T, O'Clair C. Deep-Water Bark Accumulation and Benthos Richness at Log Transfer and Storage Facilities. Alaska Fishery Research Bulletin. 1998; 5: 103-15.
[31]. Booth J. Method for development of planning buffers around VMEF's for use in coastal planning. Vancouver: DFO Habitat Branch2005 March 2005.
[32]. Williamson C, Levings C, Macdonald J, White E, Kopeck K, Pendray T. A Priliminary Assessment of Wood Debris at Four Log Dumps on Douglas Channel, British Columbia: Comparison of Techniques. Burnaby, BC: Fisheries and Oceans Canada, Science Branch, Pacific Region2000. Report No.: 2539.
[33]. Tian F. Accumulation of Resin Acids in Sediments Adjacent to a Log Handling Area, Tauranga Harbour, New Zealand. Bulletin of Environmental Contamination and Toxicology. 1998; 60: 441-7.
[34]. Booth J. Ecosystem Overview and Assessement Report: Fisheries and Ocean Canada2007.
[35]. Anderson PG. Sediment generation from forestry operations and associated effects on aquatic ecosystems. Forest-fish Conference: Land Management Practices Affecting Aquatic Ecosystems MK Brewin etD MA Monita, tech coords Proc Forest-Fish Conf, May. 1996: 1-4.
[36]. Bird P, Comber SDW, Gardner MJ, Ravenscroft JE. Zinc inputs to coastal waters from sacrificial anodes. Science of The Total Environment. 1996; 181: 257-64.
[37]. Nightingale B, Simenstad CA. Overwater structures: marine issues. Seattle, WA: Washington State Transportation Center2001.
[38]. Stevens RL, Ekermo S. Sedimentation and erosion in connection with ship traffic, Göteborg Harbour, Sweden. Environmental Geology. 2003; 43: 466-75.
[39]. Turner SJ, Thrush SF, Cummings VJ, Hewitt JE, Wilkinson MR, Williamson RB, et al. Changes in epifaunal assemblages in response to marina operations and boating activities. Mar Environ Res. 1997; 43: 181-99.

[40]. Matthiessen P, Reed J, Johnson M. Sources and Potential Effects of Copper and Zinc Concentrations in the Estuarine Waters of Essex and Suffolk, United Kingdom. Marine Pollution Bulletin. 1999; 38: 908-20.
[41]. Stewart C, Thompson J. Extensive butyltin contamination in southwestern coastal British Columbia, Canada. Marine Pollution Bulletin. 1994; 28: 601-8.
[42]. Padma T, Hale R, Roberts MJ. Toxicity of water-soluble fractions derived from whole creasote and creosote-contaminated sediments. Environmental Toxicology and Chemistry. 1998; 17: 1606-10.
[43]. Environmental Assessment Office (BC) ECTCaINAC. Kitimat LNG Terminal Project: Assessment Report and Comprehensive Study Report: Environmental Assessment Office (BC), E.C. Transport Canada and Indian & Northern Affairs Canada2006.
[44]. Bolton JL, Stehr CM, Boyd DT, Burrows DG, Tkalin AV, Lishavskaya TS. Organic and trace metal contaminants in sediments and English sole tissues from Vancouver Harbour, Canada. Mar Environ Res. 2004; 57: 19-36.
[45]. Backhurst MK, Cole RG. Biological impacts of boating at Kawau Island, north-eastern New Zealand. J Environ Manag. 2000; 60: 239-51.
[46]. Williams G, Thom R. Marine and Estuarine Shoreline Modification Issues. Sequim, Washington, US: Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington Department of Transportation2001.
[47]. Jones J, Francis C. The effects of light characteristics on avian mortality at lighthouses. Journal of Avian Biology. 2003; 34: 328-33.
[48]. Sanger DM, Holland AF. Evaluation of the impacts of dock structures on South Carolina estuarine environments. Charleston, South Carolina: South Carolina Department of Natural Resources2002.
[49]. Macfarlane SL, Early J, Henson T, Balog T, Mcclennen A. A resource-based methodology to assess dock and pier impacts on Pleasant Bay, Massachusetts. J Shellfish Res. 2000; 19: 455-64.
[50]. Johannessen D, Ross P. Late-run sockeye at risk: An overview of environmental contaminants in Fraser river salmon habitat: Department of Fisheries and Oceans2002. Report No.: 2429.
[51]. Weis J. The Extent of Benthic Impacts of CCA-Treated Wood Structures in Atlantic Coast Estuaries. Archives of Environmental Contamination and Toxicology. 1998; 34: 313-22.
[52]. Lerberg S, Holland A, Sanger D. Responses of Tidal Creek Macrobenthic Communities to the Effects of Watershed Development. Estuaries. 2000; 23: 838-53.
[53]. Sanger D, Holland A. Evaluation of the Impacts of Dock Structures on South Carolina Estuarine Environments. Charleston, South Carolina: Office of Ocean and Coastal Resource Management (US)2002. Report No.: 99.
[54]. Sanger a D. Tidal Creek and Salt Marsh Sediments in South Carolina Coastal Estuaries: I. Distribution of Trace Metals. Archives of Environmental Contamination and Toxicology. 1999; 37: 445-57.
[55]. Sanger b D. Tidal Creek and Salt Marsh Sediments in South Carolina Coastal Estuaries: II. Distribution of Organic Contaminants. Archives of Environmental Contamination and Toxicology. 1999; 37: 458-71.
[56]. Environment Canada. Compendium of Monitoring Activities at Disposal at Sea Sites in 2004-2005. Client Edition: Disposal at Sea Program. Environmental Protection Service. Environment Canada2006 March 2006.
[57]. Richardson WJ, Malme B. Zones of noise influence. In: Richardson WJ, Greene CR, Malme CI, Thomson DH, editors. Marine mammals and noise. San Diego: Academic Press; 1995.
[58]. Hampton S, Kelly PR, Carter HR. Tank vessel operations, seabirds, and chronic oil pollution in California. Mar Ornithol. 2003; 31: 29-34.
[59]. Foote AD, Osborne RW, Hoelzel AR. Whale-call response to masking boat noise. Nature. 2004; 428: 910.

[60]. United States Environmental Protection Agency. Cruise ship plume tracking survey report: United States Environmental Protection Agency2002. Report No.: EPA842-R-02-001.
[61]. Bogoslovskaya L, Votrogov L, Semenova T. Feeding habits of the gray whale off Chukotka. Report of the International Whaling Commission. 1981; 31: 507-10.
[62]. Wyrick R. Observations on the Movements of the Pacific Gray Whale Eschrichtius glaucus (Cope). Journal of Mammalogy. 1954; 35: 596-8.
[63]. Burger A. Effects of the Nestucca Oil Spill on Seabirds Along the Coast of Vancouver Island in 1989: Canadian Wildlife Service, Pacific and Yukon Region1993.
[64]. Sea Otter Recovery Team D. National Recovery Strategy for the Sea Otter (*Enhydra lutris*) in British Columbia: DFO2003 June 2003.
[65]. Berger A. Effects on the Nestucca Oil Spill on Seabirds Along the Coast of Vancouver Island in 1989: Canadian Wildlife Service, Pacific and Yukon Region1993.
[66]. Sloan N. Oil impacts on cold-water marine resources: a review relevant to Parks Canada's evolving marine mandate: Parks Canada1999. Report No.: 11.
[67]. Koeth T, Vauk-Hentzelt E. Influence of plumage and stomach oiling on body and organ growth in young kittwakes. Marine Pollution Bulletin. 1988; 19: 71-3.
[68]. Derraik J. The pollution of the marine environment by plastic debris: a review. Mar Pollut Bull. 2002; 44: 842-52.
[69]. Sheavly S, editor. An overview of a critical issue for our oceans. Sixth Meeting on the UN Open-ended Informal Consultative Processes on Oceans & the Law of the Sea; 2005 June 6-10, 2005.
[70]. Hines ME, Horvat M, Faganeli J, Bonzongo J-CJ, Barkay T, Major EB, et al. Mercury biogeochemistry in the Idrija River, Slovenia, from above the Mine into the Gulf of Trieste. Environ Res. 2000; 83: 129-39.
[71]. Grout JA, Levings CD. Effects of acid mine drainage from an abandoned copper mine, Britannia Mines, Howe Sound, British Columbia, Canada, on transplanted blue mussels (Mytilus edulis). Mar Environ Res. 2001; 51: 265-88.
[72]. Marsden AD, DeWreede RE. Marine macroalgal community structure, metal content and reproductive function near an acid mine drainage outflow. Environmental Pollution. 2000; 110: 431-40.
[73]. Burd B. Evaluation of mine tailings effects on a benthic marine infaunal community over 29 years. Mar Environ Res. 2002; 53: 481-519.
[74]. Berrens L, de la Cuadra B, Gallego M, Readman J, Albanis T, Barcelo D, et al. Fungicide Contamination of Mediterranean Estuarine Waters: Results from a MED POL Pilot Survey. Marine Pollution Bulletin. 1997; 34: 259-63.
[75]. Naes K, Knutzen J, Berglind L. Occurrence of PAH in marine organisms and sediments from smelter discharge in Norway. Science of The Total Environment
Environmental and Health Aspects Related to the Production of Aluminium. 1995; 163: 93-106.
[76]. Khan RA. Effect of Sediment from Two Sulphite-Bleaching Paper Mills on Winter Flounder (*Pleuronectes americanus*) Following Chronic Exposure. Bull Environ Contam Toxicol. 1997; 59: 139-45.
[77]. Afonso L, Smith J, Ikonomou M, Devlin R. Y-Chromosomal DNA Markers for Discrimination of Chemical Substance and Effluent Effects on Sexual Differentiation in Salmon. Environmental Health Perspectives. 2002; 110: 881-8.
[78]. Yunker M, Cretney W, Ikonomou M. Assessment of chlorinated dibenzo-p-dioxin and dibenzofuran trends in sediment and crab hepatopancreas from pulp mill and harbour sites using multivariate- and index-based approaches. Environmental Science and Technology. 2002.
[79]. Grant S, Ross P. Southern resident killer whales at risk: Toxic chemicals in the Brititsh Columbia and Washington environment: DFO2002. Report No.: 2412.
[80]. Colodey A, Wells P. Effects of pulp and paper mill effluents on estuarine and marine ecosystems in Canada: a review. Journal of Aquatic Ecosystem Health. 1992; 1: 201-26.

[81]. Geological Survey of Canada EC, editor. Proceedings. Howe Sound Environmental Science Workshop; 1991 Sept. 30 to Oct. 3, 1991; Bowen Island, BC.
[82]. LeDrew B, Bennett B. Humber Arm monitoring program: 1988 sampling: Fudge and Associates Ltd. submitted to Corner Brook Pulp and Paper Ltd.1989 September 1989.
[83]. Birtwell I. Comments on the sensitivity of salmonids to reduced levels of dissolved oxygen, and to pulp mill pollution in Neroutsos Inlet, British Columbia. 1989.
[84]. Parker R, Sibert J. Effects of pulpmill effluent on the dissolved oxygen supply in Alberni Inlet, British Columbia. Tech Rep Fish Res Board Can. 1972; 316: 1-41.
[85]. Kay B. Pollutants in British Columbia's marine environment: A status report. A state of the environment report. Canada Environmental Protection PaYR, editor. West Vancouver: Canada Environmental Protection, Pacific and Yukon Region; 1989.
[86]. Je J-G, Belan T, Levings C, Koo BJ. Changes in benthic communities along a presumed pollution gradient in Vancouver Harbour. Mar Environ Res. 2004; 57: 121-35.
[87]. O'Neil S, West J, Hoeman J. Spatial trends in the concentrations of polychlorinated biphenyls (PBC's) in chinook (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) in Puget Sound and factors affecting PCB accumulations: Results from Puget Sound Ambient Monitoring Program. Seattle, Washington: The Puget Sound Water Quality Authority1998.
[88]. Miller M, Gardner I, Kreuder C, Paradies D, Worcester K, Jessup D, et al. Coastal freshwater runoff is a risk factor for Toxoplasma gondii infection of southern sea otters(Enhydra lutris nereis). International Journal for Parasitology. 2002; 32: 997-1006.
[89]. Frenkel J, Dubey J. Toxoplasmosis and its prevention in cats and man. J Infect Dis. 1972; 126: 664-73.
[90]. Savage C. Tracing the influence of sewage nitrogen in a coastal ecosystem using stable nitrogen isotopes. Ambio. 2005; 34: 145-50.
[91]. Atkinson S, Atkinson M, Tarrant A. Estrogens from Sewage in Coastal Marine Environments. Environmental Health Perspectives. 2003; 111: 531-6.
[92]. Costanzo S, O'Donohue M, Dennison W, Loneragan N, Thomas M. A new approach for detecting and mapping sewage impacts. Mar Pollut Bull. 2001; 42: 149-56.
[93]. US Environmental Protection Agency. Assessing and monitoring floatable debris. Washington, DC: Oceans and Coastal Protection Division, Office of Wetlands, Oceans, and Watersheds, Office of Water, US Environmental Protection Agency1992. Report No.: 20460.
[94]. Church M. Geomorphic response to river flow regulation: Case studies and time-scales. Regulated Rivers: Research & Management[REGUL RIVERS: RES MANAGE]. 1995; 11.
[95]. Wasson K, Zabin C, Bedinger L, Diaz M, Pearse J. Biological invasions of estuaries without international shipping: the importance of intraregional transport. Biological Conservation. 2001; 102: 143-53.
[96]. National Research Council. Oil in the Sea 3: Inputs, Fates and Effects. New Ed edition ed: National Academy Press; 2003.
[97]. Williams R, Trites A, Bain D. Behavioural responses of killer whales (Orcinus orca) to whale-watching boats: opportunistic observations and experimental approaches. Journal of Zoology. 2002; 256: 255-70.
[98]. Rouphael AB, Inglis GJ. Impacts of recreational SCUBA diving at sites with different reef topographies. Biological Conservation. 1997; 82: 329-36.
[99]. Lien J. The Conservation Basis for the Regulations of Whale Watching in Canada by the Department of Fisheries and Oceans: A Precautionary Approach. St-John's, Newfoundland: Department of Fisheries and Oceans, Central and Arctic Region2001. Report No.: 2363.
[100]. Kruse S. Dolphin Societies: Discoveries and Puzzles (Chapter 4). Norris EbKPaKS, editor: University of California Press; 1998.
[101]. Halpern BS, Kappel CV, Selkoe KA, Micheli F, Ebert C, Kontgis C, et al. Mapping cumulative human impacts to California Current marine ecosystems. Conservation Letters. 2009; 2: 138-48.