**San Juan Islanders for Safe Shipping**

# ANNOTATED BIBLIOGRAPHY

**For NEB Comment Letters RE: Kinder Morgan TMPE Project Application**

**Almeda R., Z. Wambaugh, Z. Wang, C. Hyatt, Z. Liu, et al.** 2013. Interactions between Zooplankton and Crude Oil: Toxic Effects and Bioaccumulation of Polycyclic Aromatic Hydrocarbons. PLoS ONE 8(6): e67212. doi:10.1371/journal.pone.0067212
**Keywords:** copepods/ crude oil/ hydrocarbons/ marine fish/ oil spill/ petroleum/ toxicity/ zooplankton/
**Abstract:** We conducted ship-, shore- and laboratory-based crude oil exposure experiments to investigate (1) the effects of crude oil (Louisiana light sweet oil) on survival and bioaccumulation of polycyclic aromatic hydrocarbons (PAHs) in mesozooplankton communities, (2) the lethal effects of dispersant (Corexit 9500A) and dispersant-treated oil on mesozooplankton, (3) the influence of UVB radiation/sunlight exposure on the toxicity of dispersed crude oil to mesozooplankton, and (4) the role of marine protozoans on the sublethal effects of crude oil and in the bioaccumulation of PAHs in the copepod *Acartia tonsa*. Mortality of mesozooplankton increased with increasing oil concentration following a sigmoid model with a median lethal concentration of 32.4 µl L−1 in 16 h. At the ratio of dispersant to oil commonly used in the treatment of oil spills (i.e. 1:20), dispersant (0.25 µl L−1) and dispersant- treated oil were 2.3 and 3.4 times more toxic, respectively, than crude oil alone (5 µl L−1) to mesozooplankton. UVB radiation increased the lethal effects of dispersed crude oil in mesozooplankton communities by 35%. We observed selective bioaccumulation of five PAHs, fluoranthene, phenanthrene, pyrene, chrysene and benzo[*b*]fluoranthene in both mesozooplankton communities and in the copepod *A. tonsa*. The presence of the protozoan *Oxyrrhis marina* reduced sublethal effects of oil on *A. tonsa* and was related to lower accumulations of PAHs in tissues and fecal pellets, suggesting that protozoa may be important in mitigating the harmful effects of crude oil exposure in copepods and the transfer of PAHs to higher trophic levels. Overall, our results indicate that the negative impact of oil spills on mesozooplankton may be increased by the use of chemical dispersant and UV radiation, but attenuated by crude oil-microbial food webs interactions, and that both mesozooplankton and protozoans may play an important role in fate of PAHs in marine environments.
**Web Address:**
http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0067212
Accessed 11/22/2014.

**Anderson, J. A., A. J. Kuhl, A. N. Anderson.** 2014. Toxicity of Oil and Dispersed Oil on Juvenile Mud Crabs, *Rhithropanopeus harrisii*. *Bulletin on Environmental Contamaminants nad Toxicology* 92:375-380.
**Keywords:** crabs/ dispersants/ natural resource damage/ Rhithropanopeus Harrisii/ oiled shoreline/ oil spills/ oiled wildlife/ Louisiana sweet crude oil/
**Abstract:** In order to simulate an offshore oil spill event, we assessed the acute toxicity of the non-dispersed and the chemically dispersedwater-accommodated fraction (WAF) of crude oil using Louisiana sweet crude and Corexit_ 9500A with juvenile Harris mud

crabs (Rhithropanopeus harrisii), an important Gulf of Mexico benthic crustacean. The chemical dispersion of crude oil significantly increased acute toxicity of the WAF in juvenile mud crabs compared to naturally dispersed oil. The majority of the mortality in the chemically dispersed treatments occurred within 24 h. While higher concentrations of chemically dispersed WAF had no survivors, at lower concentrations surviving juvenile crabs displayed no long-term effects. These results suggest that if the juvenile crabs survive initial exposure, acute exposure to dispersed or non-dispersed crude oil may not induce long-term effects.
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**Anderson, Nancy L.** 2014. Development of Field Stabilization Program to Enhance Survival of Seabirds During Oil Spill Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1545-1558.
**Keywords:** field stabilization/ oiled wildlife/ seabirds/ spill response planning/
**Abstract:** Particularly during large or remote spills, transportation of oiled animals to a primary care center where they can receive medical care can take more than half a day. The primary goal of developing a Field Stabilization (FS) program is to provide initial medical care as quickly as possible after capture in order to increase survival. A secondary benefit is the ability to organize the transportation of birds to primary care centers to avoid overwhelming limited space and personnel resources.
To meet these goals FS programs must be mobile, flexible and scalable. Personnel, equipment and shelter need to be located near sites where birds are being recovered. Depending on the size of the spill, multiple FS sites may be required. The numbers and locations may need to change overtime. Therefore a modular design is desirable. This talk will provide an overview of one FS program and information to consider when adding FS to an existing oil spill response program.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1545
Accessed 11/8/2014.

**Antonio F. J., R. S. Mendes, S. M. Thomaz.** DATE?. Identifying and modeling patterns of tetrapod vertebrate mortality rates in the Gulf of Mexico oil spill.
**Keywords:** BP/ Oil spill/ Deepwater Horizon/ Exponential behavior/ Tetrapod vertebrate mortality rate/
**Abstract:** The accidental oil spill in the Gulf of Mexico in 2010 has caused perceptible damage to marine and freshwater ecosystems. The large quantity of oil leaking at a constant rate and the long duration of the event caused an exponentially increasing mortality of vertebrates. Using data provided by NOAA and USFWS, we assessed the effects of this event on birds, sea turtles, and mammals. Mortality rates (measured as the number of carcasses recorded per day) were exponential for all three groups. Birds were the most affected group, as indicated by the steepest increase of mortality rates over time. For sea turtles and mammals, an exponential increase in mortality was observed after an initial delay. These exponential behaviors are consistent with a unified scenario for the mortality rate for tetrapod vertebrates. However, at least for mammals, pre-spill data seem to indicate that the growth in the mortality rate is not entirely a consequence of the spill.

**Web Address:** http://arxiv.org/ftp/arxiv/papers/1106/1106.3293.pdf Accessed: 11/4/2014

**Antrim, L. C., R. M. Thom, W. W. Gardiner, V. I. Cullinan, D. K. Shreffler, R. W. Bienert.** 1995. Effects of Petroleum Products on Bull Kelp (*Nereocystis luetkeana*). *Marine Biology* 122:23-31.
**Keywords:** bull kelp/ natural resource damage/ *Nereocystis Luetkeana*/ weathering on *N. luetkeana*/
**Abstract:** Although research has been conducted on the effects of oil on the giant kelp *Macrocystis pyrifera,* no similar studies have been completed on bull kelp, *Nereocystis luetkeana,* the dominant kelp in Washington State, British Columbia, and Alaska. The effects of three petroleum products [diesel fuel, intermediate fuel oil (IFO), and crude oil] were tested before and after weathering on *N. luetkeana.* Whole plants were exposed to petroleum product for 4 or 24 h and then transferred to the field; observations on the condition of the plants were made daily for 7 d. In addition, controlled bioassays were performed to measure the effects of petroleum exposure on net photosynthetic rate (NP) and respiration rate (R), using light and dark-bottle techniques. These experiments verified the susceptibility of *N. luetkeana* tissue to the damaging effects of direct exposure to several oil types. The 4 h exposures to weathered diesel and unweathered IFO, and 24 h exposures to unweathered and weathered diesel and IFO resulted in moderate to severe damage to kelp tissue (i.e., clearly delineated bleached line accompanied by tissue necrosis). Weathered diesel was more toxic than unweathered diesel. The most severe damage to bull kelp was concentrated at the meristematic zone (junction of stipe and bulb) where new tissue growth occurs. Petroleum type significantly affected stipe and blade NP, R, and NP:R ratios. Diesel treatments had a greater negative effect on NP than did the IFO treatments. Based on these experiments, the relative ranking of the damaging effects of petroleum treatment on bull kelp are weathered diesel>unweathered IFO > unweathered diesel > weathered IFO > unweathered crude > weathered crude.
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**Arkoosh, M. R., L. Johnson, P. A. Rossignol, and T. K. Collier.** 2004. Predicting the Impact of Perturbations on Salmon (*Oncorhynchus* spp.) Communities: Implications for Monitoring. *Canadian Journal Of Fisheries & Aquatic Sciences 61*(7):1166-1175.
**Keywords:**
**Abstract:** Twenty-six salmon (*Oncorhynchus* spp.) stocks from the Pacific Northwest are listed as either threatened or endangered. A number of anthropogenic factors, likely including degradation of habitat by chemical contaminant exposure, have contributed to their decline. Techniques that can assess injury or judge the efficacy of regulatory actions on the recovery of this species are needed. We strive to understand why a population is changing by examining changes in their intrinsic birth rates, death rates, and (or) growth rates. However, salmon populations are influenced by other species in the community. To address this issue, we developed a parsimonious three-trophic-level community model consisting of prey, salmon, and parasites and examined the model's response to one anthropogenic factor (contaminant exposure) using qualitative analysis. This community model may not only provide valuable insight into salmon survival but

also may broaden the approaches available to elucidate direct and indirect effects. We demonstrate analytically that some community members, possibly salmon themselves, might be ambiguous or unreliable variables to monitor. We also demonstrate that other species in the community, such as parasites, may be more sensitive than salmon in monitoring the influence of anthropogenic factors such as contaminants.
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**Ayres, K. L, R. K. Booth, J. A. Hempelmann, K. L. Koski, C. K. Emmons, R. W. Baird, K. Balcom-Bartok, M. B. Hanson, M. J. Ford, S. K. Wasser.** 2012. Distinguishing the Impacts of Inadequate Prey and Vessel Traffic on an Endangered Killer Whale (*Orcinus orca*) Population. *PLoS ONE* 7(6): e36842.
**Keywords:** Chinook salmon/ *Oncorhynchus tshawytscha* / *Orcinus orca*/ Southern Resident Killer Whales/ SRKW/ vessel noise/ vessel traffic/
**Abstract:** Managing endangered species often involves evaluating the relative impacts of multiple anthropogenic and ecological pressures. This challenge is particularly formidable for cetaceans, which spend the majority of their time underwater. Noninvasive physiological approaches can be especially informative in this regard. We used a combination of fecal thyroid (T3) and glucocorticoid (GC) hormone measures to assess two threats influencing the endangered southern resident killer whales (SRKW; Orcinus orca) that frequent the inland waters of British Columbia, Canada and Washington, U.S.A. Glucocorticoids increase in response to nutritional and psychological stress, whereas thyroid hormone declines in response to nutritional stress but is unaffected by psychological stress. The inadequate prey hypothesis argues that the killer whales have become prey limited due to reductions of their dominant prey, Chinook salmon (Oncorhynchus tshawytscha). The vessel impact hypothesis argues that high numbers of vessels in close proximity to the whales cause disturbance via psychological stress and/or impaired foraging ability. The GC and T3 measures supported the inadequate prey hypothesis. In particular, GC concentrations were negatively correlated with short-term changes in prey availability. Whereas, T3 concentrations varied by date and year in a manner that corresponded with more long term prey availability. Physiological correlations with prey overshadowed any impacts of vessels since GCs were lowest during the peak in vessel abundance, which also coincided with the peak in salmon availability. Our results suggest that identification and recovery of strategic salmon populations in the SRKW diet are important to effectively promote SRKW recovery.
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**Baron, Gerald and Timothy O'Leary.** 2011. Intelligence-Based Response Management: The Coming Revolution in Situation Awareness/How Social Media Can Improve Situational awareness and Command Decisions. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs54.
**Keywords:** communications/ spill response planning/ spill response preparedness/
**Abstract:** Response commanders base their critical resource deployment decisions on the best information they can gather. In the past, that information has come primarily from observations by staff in the field filtered back through the Operations, Planning and Logistics sections. Also, important information comes into the response via the JIC and

Liaison Officer functions, but is that enough? Can ICS keep up with the need to take in and process information during a response in the internet age?
During the 2010 Olympics, DHS issued a document stating that they were monitoring social media in order to meet their statutory obligations to provide response management with a situation analysis and a common operating picture. This level of attention to social media changes the game in terms of how and where response managers get crucial information about an event.
NIMS and ICS provides for a flexible, modular system of management. This paper calls for an increase in the capabilities of Unified Command, using ICS, to capture, measure and understand the social media environment and to use the tools available to fulfill an incident response objective that is appropriate in every response: "communicate with and keep stakeholders informed."
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-54
Accessed 1/9/2014.

**Beamer, E. M. and K. Fresh.** 2012. Juvenile salmon and forage fish presence and abundance in shoreline habitats of the San Juan Islands, 2008-2009: Map applications for selected fish species. Skagit River System Cooperative, LaConner, WA.
**Keywords:** Chinook salmon/ *Oncorhynchus tshawytscha*/ chum salmon/ *Oncorhynchus keta*/ pink salmon/ *Oncorhynchus gorbuscha*/ Pacific herring/ *Clupea pallasii*/ Pacific sand lance/ *Ammodytes hexapterus*/ surf smelt/ *Hypomesus pretiosus*/ lingcod/greenling/ *family Hexagrammidae*/ shoreline habitat/
**Abstract:** Fish presence probabilities for the San Juan Islands' shorelines were calculated for seven juvenile fish species or species groupings from results of 1,350 beach seine sets made at 80 different sites throughout the San Juan Islands in 2008 and 2009. The juvenile fish species evaluated were: unmarked (assumed wild) Chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*Oncorhynchus keta*), pink salmon (*Oncorhynchus gorbuscha*), Pacific herring (*Clupea pallasii*), Pacific sand lance (*Ammodytes hexapterus*), surf smelt (*Hypomesus pretiosus*), and lingcod/greenling (*family Hexagrammidae*). Because juvenile salmon are known to be migratory in nearshore waters, our sampling plan was established to encompass the times of year when it is possible for juvenile salmon to be present within shoreline habitats of the San Juan Islands. Beach seining typically occurred at each site twice per month from March through October each year. We hypothesized that space (i.e., where within the San Juan Islands) and habitat type differences would influence whether or not fish were present (or abundant) at specific locations within the San Juan Islands. Beach seine sites were selected to represent different regions within the San Juan Islands (SiteType2) and different geomorphic shoreline types (SiteType3). We also stratified by two coarser-scale variables for space and habitat type. The coarse variable for space has two possible values related to whether the site is located in "interior" or "exterior" areas of the San Juan Islands. The coarse scale variable for habitat was either "enclosure" or "passage." All 80 sites were characterized by these space and habitat type variables. We used generalized linear models (GLM) to test whether our hypothesized variables of space and habitat type influence fish presence and abundance. We found strong support for both influences with no strong indication to weigh one variable over the other. Thus, we created two model versions to predict

indices of fish presence probability based on fish presence rate results summarized by each of the 80 sites for each space and habitat type variable. Models were created for each of the seven juvenile fish species or species grouping. A high resolution model (HRM) multiplied fish presence values for SiteType2 by SiteType3. A lower resolution model (LRM) multiplied fish presence rate values for the coarse space variable by the coarse habitat type variable. For each model, the calculated fish presence probabilities could range between 0 and 1. The resulting fish probability of presence estimates relate to our beach seine sampling regime of twice per month from March through October. For example, a Chinook probability of presence value of 1 for a site means you are certain to find Chinook salmon present at the site if you beach seine twice per month from March through October. We also found fish presence rates to be positively correlated with fish density for all fish species or species groupings in this report. This means sites with higher values of fish presence also have higher values of fish abundance. The strength and type (e.g., linear, exponential) of the correlated relationships varied.
**Web Address:** http://www.skagitcoop.org/documents/Beamer_Fresh_2012_Final.pdf
Accessed 1/12/2015

**Bejarano, Adriana C., Valerie Chu, Jeff Dahlin, Jim Farr.** 2014. DEVELOPMENT AND APPLICATION OF DTox: A QUANTITATIVE DATABASE OF THE TOXICITY OF DISPERSANTS AND CHEMICALLY DISPERSED OIL. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 733-746.
**Keywords:** chemically dispersed oil/ dispersants/ oil toxicity/
**Abstract:** The *Deepwater Horizon* oil spill revived discussions on the use of dispersants as an oil spill countermeasure. One of the greatest concerns regarding the use of dispersants deals with potential exposure of water column organisms to high concentrations of oil. While toxicity data on dispersants and physically and chemically dispersed oil have been generated for decades under controlled laboratory conditions, the practical use of this information has been limited by the lack of a centralized data repository. As a result, the Dispersant and Chemically Dispersed Oil Toxicity Database (DTox) was created to address that shared need of unrestricted and rapid access to toxicity data. DTox is a quantitative database that gathers existing toxicity data through a careful review and compilation of data extracted from the peer-review and gray literature. Through a rigorously evaluation of the quality of each data source, this database contains pertinent information including species scientific name, life stage tested, dispersant name, exposure type, oil weathering stage, exposure duration, etc. More importantly, this database contains effects concentrations reported on measured or nominal basis. Within the database, each data source is assigned an applicability score based on their relevance to oil spills. Key criteria in the determination of source applicability include exposure type, reported effects concentrations, and reported analytical chemistry. Information in DTox has been further integrated into a user-friendly tool that allows for on-the-fly data searches and data plotting in the form of Species Sensitivity Distributions. To date, +400 papers have been evaluated for potential inclusion into the database, and data extracted from +170 sources. Despite inherent limitations, existing toxicity data are of great value to the oil spill scientific community. Although toxicity data will never be enough to answer all toxicity questions regarding the

use of dispersants, this centralized data repository can help inform decisions on dispersant use and can help identify data needs and gaps. The ultimate goal of this tool is its contribution to a better understanding of the biological effects of dispersants and oil in the aquatic environment.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.733
Accessed 11/8/2014.

**Benggio (SSC), Bradford., Debra Scholz, Dave Anderson, Joseph Dillon, Greg Masson, Lindy Nelson, Daniel Odess, Elizabeth Petras.** 2014. Addressing the Uncertainty and Requirements for Oil Spill Response Consultations. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1881-1898.
**Keywords:** consultation requirements/ National Oil and Hazardous Substances Pollution Contingency Plan/ spill response planning/
**Abstract:** In the United States (U.S.), oil spill response planning, preparedness, and response requirements are dictated primarily by the National Oil and Hazardous Substances Pollution Contingency Plan, a regulation that implements the Oil Pollution Act of 1990, the Clean Water Act, and the Comprehensive Environmental Response, Compensation and Liability Act. At the planning stage, these regulations require the development of national, regional, and local response capabilities and promote overall coordination among responders. During a spill, these capabilities are utilized by the Federal On-Scene Coordinator (FOSC) to analyze whether response actions are likely to impact protected resources. The consultation process required under Federal statutes, charges the FOSC to consult with Federal, state, Tribal entities, and other Federal agencies to determine potential effects of response actions during an incident and to develop strategies to avoid, minimize, and mitigate those effects (40 CFR § 300.135(j); § 300.305(e); and § 300.322(a), 1994). Consultations should continue until response operations are concluded and may continue after operations are complete. Four key regulatory mandates that require an FOSC to initiate consultation during a response include:

- Endangered Species Act of 1973, as amended requires consultation with US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) on federally listed species and designated critical habitats;
- Magnuson-Stevens Act requires consultation with NMFS on any action that may affect Essential Fish Habitats;
- National Historic Preservation Act of 1966, as amended requires Federal agencies to consult with states, federally recognized tribes, and other stakeholders on potential impacts to historic and cultural resources; and
- Tribal Consultations under Executive Order 13175 – Consultation and Coordination with Indian Tribal Governments when federally recognized Indian Tribes and their interests are affected by a response.

Consultation is also required under the Native American Graves Protection and Repatriation Act when Native American burial sites, human remains, funerary objects, sacred objects, or items of cultural patrimony are identified on Federal or Tribal lands during a response and no pre-consultation plan of action has been developed.[1] Consultation requirements are not universally understood, leading to uncertainty and inconsistencies across the response community and Trustees regarding when to initiate

and how to conduct the consultations. This paper discusses the Federal consultation requirements and identifies areas of possible uncertainties in the consultation process throughout the pre-spill planning, response, and post-response phases of an incident. This paper will suggest resolutions and recommendations to further enhance the consultation process by the Federal spill response decision-makers and planning bodies.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1881 Accessed 11/8/2014.

**Boehm, Paul D., David S. Page, John S. Brown, Jerry M. Neff, Erich Gundlach.** 2014. Long-Term Fate and Persistence of Oil from the *Exxon Valdez* Oil Spill: Lessons Learned or History Repeated?. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 63-79.
**Keywords:** EVOS/ Exxon Valdez oil spill/ oiled shoreline/ spill response planning/ subsurface oil/ subsurface oil residues/
**Abstract:** For over 20 years, scientists have studied the shorelines of Prince William Sound (PWS) to understand the distribution, fate, persistence, and bioavailability of *Exxon Valdez* oil residues that stranded on the shore in 1989. Shoreline surveys in 1989 found that approximately 783 km (16%) of the 4,800 km of the shoreline in PWS, Alaska, and another 1,300 km (13%) of the roughly 10,000 km of shoreline in the western Gulf of Alaska were oiled to varying degrees. The remaining buried subsurface oil (SSO) has been observed on the shorelines in the middle and upper tide zones of a small fraction of the shores where it was originally documented in 1991. Few locations remain with any significant SSO, but the presence of these SSO residues (SSORs) continues to support the hypothesis of continuing harm to wildlife. Our most recent surveys, from 2007−2009, found SSOR in only isolated patches on a very small percentage of shoreline. They were sequestered and largely isolated from the natural weathering processes that would result in their complete and rapid removal. The SSORs are highly weathered and are not accessible or bioavailable to wildlife that forage on the shore. These findings confirm the lessons learned from all previous crude oil spills: 1) weathered SSOR can be sequestered for decades in intertidal sediments at locations where the subsurface water flow required for erosion, dissolution, and biodegradation of the oil is low 2) sequestration limits the exposure of biota to the potentially harmful fractions of the SSO.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.63 Accessed 11/3/2014.

**Booth, Sara., Rhianna Macon.** 2014. Action, not Alarm: Preparing for Oil Sands Response at the Local Level. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 417-425.
**Keywords:** bitumen/ Canadian Oil Sands Products/ oil spill response planning/
**Abstract:** *Canadian Oil Sands Products (OSP)* are bitumen-derived fuels that present a variety of spill response challenges. Within the response community, however, these challenges should elicit preparedness actions, but not alarm. This paper will provide an overview of *Canadian OSP*; briefly describe the growing need for preparedness that is a result of the increased transportation of *Canadian OSP* within the U.S.; and introduce

the concept that many aspects of a *Canadian OSP* response can be addressed through existing strategies and technologies. Most importantly, this paper will propose specific, low cost, high impact actions that can be taken at the local and regional level to better plan and prepare for a *Canadian OSP* spill response.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.417
Accessed: 11/3/2014.

**Bowman, T. D., P. H. Schempf, J. I. Hodges.** 1997. Population in Prince William Sound after the Exxon Valdez Oil Spill. *The Journal of Wildlife Management* 61(3): 962-967.
**Keywords:** aerial survey/ age ratio/ Alaska/ bald eagle/ contaminants/ Exxon Valdez/ *Haliaeetus leucocephalus*/ oil/ oil spill/ populations/ Prince William Sound/ raptors/ surveys/
**Abstract:** We initiated studies to determine whether the Exxon Valdez oil spill influenced bald eagle (Hal-iaeetus leucocephalus) demography in Prince William Sound (PWS), Alaska. Using fixed-wing aircraft, we surveyed bald eagle populations within random plots once each year and censused nearly all islands in PWS in 1989-91 and 1995 to estimate population size. We calculated population indices (uncorrected for birds not seen) of 2,199; 1,935; 2,116; and 2,641 adult eagles for the 4 years studied. Subsequent to the 1989 oil spill, the eagle population returned to its estimated pre-spill size by 1995. The PWS bald eagle population has increased at an average annual rate of 3.7% from 1982 to 1995. The proportion of immatures in the population averaged 29% and did not vary significantly among years.
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**Buscaino, G., F. Filiciotto, G. Buffa, A. Bellante, V. Di Stefano, A. Assenza, F. Fazio, G. Caola, S. Mazzola.** 2010. Impact of an Acoustic Stimulus on the Motility and Blood Parameters of European Sea Bass (*Dicentrarchus labrax* L.) and Gilthead Sea Bream (*Sparus aurata* L.). *Marine Environmental Research* 69:136-142.
**Keywords:** acoustic pollution/ acoustic stimulus/ European sea bass/ gilthead sea bream/ motility/ blood glucose/ blood lactate/ haematocrit value
**Abstract:** The physiological responses of fish to underwater noise are poorly understood and further information is needed to evaluate any possible negative effects of sound exposure. We exposed European sea bass and gilthead sea bream to a 0.1–1 kHz linear sweep (150 $dB_{rms}$ re 1 μPa). This band frequency is perceptible by many species of fish and is mainly produced by vessel traffic. We assessed the noise-induced motility reaction (analysing the movements) and the haematological responses (measuring blood glucose and lactate, and haematocrit levels). The noise exposure produced a significant increase in motility as well as an increase in lactate and haematocrit levels in sea bream and sea bass. A significant decrease of glucose was only observed in sea bream. A linear correlation between blood parameters and motility in fish exposed to the noise was observed. The acoustic stimulus produced intense muscle activity.
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**Carro, N., J. Cobas, and J. Maneiro.** 2005. Distribution of Aliphatic Compounds in Bivalve Mollusks from Galicia after the Prestige Oil Spill: Spatial and Temporal Trends. *Environmental Research* 100:339-348.
**Keywords:** Aliphatic hydrocarbons/ Mussels/ Cockles/ Galicia coast/ High-resolution gas chromatography/
**Abstract:** The content and distribution of *n*-alkane ($C_8$–$C_{35}$) and isoprenoid (pristine and phytane) hydrocarbons were investigated in two species of bivalve mollusk, mussel (*Mytilus galloprovincialis*) and cockle (*Cerastoderma edule*), collected at different points of the Galicia littoral zone during the period from December 2002 to February 2003 (after the Prestige oil spill). Samples were analyzed by high-resolution gas chromatography equipped with a flame ionization detector. The highest levels were found in mussels and cockles coming from two estuarine bays, Rı´as de Arousa and Vigo. Hydrocarbons with carbon chain length **>**30 were detected and determined in all samples. The abundance of these hydrocarbons in biota could be interpreted with regard to the feeding and living habits. Chemometric techniques have been employed to analyze data and determine the potential source of hydrocarbon contamination. Differences between mussels and cockles were observed in relation to aliphatic content. According to the data analysis, the main source of hydrocarbon contamination of investigated samples seems to be more related to the intense traffic of vessels in these estuarine bays than to the Prestige oil spill.
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**Carson, R.T., R. C. Mitchell, M. Hanemann, R. J. Kopp, S. Presser, P. A. Ruud.** 2003. Contingent Valuation and Lost Passive Use: Damages from the Exxon Valdez Oil Spill. Environmental and Resource Economics 25: 257-286
**Keywords:** EVOS/ Exxon Valdez Oil Spill/ Natural Resource Damage Assessment/
**Abstract:** We report on the results of a large-scale contingent valuation (CV) study conducted after the Exxon Valdez oil spill to assess the harm caused by it. Among the issues considered are the design features of the CV survey, its administration to a national sample of U.S. households, estimation of household willingness to pay to prevent another Exxon Valdez type oil spill, and issues related to reliability and validity of the estimates obtained. Events influenced by the study's release are also briefly discussed
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**Carvalho, F. P. J.-P. Villeneuve, and C. Cattini.** 1999. The determination of organochlorine compounds and petroleum hydrocarbons in a seaweed sample: results of a world-wide intercomparison exercise. *Trends in Analytical Chemistry* 18:6560-664.
**Keywords:** Intercomparison exercise/ Organochlorine compounds/ Petroleum hydrocarbons/ Reference materials/ Quality assurance/
**Abstract:** A seaweed sample (*Fucus* sp.) was prepared, homogenised and distributed to laboratories worldwide as the IAEA-140 intercomparison material for the analysis of organochlorine compounds and petroleum hydrocarbons. A total of 80 laboratories from 51 countries reported results for this sample. The data sets reported by laboratories were evaluated statistically and the mean concentration values could be computed with 95% confidence limits for a large number of analytes. The accuracy of the analytical

performance of each laboratory has been introduced by using Z-scores. The spread of results reported generally indicates that the accurate determination of many persistent organic pollutants, such as hexachlorobenzene, lindane, Aroclors or fluoranthene, is still difficult for many laboratories. The final results of this intercomparison exercise enable individual participants to assess their performance and, where necessary, to introduce appropriate modifications in their analytical procedures. Furthermore, as a series of statistical criteria was fulfilled for a number of compounds, the sample IAEA-140 can now be used as a reference material for quality control in the determination of chlorinated compounds and petroleum hydrocarbons in environmental samples.
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**Casey, Drew (LCDR)., John Caplis.** 2014. Improving Planning Standards for the Mechanical Recovery of Oil Spills on Water. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1772-1783.
**Keywords:** mechanical recovery/ skimmer system performance/ spill cleanup/ spill response planning/
**Abstract:** As observed during several recent major oil spills, most notably the BP Deepwater Horizon Oil Spill, the current regulatory planning standard for mechanical recovery equipment has been often scrutinized as an inadequate means for vessel and facility plan holders to calculate their oil spill equipment needs. Effective Daily Recovery Capacity, or EDRC, was developed during a negotiated rulemaking process following the enactment of the Oil Pollution Act of 1990.
During an IOSC 2011 Workshop sponsored by the American Petroleum Institute (API), the Bureau of Safety and Environmental Enforcement (BSEE), and the U.S. Coast Guard, there was general agreement among workshop participants that EDRC is not an accurate planning tool for determining oil spill response equipment needs. In addition, many attendees agreed that EDRC should account for the skimmer system as a whole, not individual skimmer components such as pump nameplate capacity.
In 2012, the Bureau of Safety and Environmental Enforcement (BSEE) and the U.S. Coast Guard initiated and completed a third-party, independent research contract to review the existing EDRC regulations and make recommendations for improving planning standards for mechanical recovery. The contractor's final report methodology is based on oil spill thickness as a fundamental component in calculating mechanical recovery potential, and it emphasizes the importance of response time on-scene and storage for recovered oil. This research provides a more realistic and scientific approach to evaluating skimmer system performance, and more accurately accounts for a wide range of operating conditions and external influences. The federal government, with input from the oil industry, OSRO community, and other interested stakeholders, now has a sound methodology to serve as a starting point for redesigning the current planning standard that more accurately reflects skimmer system performance.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1772 Accessed 11/9/2014.

**Clumpner, Curt., Barbara Callahan.** 2014. Optimizing the value of near misses in wildlife response preparedness: The Kulluk Incident. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2288-2294.

**Keywords:** hazing/ natural resource damage/ oiled wildlife/ spill response planning/
**Abstract:** Mitigating the impact of an oil spill on wildlife is one of the stated priorities in nearly every oil spill. Wildlife in some way is regularly included in drills and exercises in many places around the world. While planning, training, and exercising are critical to wildlife preparedness, responders know that nothing compares to real world experience. In many spills and near miss situations, the Wildlife Branch is not activated until after there are documented wildlife impacts. Most incident management teams will only bring in professional oiled wildlife responders when oiling of wildlife has occurred or is imminent. During the December 2013 response to the Kulluk Tow Incident, a small Wildlife Branch was activated as an integral part of the Incident Command structure put in place. The Wildlife Branch proceeded to provide a detailed plan for an active response, if one was needed. Over the next week, while the rig grounded, refloated and finally towed to a place of refuge, the Wildlife Branch, working with the Environmental Unit, developed a wildlife plan that identified the resources at risk, the wildlife response options and the personnel, equipment and facilities that would be needed if oil were to be released. The Alaska Wildlife Response Center was prepared for activation, wildlife responder's availability, and travel time was documented and incident specific equipment gaps were identified and sourced. Additionally, specific incident plans were developed for hazing (bird deterrence), solid waste and wastewater that stood ready for implementation. While Alaska has a robust preparedness and exercise program, the quick decision by Shell and the Unified Command to ensure wildlife response was in place, if needed, provided a real test of the oiled wildlife response system with all the problems, challenges and changing parameters of a real event. It added real value by showing the public and trustees the importance that was placed on wildlife protection as well as by increasing integration, confidence and teamwork in the Alaskan response community.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.2288
Accessed 11/9/2014.

**Codarin, A., L. E. Wysocki, F. Ladich, and M. Picciulin.** 2009. Effects of Ambient and Boat Noise on Hearing and Communication in Three Fish Species Living in a Marine Protected Area (Miramare, Italy). *Marine Pollution Bulletin* 58:1880-1887.
**Keywords:** ambient noise/ fish acoustic communication/ hearing/ masking/ vessel noise/
**Abstract:** The WWF-Natural Marine Reserve of Miramare (Trieste, Italy) is located in a major industrial and vacation area in the Adriatic Sea. Consequently, noise emanating from boating and shipping is an inevitable factor for local fishes. This study investigates the effects of ambient and ship noise on representatives of three vocal fish families with different hearing abilities. Ambient and ship noise were recorded, their sound pressure levels measured and played back in the lab. Auditory sensitivity was determined in *Chromis chromis*, *Sciaena umbra* and *Gobius cruentatus*, utilizing the auditory evoked potential recording technique. Compared to lab conditions, hearing thresholds determined during ambient noise playbacks were barely masked. Contrary, the noise emanating from a cabin-cruiser substantially reduced auditory sensitivity relative to thresholds in ambient noise. This masking effect was most pronounced in the frequency

range where acoustic communication takes place. Boat noise potentially affects acoustic communication in fishes inhabiting the reserve.
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**Coolbaugh, Thomas., Erik DeMicco, Emily Kennedy.** 2014. Dispersant-Related Oil Spill Response Communication Tools: Toward an Enhanced Approach to Conveying Complex Topics in an Approachable Manner. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1163-1171.
**Keywords:** communications/ Deep Water Horizon/ dispersants/ dispersant use/ spill response planning/
**Abstract:** During the response to the Macondo Well release in the Gulf of Mexico in 2010, it became evident fairly quickly that there was a potential disconnect between existing scientifically-based information relating to the use of oil spill dispersants and the information that was readily available to the general public, the media, and government officials.
At best, both sets of information were aligned and provided a valuable perspective to those who sought an increased understanding of the workings of oil spill response tools. At worst, there was a large misalignment and the information that was available to the public did not accurately reflect the known science of what dispersants have been designed to achieve. In this latter case, conclusions about dispersant use may have been formed incorrectly, providing a backdrop upon which individuals were not able to develop an informed opinion regarding the use of dispersants.
In the case where incomplete and potentially unbalanced information is used to inform the public, it is possible that negative effects will result, i.e., opinions may be formed based on fear of the unknown, causing a delayed or less than optimal decision making process. While it is recognized that decisions made during a spill response may be challenging and may involve an environmental trade-off, an informed public can be a valuable asset during the stages of an emergency response when the pros and cons of the specific response options are being debated. To assist with an informed dialog, it is important to have materials available that accurately reflect the scientific principles upon which they are based, but without requiring extensive study of their details for a general understanding of their primary assumptions and conclusions.
This paper summarizes recent efforts to develop readily available materials that can provide a better understanding of the use of dispersants during an offshore oil spill response. These efforts have been focused on developing simple yet effective tools which describe dispersants within the framework of an oil spill response tool box and the scenarios in which these tools may be used for the most positive environmental effect.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1163 Accessed 11/8/2014.

**Cormack, Christopher D., Jason. A. Hale, Jeremy. J. Gabriel, Owen Langman.** 2011. *Nasima* and Oil – Do They Mix? Assessing Crab Survival in Oiled Sediments. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs200.
**Keywords:** crab/ lingering oil spill impacts/ *Nasima dotilliforme*/ salt marsh/

**Abstract:** At the conclusion to the First Gulf War in 1991 an estimated 10 million barrels of crude oil were released into the Arabian Gulf affecting approximately 800 km of the Saudi Arabian coastline. Oil penetrated the substrate of the salt marsh directly and through crab burrows, and nearly two decades later, this oil persists; its subsurface distribution, however, is spatially variable. As of 2010, salt marshes remain some of the most heavily-impacted habitats, many of these covered by extensive algal mats with rather limited other flora or fauna. Determining the current impact of the lingering oil on the biota is important; however, chemical concentration analysis alone is not a prediction of biological consequences and ecological recovery. A microcosm experiment was implemented to determine the current effects of oil toxicity on *Nasima dotilliforme*, a common burrowing salt marsh crab within the Arabian Gulf. *Nasima* crabs have in places re-occupied these oiled sediments, raising the question whether they are able to survive in the oiled sediments. To test this hypothesis, crabs were added to "comparison" and "impact" microcosms containing approximately 20,000 $cm^3$ of sediments from recovered and non-recovering areas. "Comparison" microcosms were filled with sediments from areas displaying full recovery in faunal abundance; "Impact" microcosms were filled with sediments which were heavily contaminated by oil. The contents of each microcosm were homogenized so that crabs in the "impact" treatments would not be able to avoid oiled conditions. Results of these microcosm experiments show no relationship between Total Petroleum Hydrocarbons (TPH) and survival after 90 days in the treatments for TPH levels below 1,000 mg/kg. Thus, oil is not the sole reason preventing re-colonization in areas under this threshold and remediation of other stress factors should result in successful re-colonization. However, areas with TPH levels >1,000 mg/kg can be expected to reduce the ability of crabs to colonize and may require additional remediation efforts before crabs will populate these areas.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-200
Accessed 11/9/2014.

**De La Cruz, Susan E. W., John Y. Takekawa, Kyle A. Spragens, Julie Yee, Richard T. Golightly, Greg Massey, Laird A. Henkel, R. Scott Larsen, Michael Ziccardi.** 2013. Post-release survival of surf scoters following an oil spill: An experimental approach to evaluating rehabilitation success. Marine Pollution Bulletin 67 (2013) 100–106
**Keywords:** San Francisco Bay/ Melanitta perspicillata/ Sea duck/ Wildlife rehabilitation/ Oil exposure/ Radio telemetry
**Abstract:** Birds are often the most numerous vertebrates damaged and rehabilitated in marine oil spills; however, the efficacy of avian rehabilitation is frequently debated and rarely examined experimentally. We compared survival of three radio-marked treatment groups, oiled, rehabilitated (ORHB), un-oiled, rehabilitated (RHB), and un-oiled, non-rehabilitated (CON), in an experimental approach to examine post-release survival of surf scoters (Melanitta perspicillata) following the 2007 M/V Cosco Busan spill in San Francisco Bay. Live encounter-dead recovery modeling indicated that survival differed among treatment groups and over time since release. The survival estimate (±SE) for ORHB was 0.143 ± 0.107 compared to CON (0.498 ± 0.168) and RHB groups (0.772 ± 0.229), suggesting scoters tolerated the rehabilitation process itself well, but oiling resulted in markedly lower survival. Future efforts to understand the physiological

effects of oil type and severity on scoters are needed to improve post-release survival of this species.
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**Dean, T. A., M. S. Stekoll, S. C. Jewett, R. O. Smith and J. E. Hose.** 1998. Eelgrass (*Zostera marina* L.) in Prince Willliam Sound, Alaska: Effects of the *Exxon Valdez* Oil Spill. *Marine Pollution Bulletin* 36:201-210.
**Keywords:** Alaska/ eelgrass/ *Exxon Valdez*/ EVOS/ injury/ oil spill/ Prince William Sound/ recovery/ seagrasses/ *Zostera marina* L./
**Abstract:** Possible injury to, and recovery of, populations of eelgrass, *Zostera marina* L., in Prince William Sound were assessed following the *Exxon Valdez* oil spill by comparing populations at oiled vs reference sites between 1990 and 1995. Eelgrass beds in !heavily oiled bays were exposed to moderate concentrations of hydrocarbons. In 1990, a year after the spill, concentrations of total polycyclic aromatic hydrocarbons averaged nearly 4000 ng $g^{-1}$ dry weight of sediment at oiled sites compared to less than 700 ng $g^{-1}$ at reference sites. Injuries to eelgrass, if any, appeared to be slight and did not persist for more than a year after the spill. There were possible effects on the average density of shoots and flowering shoots, as these were 24 and 62% lower at oiled than at reference sites in 1990 ($p < 0.10$ for both). However, there were no differences between oiled and reference sites with respect to eelgrass biomass, seed density, seed germination or the incidence of normal mitosis in seedlings, and there were no signs of the elimination of eelgrass beds. Populations recovered from possible injuries by 1991, as there was a sharp decline in hydrocarbon concentrations and there were no differences in shoot or flowering shoot densities between oiled and reference sites in 1990 or subsequent years.
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**DFO [Fisheries and Oceans Canada].** 2015. Sufficiency review of the information on effects of underwater noise and the potential for ship strikes from Marine Shipping on Marine Mammals in the Facilities Application for the Trans Mountain Expansion Project. DFO Can. Sci. Advis. Sec. Sci. Resp. 2015/007.
**Keywords:** Kinder Morgan Trans Mountain Pipeline Expansion project application/ marine mammal vessel strikes/ vessel noise/
**Summary of report objective:** The objective of this CSAS Science Response (SR) is to review information provided by the Proponent in the December 2013 Facilities Application, and in supplemental filings with the NEB, and to provide a Science Response to answer the following questions:
1. Is the information provided by the Proponent in the Project Application sufficient for DFO Science to assess underwater noise and marine vessel strikes, and their potential impacts on the marine mammal indicator species identified in the Project Application?
2. Are the methods used to assess the potential effects of underwater noise and marine vessel strikes on the marine mammal indicator species appropriate and executed properly?
This Science Response Report results from the Science Response Process of December 5, 2014 on the Sufficiency review of the information on effects of Marine

Shipping on Marine Mammals in the Facilities Application for the Trans Mountain Expansion Project.
**Web Address:** http://www.dfo-mpo.gc.ca/csas-sccs/publications/scr-rs/2015/2015_007-eng.pdf Accessed 2/17/2015.

**Dollhopf, Ralph and Mark Durno.** 2011. Kalamazoo River\Enbridge Pipeline Spill 2010. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs422.
**Keywords:** dilbit/ diluted bitumen/ Enbridge Pipeline Spill/ Kalamazoo River/ oil spill/
**Abstract:** On July 26, 2010 Enbridge reported that approximately 19,500 barrels (819,000 gallons) of oil had been released from its ruptured oil pipeline near Marshall, Michigan to Talmadge Creek and the Kalamazoo River at a point approximately 80 miles upstream from Lake Michigan. Enbridge's 30-inch pipeline transported Cold Lake Crude Oil (with benzene diluent) from western Canada to refineries in Michigan and Ohio.
Over 2,000 responders (comprised of personnel from the United States Environmental Protection Agency [U.S. EPA], U.S. EPA contractors, other federal agencies, local agencies, state agencies, Enbridge and Enbridge contractors) worked to stop the flow of oil, contain and recover the released oil, and to prevent the spilled oil from reaching Lake Michigan. Eighty miles of shoreline and adjacent lands (e.g., overbank areas) were assessed and cleaned. Submerged oil was assessed and recovered at over 25 locations. Over 100 residents were displaced and relocated in response to air quality (benzene) concerns.
This manuscript describes some of the challenges of conducting response actions over a broad geographic scale quickly. This manuscript addresses organizational concepts beyond the basics of Incident Command System (ICS) and the technical, scientific and logistical considerations of managing an oil spill response that covered nearly forty miles of river (eighty miles of shoreline).
The response actions required (and continue to require) a delicate balance between cleaning a riverine environment and minimizing adverse impacts to the ecosystems and/or changing river dynamics.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-422
Accessed 11/9/2014.

**Dollhopf, Ralph H., Faith A. Fitzpatrick, Jeffrey W. Kimble, Daniel M. Capone, Thomas P. Graan, Ronald B. Zelt, Rex Johnson.** 2014. Response to Heavy, Non-Floating Oil Spilled in a Great Lakes River Environment: A Multiple-Lines-Of-Evidence Approach for Submerged Oil Assessment and Recovery. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 434-448.
**Keywords:** diluted bitumen/ Enbridge Kalamazoo River oil spill/ field assessments of submerged oil (poling)/ forensic oil chemistry/ geomorphic mapping/ hydrodynamic and sediment transport modeling/ net environmental benefit analysis/ tracking and mapping of oil sheen/
**Abstract:** The Enbridge Line 6B pipeline release of diluted bitumen into the Kalamazoo River downstream of Marshall, MI in July 2010 is one of the largest freshwater oil spills in North American history. The unprecedented scale of impact and massive quantity of

oil released required the development and implementation of new approaches for detection and recovery. At the onset of cleanup, conventional recovery techniques were employed for the initially floating oil and were successful. However, volatilization of the lighter diluent, along with mixing of the oil with sediment during flooded, turbulent river conditions caused the oil to sink and collect in natural deposition areas in the river. For more than three years after the spill, recovery of submerged oil has remained the predominant operational focus of the response.
The recovery complexities for submerged oil mixed with sediment in depositional areas and long-term oil sheening along approximately 38 miles of the Kalamazoo River led to the development of a multiple-lines-of-evidence approach comprising six major components: geomorphic mapping, field assessments of submerged oil (poling), systematic tracking and mapping of oil sheen, hydrodynamic and sediment transport modeling, forensic oil chemistry, and net environmental benefit analysis. The Federal On-Scene Coordinator (FOSC) considered this information in determining the appropriate course of action for each impacted segment of the river.
New sources of heavy crude oils like diluted bitumen and increasing transportation of those oils require changes in the way emergency personnel respond to oil spills in the Great Lakes and other freshwater ecosystems. Strategies to recover heavy oils must consider that the oils may suspend or sink in the water column, mix with fine-grained sediment, and accumulate in depositional areas. Early understanding of the potential fate and behavior of diluted bitumen spills when combined with timely, strong conventional recovery methods can significantly influence response success.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.434 Accessed 11/3/2014.

**Douglas, A. B., J. Calambokidis, S. Raverty, S. J. Jeffries, D. M. Lambourn and S. A. Norman.** 2008. Incidence of ship strikes of large whales in Washington State. Journal of the Marine Biological Association of the UK, 88, pp 1121-1132. doi:10.1017/S0025315408000295.
**Keywords:** *Balaenoptera physalus*/ immature fin whale/ grey whale/ ship strike/ stranding/ Washington State/
**Abstract:** Ship strikes of large whales cause mortalities worldwide, but there is uncertainty regarding the frequency and species involved. We examined 130 records (from 1980–2006) of large whale strandings in Washington State. Nineteen strandings (seven species) had evidence of ship-strikes. Fin whales (*Balaenoptera physalus*) had the highest incidence of ante-mortem ship strike (five of seven, with the remaining two possibly post-mortem) and all but one occurring since 2002. Six grey whales (*Eschrichtius robustus*) suffered 'possible ship strike' injuries, likely the result of their large numbers in the area, rather than high levels of ship strikes. Only one possible ship-struck humpback whale was recorded, despite concentrations of humpbacks feeding within shipping lanes in this region. This study shows dramatic differences in occurrences of ship-struck large whales by species, which we believe results from a combination of species' vulnerability to ship strikes, and how likely a struck whale is to be caught up on the bow of a ship and brought to waters where it can be examined.
**Web Address:** LINK TO? Paid version:
http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=2183036

**van Dorp, Johan Rene., Jason Merrick.** 2014. 2014 VTRA 2010 Final Report: Preventing Oil Spills from Large Ships and Barges in Northern Puget Sound & Strait of Juan de Fuca. Prepared for Washington State Puget Sound Partnership
**Keywords:** accident/ Boundary Pass/ collision/ Delta Port/ Gateway Pacific Terminal/ Georgia Strait/ grounding/ Haro Strait/ Kinder Morgan Trans Mountain Pipeline Expansion/ mitigation/ oil spill/ risk mitigation measure/ Roberts Bank Terminal/ Rosario Strait/ Strait of Juan de Fuca/
vessel traffic risk assessment/
**Web Address:** Executive Summary:
http://www.seas.gwu.edu/~dorpjr/VTRA/PSP/FINAL%20REPORT/Pages%20from%20PSP%20FINAL%20REPORT%20033114%20-%20EXECUTIVE%20SUMMARY.pdf
Full Report:
http://www.seas.gwu.edu/~dorpjr/VTRA/PSP/FINAL%20REPORT/PSP%20FINAL%20REPORT%20033114%20-%20SIGNED.pdf Accessed 10/30/14.

**Drury, Alice., Gary Shigenaka, Mark Toy.** 2014. Washington State Case Study and Guidance Developed on the Closing and Re-Opening of a Shellfishery Due to Oil Contamination. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2273-2287.
**Keywords:** contaminated seafood/ natural resource damage/ shellfishery/
**Abstract:** The 128 foot F/V Deep Sea was illegally anchored on Washington state-owned aquatic lands in Whidbey Island's Penn Cove from December 24th 2011 until it sank on May 14th, 2012, following a fire aboard the vessel. Penn Cove is the home of Penn Cove Shellfish, LLC, the United States' largest and oldest mussel farm. The Deep Sea sank within approximately 200 meters of Penn Cove LLC's mussel raft growing system with an unknown amount of oil aboard. After the vessel sank Penn Cove Shellfish, LLC, voluntarily ceased harvesting their shellfish. Not long after the Washington State Department of Health closed commercial and recreational harvest of shellfish in Penn Cove. Although efforts were made to plug the vessel's vents and seal the vessel's fuel tanks a cracked vent allowed fuel to leak from the sunken vessel, later identified as marine diesel by the Washington State Department of Ecology. Sheen was documented over the mussel rafts.
Based on sensory testing the Washington State Department of Health re-opened Penn Cove's shellfish harvest in stages, with sampling plan and testing assistance from the National Oceanic and Atmospheric Administration.
Following response to the F/V Deep Sea all agencies involved in the shellfish closure that was as result of this incident convened to establish guidelines on the best way to run the closure and subsequent re-opening process for inclusion in the Northwest Area Contingency Plan, based off of lessons learned from the response. This was especially important since shellfishery closures due to oil spill contamination are not common in Washington State. This paper outlines those lessons learned during the F/V Deep Sea response in regards to closing and then re-opening a shellfishery in Washington State, and includes the guidelines that were established and incorporated into the Northwest Area Contingency Plan as a result.

**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.2273 Accessed 11/9/2014.

**Duerr, Rebecca S., Massey, J. Gregory, Ziccardi, Michael H., Addassi, Yvonne Najah.** 2011. Physical Effects of Prudhoe Bay Crude Oil Water Accommodated Fractions (WAF) and Corexit 9500 Chemically Enhanced Water Accommodated Fractions (CEWAF) on Common Murre Feathers and California Sea Otter Hair. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs252.
**Keywords:** Corexit 9500/ dispersants/ dispersant use/ dispersed oil/ waterproofing properties/ fur/ feathers/
**Abstract:** The use of chemical dispersants has often been discussed for larger spills due to the perceived advantage to the environment. Evaluation and development of dispersant use plans were undertaken throughout the United States in the late 1990 and early 2000. Net environmental benefit analysis used in this process, assumed that removing oil from the water surface and dispersing it into the water column will benefit marine wildlife by decreasing the risk of significant contamination to feathers or fur. The physical effect of chemical dispersants and dispersed oil, though, has been poorly investigated. The National Research Council (NRC) in 2005 described that limited available data suggested comparable toxicity of dispersed and untreated oil to seabirds and mammals, but found no conclusive information regarding the impacts of dispersed oil and dispersants in the waterproofing properties of fur and feathers. Evaluating the validity of these assumptions is critical because it is often a key factor in the decision on whether or not to use dispersants and is of key interest given dispersants use in response to the recent Deepwater Horizon oil spill.
Research was undertaken to addresses the lack of scientific data on dispersant effects on wildlife by: 1) designing a system to exposure fur and feathers to dispersant and dispersed oil; 2) quantifying petroleum hydrocarbon (TPH) levels on individual feathers and hair; 3) assessing structural changes to feathers and hair associated with dispersant and/or oil exposure; and 4) evaluating dose-response relationships in these results with differing levels of dispersant and/or oil. Body feathers from common murres and hair trimmed from one Southern sea otter were exposed to Alaska North Slope crude and/or Corexit 9500 in the following exposure groups: 1) mechanically dispersed oil, 2) oil mixed with dispersant, and 3) dispersant alone at three concentrations (low, medium and high). Resultant samples were digitally photographed both under a standard laboratory microscope and a transmission electron microscope, and a blinded observer scored observable damage to each sample. Samples were also analyzed for TPH levels at the Petroleum Chemistry Lab. The significant findings of this study will be presented.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-252 Accessed 11/9/2014.

**Dunagan, Heidi H., Jacqueline Michel, Jonathon Burr.** 2011. Assessment and Restoration Scaling of Stream Services Impaired by the Obed River 2002 Oil Spill. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs39.

**Keywords:** benthic macroinvertebrate/ damage assessment/ restoration/ restoration compensation/
**Abstract:** Under federal regulations, natural resource trustees are charged with making the environment whole after injury to or loss of natural resources and services as a result of anthropogenic activities such as waste sites, vessel groundings, or oil spills. Here we provide a case study that uses the Habitat Equivalency Analysis (HEA) model to quantify injury and determine restoration compensation after an oil spill contaminated aquatic resources in the Obed Wild and Scenic River in Morgan County, Tennessee. Our goal is to describe the methodology used for scaling the injury to the restoration activities using the condition of a benthic macroinvertebrate assemblage as the metric. The total injury to stream services was 26.1 discounted service-acre years (DSAYs). The restoration projects chosen to compensate for the injured stream services included streambank restoration (generating 3.68 DSAYs), invasive vegetation removal along 229 meters of stream (generating 0.18 DSAYs), creation of 0.86 ha of bog gardens (generating 12.6 DSAYs), and construction of 0.81 ha of rain gardens (generating 9.65 DSAYs) along a headwater stream. Using the HEA model as the framework for quantifying ecosystem service losses and gains from degraded habitats and restoration projects, respectively, may alleviate some of the ecological uncertainties and provide resource managers more quantitative tools for pursuing specific restoration activities to compensate for injured resources.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-39
Accessed 11/9/2014.

**Dunford, Richard W., Melissa K. Lynes.** 2014. PREDICTING NATURAL RESOURCE DAMAGES FROM OIL SPILLS IN THE UNITED STATES. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 588-603.
**Keywords:** natural resource damages/ NRD/ NRD settlements/ oiled wildlife/
**Abstract:** Most major oil spills in the United States result in some natural resource damages (NRD), which arise from injuries to natural resources and losses of their services. Other things being equal, larger spills lead to larger NRD. However, factors other than the number of gallons spilled can affect the subsequent amount of natural resource damages. These factors may include the type of oil spilled, the geographic location of the spill, the season in which the spill occurred, whether threatened and endangered species were injured, whether recreation closures occurred, whether the spill occurred in saltwater or freshwater, and other characteristics of the spill.
This paper presents a statistical model using multiple-regression analysis that explains variations in 86 NRD settlements for oil spills in the United States based on a variety of factors. The results of the statistical analysis identify which of the factors influence NRD settlements and the magnitude of the effect. Then, the results of the statistical model are used to predict a point estimate and 90% confidence interval for the NRD settlement for three hypothetical oil spills. Such predictions could give both Trustees (i.e., government agencies that pursue NRD claims on behalf of the public) and responsible parties a useful damage range, for planning purposes, within days of future oil spills.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.588
Accessed 11/8/2014.

**Dunlop, R. A., D. H. Cato and M. J. Noad.** 2010. Your attention please: increasing ambient noise levels elicits a change in communication behavior in humpback whales (*Megaptera novaeangliae*). Proceedings: Biological Sciences 277:2521-2529.
**Keywords:** acoustic behavior/ acoustic communication/ background noise/ communication strategy/ humpback whales/ vessel noise/
**Abstract:** High background noise is an important obstacle in successful signal detection and perception of an intended acoustic signal. To overcome this problem, many animals modify their acoustic signal by increasing the repetition rate, duration, amplitude or frequency range of the signal. An alternative method to ensure successful signal reception, yet to be tested in animals, involves the use of two different types of signal, where one signal type may enhance the other in periods of high background noise. Humpback whale communication signals comprise two different types: vocal signals, and surface-generated signals such as 'breaching' or 'pectoral slapping'. We found that humpback whales gradually switched from primarily vocal to primarily surface-generated communication in increasing wind speeds and background noise levels, though kept both signal types in their repertoire. Vocal signals have the advantage of having higher information content but may have the disadvantage of loosing this information in a noisy environment. Surface-generated sounds have energy distributed over a greater frequency range and may be less likely to become confused in periods of high wind-generated noise but have less information content when compared with vocal sounds. Therefore, surface-generated sounds may improve detection or enhance the perception of vocal signals in a noisy environment.
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**Elfring, Chris., Kim Waddell.** 2014. Research to Advance Health, Environment, and Oil System Safety in the Gulf of Mexico and other Coastal Regions: An Update from the National Academy of Sciences. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 340-347.
**Keywords:** crude oil spill/ Deepwater Horizon/ education and training/ environmental monitoring/ Gulf Research Program/ National Academy of Sciences/ research and development/
**Abstract:** In 2010, the *Deepwater Horizon* explosion and fire caused the release of approximately 200 million gallons of crude oil into the Gulf of Mexico. As part of legal settlements with the companies involved, the federal government asked the National Academy of Sciences – an independent, non-profit organization chartered by Congress in 1863 to provide independent, expert, scientific, engineering, and healthcare advice to the nation – to establish a new $500 million, 30-year research program focused on human health, environmental protection, and oil system safety in the Gulf region. The new program, called the Gulf Research Program, is directed to work in three areas: research and development, education and training, and environmental monitoring. Activities will focus on the Gulf of Mexico and other U.S. Outer Continental Shelf (OCS) regions, but work that transfers knowledge to or from other offshore U.S. or international hydrocarbon-producing regions is allowed under the mandate. The program seeks to encourage communication and collaboration among industry, academia, and government, and will emphasize innovation, education, collaboration, and cross-

disciplinary work. This paper introduces the program, summarizes program planning, outlines the program's mission and goals, and highlights first-year activities.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.340
Accessed 11/3/2014.

**Fernández-Fernández, Sandra., Ana M Bernabeu, Frédéric Bouchette, Daniel Rey, Federico Vilas.** 2011. Persistence of 7- years- old Prestige Oil Spill on Sandy Beaches (NW Spain). International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs209.
**Keywords:** natural resources damage assessment/ persistence of oil on sandy beaches/ Prestige oil spill/
**Abstract:** The persistence of oil after an oil spill has been widely researched on gravel beaches where the oil percolates in the superficial coarser sediment and is stored in a deeper layer of fine sediment, protected from hydrodynamics. However, the knowledge of long-term fate of the deep buried oil on sandy beaches is limited.
In November 19th, 2002, the tanker Prestige broke and sunk in the East Atlantic coast of Galicia (NW Spain). The biggest oil spill occurred on Spain affected to Portugal, Spanish and French coasts, with more than 700 sandy beaches oiled. In 2009 two fieldworks were carried out in the intertidal area of two of the most seriously affected beaches: Nemiña and O Rostro. During these fieldworks, sediment cores were extracted and topographic data were acquired.
In the laboratory, buried oil was found at different depths (even 286 cm, being the maximum depth of extraction). The oil appearance varied from centimeter-long tar-balls (CTB), oil coatings forming layers of variable thickness (both corresponding to relatively recent burial), and millimeter-long tar–balls (MTB; observed at binocular). The distribution of oil was different in the two beaches and changed between both fieldworks, being these changes linked with changes in oceanographic conditions.
Seven years after the spillage, low concentrations of oil were still detected on beaches affected by Prestige oil spill. This reveals the persistence of oil on sandy beaches, despite their highly changing and hydrodynamically forcing behavior.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-209
Accessed 11/9/2014.

**Fingas, Merv.** 2014. Review of Emissions from Oil Fires. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1795-1805.
**Keywords:** human health impacts/ in-situ burning/ oil spill cleanup/
**Abstract:** The concern over emissions often dominates concerns regarding in-situ burning of oil spills. This paper reviews the results of emission measurement from both test fires and full-scale fires. More than 50 meso-scale burns of crude and diesel were conducted to study various aspects of diesel and crude oil burning in-situ. Extensive sampling and monitoring of these burns were conducted at downwind stations, and in the smoke plume. Later, the burning characteristics of heavy oils and emulsified heavy oils were studied. More than 15 meso-scale burns of these heavy oils were conducted. Measurements of the volatile components and particulates were made. Finally, some measurements were made on the in-situ burns carried out during the 2010 Deepwater Horizon spill.

In summary, these measurements found that PAHs were found to be lower in the soot than in the starting oil, although somewhat higher concentrations of the larger molecular PAHs were found in the soot and residue. Particulates in the air were measured by several methods and were only found to be greater than recommended exposure levels at ground level if an inversion was present . Combustion gases including carbon dioxide and carbon monoxide did not reach exposure level maximums. Volatile organic compound (VOCs) emissions were found to be extensive from fires, but the levels were lower than an evaporating crude oil spill. Carbonyls, including aldehydes and ketones, were found to be higher from diesel burns than from crude oil burns.
Measurement of the highly toxic compounds, dioxins and dibenzofurans, were made during the test fires. None were found. Similar results were found for the 2010 Deepwater Horizon burns.
Water under the burns was analysed in the case of some of the test fires; no compounds of concern could be found at the detection levels of the methods. The burn residue was analysed for the same compounds as the air particulate samples. The concentrations of PAHs were lower in the residue than in the original oil, although the concentrations of some higher molecular weight species increased slightly.
Furthermore, in all burns it was found that emissions of any type, did not exceed that of health concerns at distances greater than about 1 km, if the smoke plume did not impact the ground.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1795
Accessed 11/8/2014.

**Le Floch, Stéphane., Mathieu Dussauze, François-Xavier Merlin, Guy Claireaux, Michael Theron, Philippe Le Maire, Annabelle Nicolas-Kopec.** 2014. DISCOBIOL: Assessment of the Impact of Dispersant Use for Oil Spill Response in Coastal or Estuarine Areas. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 491-503.
**Keywords:** dispersant/ near shore/ NEBA/ Net Environmental Benefit Analysis/ spill planning/ spill preparedness/ toxicity/
**Abstract:** Dispersants are known to be an appropriate solution for offshore spill response when sea conditions provide enough energy to disperse and then dilute oil into surface waters. In shallow coastal areas, the use of dispersant is restricted due to the potential that the dispersed oil might come into contact with sensitive resources before dilution can take place. However, after assessing the advantages and potential risks of dispersing oil in coastal areas, it may emerge after careful consideration that and in some cases the use of dispersants could provide a net environmental benefit. The DISCOBIOL research program aimed to provide practical recommendations on dispersant use in coastal and estuarine areas by acquiring relevant (in terms of likely dispersed oil concentrations) and robust experimental information on the impact of mechanically and chemically dispersed oil on living resources. The main conclusion from these experiments was that there is no significant difference between the impacts from oil with and without dispersant use in terms of acute toxicity. However there are some observable sub-lethal effects from exposure to dispersed oil which do not persist more than a few weeks. In a natural environment, on a medium or long timescale, biota which have been exposed to oil (with and without dispersant) do exhibit some

symptoms which could affect their survival rate in the field even though they do not lead to acute toxicity effects. However the DISCOBIOL project demonstrated that effects of dispersed oil were less severe than previously recorded for near shore environments. In terms of applying these results to decision making at an oil spill, it highlights the need in coastal areas prior to the use of dispersant to complete a “Net Environmental Benefit Analysis” (NEBA) to determine whether the use of dispersant is expected to minimize the overall damage resulting from the pollution. As it is difficult to cover the number of possible spill scenarios at the contingency planning stage, instead of completing a NEBA, many countries define geographical limits where dispersion can be undertaken, based on the water depth and the distance to the shore as well as the presence of sensitive resources. The DISCOBIOL study confirmed the appropriateness of these pre-defined limits for France's coastal waters but demonstrated that they could be less restrictive since the exposure to dispersed oil could be at least five times higher than was previously considered the safe limit.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.491
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**Foley, Paul.** 2014. The risk based alternative to the prescriptive EDRC approach to oil spill preparedness and response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1784-1794.
**Keywords:** spill preparedness planning/ risk based preparedness and response/
**Abstract:** Every spill is different. This is the one globally accepted truth of oil spill response, and never more so than when responding on a global scale. The number of potential variables that combine to shape the event and the ensuing response are almost incalculable. Each incident produces a chain of events that must be analysed, assessed and acted on to build the most appropriate response with the effective application of the resources available. The amount, type and availability of such resources depend largely on the rigor and level of preparedness that the responsible party has put in place or that is required by the local regulator based on prescriptive criteria.
This paper explores the risk based approach to the development of oil spill preparedness, allowing mitigating measures to be tailored to the specific risks faced and offering an alternative approach to that offered by the more prescriptive and generic volume based approaches. Advantages and disadvantages of the risk based method are discussed and then anchored to the tiered approach to preparedness. The author draws on first-hand experience of how both approaches translate from the ‘page of preparedness’ to the ‘field of response’. Using international case histories as a reference the author draws conclusions as to whether the inherent variation experienced in spill response should translate to a more flexible, bespoke and risk based approach to the development of a robust and resilient level of preparedness.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1784
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**Ford, J.K.B., G.M. Ellis.** 2006. Selective foraging by fish-eating killer whales *Orcinus orca* in 11 British Columbia. Marine Ecology Progress Series 316:185-199.

**Keywords:** chinook salmon/ food sharing / foraging specialization/ Ocas/ *Oncorhynchus tshawytscha*/ *Orcinus orca*/ prey choice/ salmonid predation
**Abstract:** As the apex non-human marine predator, the killer whale *Orcinus orca* feeds on a wide diversity of marine fauna. Different ecotypic forms of the species, which often exist in sympatry, may have distinct foraging specialisations. One form found in coastal waters of the temperate NE Pacific Ocean, known as the 'resident' ecotype, feeds predominantly on salmonid prey. An earlier study that used opportunistic collection of prey remains from kill sites as an indicator of predation rates suggested that resident killer whales may forage selectively for chinook salmon *Oncorhynchus tshawytscha*, the largest but one of the least abundant Pacific salmon species. Potential biases in the prey fragment sampling technique, however, made the validity of this finding uncertain. We undertook field studies of foraging behaviour of resident killer whales to resolve this uncertainty and to examine potential variation in prey selection by season, geographical area, group membership and prey availability. Foraging by resident killer whales was found to frequently involve sharing by 2 or more whales. Prey fragments left at kill sites resulted mostly from handling and breaking up of prey for sharing, and all species and sizes of salmonids were shared. Resident killer whale groups in all parts of the study area foraged selectively for chinook salmon, probably because of the species' large size, high lipid content, and year-round availability in the whales' range. Chum salmon *Oncorhynchus keta*, the second largest salmonid, were also taken when available, but smaller sockeye *O. nerka* and pink *O. gorbuscha* salmon were not significant prey despite far greater seasonal abundance. Strong selectivity for chinook salmon by resident killer whales probably has a significant influence on foraging tactics and seasonal movements, and also may have important implications for the conservation and management of both predator and prey.
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**French-McCay, Deborah.** 2011. Oil Spill Modeling for Ecological Risk and Natural Resource Damage Assessment. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs415.
**Keywords:** natural resource damage/ natural resource damage assessment/ oil fate and effects/ spill mapping/ spill modeling/
**Abstract:** Oil fate and effects modeling performed by the author and associates to date has addressed exposure to floating oil, subsurface oil droplets, and dissolved hydrocarbon components, as well as effects predicted by dose-response relationships based on laboratory experiments and observations from field studies. A biological effects model was coupled to an oil trajectory and fates model capable of supplying required spatial (3-dimensional) and temporal quantification of oil distributions and hydrocarbon component concentrations. Lagrangian modeling approaches that are used allow tracking of weathering state of the oil and exposure levels for biota of various behavior groups, including wildlife utilizing differing habitats for varying portions of their time, fish swimming through specific portions of the water column or occupying particular habitats, plankton being carried by currents, and benthic biota on or in the bottom sediments. Recent algorithm and code development has addressed diel vertical migration and other behaviors. Long-term losses, as well as restoration/mitigation

needs, are quantified using population modeling and food web modeling. To evaluate risks of potential spill scenarios, multiple model runs are made in a Monte-Carlo design, randomizing key model inputs within probability distributions. The results statistically describe the likely effects and risks, as opposed to representing simple arbitrary assumptions for a few “representative” or “worst case” scenarios, as has traditionally been performed. Research needs for informing biological effects modeling include developing effects endpoints for dispersed oil droplets, modeling behavioral changes in response to oil presence, and ecosystem-level effects related to oil-induced changes in populations.
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Accessed 11/9/2014.

**French McCay, Deborah., Eileen Graham.** 2014. Quantifying Tradeoffs – Net Environmental Benefits of Dispersant Use. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 762-775.
**Keywords:** dispersant use/ chemically dispersed oil/ spill planning/ spill response/ toxicity/
**Abstract:** Oil spill response often involves making decisions regarding dispersant usage; the potential tradeoffs of increasing exposure of water column biota to hydrocarbons in order to reduce surface and shoreline oiling needs to be carefully considered and justified. A modeling analysis using RPS ASA's Spill Impact Model Application Package (SIMAP) was performed to evaluate the likely water volume adversely affected by naturally- or chemically-dispersed oil, as well as the surface area impacted by floating oil, and summarized in guidance useful for response planners and decision-makers. Key inputs were varied: oil type, oil volume, environmental (e.g., wind speed, temperature) conditions, dispersant use, weathering state when dispersants are applied, and toxicity to aquatic biota. Model results, including water volume where acute toxic effects would occur and the area of water surface oiled (which would impact wildlife, as well as socioeconomic uses), are summarized in tabular form, as well as a software-tool for interpolation, to provide data for quantitative comparisons of tradeoffs. Findings show that for (effective) dispersant treatment of floating oil volumes up to 100,000 gal in a single location during a short period of time (<1 hr; e.g., by a dispersant plane sortie), the area of surface water where water column biota would be affected would be much less than that affected by floating oil thick enough to directly affect wildlife. Thus, even if large volumes of oil are dispersed, a net environmental benefit may be achieved due to reduction or prevention of exposure to floating and shoreline oil, especially if the dispersant applications are over a wide area or over time.
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Accessed 11/8/2014.

**Garibaldi, A., and N. J. Turner.** 2004. Cultural Keystone Species: Implications for Ecological Conservation and Restoration. *Ecology and Society* 9 (3):1-15.
**Keywords:** biological conservation/ ecological conservation and restoration/ keystone species/ Northwest Coast tribes/ First Nations/
**Abstract:** Ecologists have long recognized that some species, by virtue of the key roles they play in the overall structure and functioning of an ecosystem, are essential to its

integrity; these are known as keystone species. Similarly, in human cultures everywhere, there are plants and animals that form the contextual underpinnings of a culture, as reflected in their fundamental roles in diet, as materials, or in medicine. In addition, these species often feature prominently in the language, ceremonies, and narratives of native peoples and can be considered cultural icons. Without these "cultural keystone species," the societies they support would be completely different. An obvious example is western red-cedar (*Thuja plicata*) for Northwest Coast cultures of North America. Often prominent elements of local ecosystems, cultural keystone species may be used and harvested in large quantities and intensively managed for quality and productivity. Given that biological conservation and ecological restoration embody human cultures as crucial components, one approach that may improve success in overall conservation or restoration efforts is to recognize and focus on cultural keystone species. In this paper, we explore the concept of cultural keystone species, describe similarities to and differences from ecological keystone species, present examples from First Nations cultures of British Columbia, and discuss the application of this concept in ecological restoration and conservation initiatives.
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**Garza-Gil M. D., Prada A., Varela M., Vázquez, M.** 2009. Indirect assessment of economic damages from the Prestige oil spill: consequences for liability and risk prevention. Disasters 33(1):95–109.
**Keywords:** economic valuation/ fisheries/ oil spill damages/ passive use values/ Recreation/ tourism/
**Abstract:** The social losses arising from the Prestige oil spill exceed the compensation granted under the IOPC (International Oil Pollution Compensation) system, with losses estimated at 15 times more than the applicable limit of compensations. This is far above the level of costs for which those responsible for hydrocarbons spills are liable. The highest market losses correspond to sectors of extraction, elaboration and commercialisation of seafood. However, damages to non-commercial natural resources could constitute an outstanding group of losses for which further primary data are needed: these losses would only be compensable under the current system by means of a refund for cleaning and restoration costs. Results show that, in Europe, the responsibility for oil spills in maritime transport is limited and unclear. The consequence of this is net social losses from recurrent oil spills and internationally accepted incentives for risky strategies in the marine transport of hydrocarbons.
**Web Address:** http://webs.uvigo.es/aprada/pdfs/Disasters_2008_Prestige.pdf Accessed 12/6/2014.

**Gaydos, J. K., L. Dierauf, G. Kirby, D. Brosnan, K. Gilardi, G. E. Davis.** 2008. Top Ten Principles for Designing Healthy Coastal Ecosystems like the Salish Sea. *EcoHealth* 5:460–471.
**Keywords:** coastal ecosystem health/ Georgia Basin/ marine/ Puget Sound/ restoration/ Salish Sea/
**Abstract:** Like other coastal zones around the world, the inland sea ecosystem of Washington (USA) and British Columbia (Canada), an area known as the Salish Sea, is changing under pressure from a growing human population, conversion of native forest

and shoreline habitat to urban development, toxic contamination of sediments and species, and overharvest of resources. While billions of dollars have been spent trying to restore other coastal ecosystems around the world, there still is no successful model for restoring estuarine or marine ecosystems like the Salish Sea. Despite the lack of a guiding model, major ecological principles do exist that should be applied as people work to design the Salish Sea and other large marine ecosystems for the future. We suggest that the following 10 ecological principles serve as a foundation for educating the public and for designing a healthy Salish Sea and other coastal ecosystems for future generations: (1) Think ecosystem: political boundaries are arbitrary; (2) Account for ecosystem connectivity; (3) Understand the food web; (4) Avoid fragmentation; (5) Respect ecosystem integrity; (6) Support nature's resilience; (7) Value nature: it's money in your pocket; (8) Watch wildlife health; (9) Plan for extremes; and (10) Share the knowledge.
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**Gaydos, J. K., and S. Pearson.** 2011. Bird and Mammals that Depend on the Salish Sea: a compilation. *Northwestern Naturalist* 92:79−89.
**Keywords:** birds/ checklist/ ecosystem health/ Georgia Basin/ indicator species/ mammals/ Puget Sound/ Salish Sea/
**Abstract:** Efforts are underway to restore the Salish Sea, a 16,925 $km^2$ inland sea shared by Washington State, USA, and British Columbia, Canada. A list of the birds and mammals that use this marine ecosystem is lacking. We compiled information from varied sources and identified 172 bird and 37 mammal species that depend on the Salish Sea marine ecosystem. Of these species, 72 bird and 29 mammal species are both highly dependent on intertidal or marine habitat as well as on marine derived food. One hundred bird species and 8 mammal species that use the Salish Sea marine ecosystem have varying degrees of dependence on the marine and terrestrial ecosystems to meet significant life history needs. These interactions between the marine and terrestrial ecosystems indicate the need to integrate marine and terrestrial restoration efforts to achieve long-term conservation of the suite of birds and mammals that use and depend on the marine ecosystem. This comprehensive list of avian and mammal fauna for the Salish Sea serves as a foundation for determining the occurrence of new species and the disappearance of others, enables selection of species as indicators for ecosystem health, and also provides a basis for identifying the mechanisms responsible for marine bird and mammal declines.
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**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, WA, April 2014.
**Keywords:** ecosystem of concern/ marine species at risk/ Puget Sound/ Salish Sea/ species of concern/ transboundary/
**Abstract:** Species of concern are native species, sub-species or ecologically significant units that warrant special attention to ensure their conservation. The number of species of concern within an ecosystem can be used as a crude measure of ecosystem health. Within the Salish Sea, four jurisdictions assess which species require special initiatives

to ensure protection and survival of the population: the Province of British Columbia, the State of Washington, the Canadian Federal Government, and the United States Federal Government. Also known as marine species at risk, the number of species of concern in the Salish Sea is used by the US Environmental Protection Agency and Environment Canada as a transboundary ecosystem indicator. As of November 15, 2013, there were 119 species at risk in the Salish Sea, almost twice the number of species at risk when the indicator was first established in 2002. While some of this increase represents an increase in the number of fish, bird and mammal species known to use the Salish Sea, most additions represent new listings due to concern about declines in populations. In terms of species richness, currently 35% of mammal species, 32% of bird species, 17% of fish species, 100% of reptile species, and less than 1% of macro invertebrate species are listed by one or more jurisdiction. The high proportion of species of concern is suggestive of ecosystem decay and we recommend that it is time to consider the Salish Sea an ecosystem of concern.
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**Geng, Xiaolong., Michel C. Boufadel.** 2014. Modeling Biodegradation of Subsurface Oil in Sand Beaches Polluted with Oil. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1113-1125.
**Keywords:** biodegradation/ model/ oiled shoreline/ PAHs/ polycyclic aromatic hydrocarbons/
**Abstract:** In April 2010, the explosion of the Deepwater Horizon (DWH) drilling platform led to the release of nearly 4.9 million barrels of crude oil into the Gulf of Mexico. The oil was brought to the supratidal zone of beaches (landward of the high tide line) by waves during storms, and was buried during subsequent storms. The objective of this paper is to investigate the biodegradation of subsurface oil in a tidally influenced sand beach located at Bon Secour National Wildlife Refuge and polluted by the DWH oil spill. Two transects were installed perpendicular to the shoreline within the supratidal zone of the beach. One transect had four galvanized steel piezometer wells to measure the water level. The other transect had four stainless steel multiport sampling wells that were used to collect pore water samples below the beach surface. The samples were analyzed for dissolved oxygen (DO), nitrogen, and redox conditions. Sediment samples were also collected at different depths to measure residual oil concentrations and microbial biomass. As the biodegradation of hydrocarbons was of interest, a biological model based on Monod kinetics was developed and coupled to the transport model MARUN, which is a two dimensional (vertical slice) finite element model for water flow and solute transport in tidally influenced beaches. The resulting coupled model, BIOMARUN, was used to simulate the biodegradation of total n-alkanes and polycyclic aromatic hydrocarbons (PAHs) trapped as residual oil in the unsaturated zone. Model parameter estimates were constrained by published Monod kinetics parameters. The field measurements, such as the concentrations of the oil, microbial biomass, nitrogen, and DO, were used as inputs for the simulations. The biodegradation of alkanes and PAHs was predicted in the simulation, and sensitivity analyses were conducted to assess the effect of the model parameters on the modeling results. Simulation results indicated that n-alkanes and PAHs would be biodegraded by 80% after 2 ± 0.5 years and 3.5 ± 0.5 years, respectively.

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**Gill, Duane A., J. Steven Picou, Liesel A. Ritchie.** 2014. Twenty-Four Years of Social Science Research on the *Exxon Valdez* Oil Spill: Sociocultural and Psychosocial Impacts in a Commercial Fishing Community. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 80-92.
**Keywords:** *Exxon Valdez* oil spill/ EVOS/ key ecological resources/ psychosocial stress/ sociocultural disruptions/
**Abstract:** Our paper provides a comprehensive overview of research findings from a unique series of studies examining human impacts of the 1989 *Exxon Valdez* oil spill (EVOS). Our focused on Cordova, Alaska—considered 'ground zero' for sociocultural and psychosocial impacts from this disaster. During the past 24 years, we used and developed a variety of theoretical and conceptual approaches to frame evolving issues and employed both quantitative and qualitative methodological designs. We used ecological-symbolic theory and the renewable resource community (RRC) concept to frame community, group, and individual responses to this environmental disaster. We also employed social capital theory, the Conservation of Resources (COR) stress model, and key concepts such as recreancy, collective stress, and secondary trauma to explain observed chronic impacts. Findings reveal sociocultural disruption and psychosocial stress and the critical role protracted litigation and prolonged ecological damage had for maintaining community and mental health problems for over two decades. Quantitative data are supported by rich, descriptive qualitative data to deepen the understanding of human impacts. Our discussion summarizes major findings on psychosocial stress and sociocultural disruptions. We note how disruption and stress changed over time, reaching their lowest levels five years after the resolution of litigation, but nonetheless still evident due to a lack of recovery of key ecological resources. Finally, we discuss how these findings can be applied to better understand and mitigate social impacts of future oil spill disasters.
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**Web Address:**
http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/other_species/eulachon/7092_06162010_142619_eulachontm105webfinal.pdf Accessed 1/26/2015

**Guzman, H. M., C. G. Gomez, and C. A. Guevara.** 2013. Potential Vessel Collisions with Southern Hemisphere Humpback Whales Wintering off Pacific Panama. *Marine Mammal Science*. 29: 629-642.
**Keywords:** humpback whale/ Megaptera novaeangliae/ satellite telemetry/ nursery Area/ vessel collision/ traffic separation scheme/ Gulf of Panama
**Abstract:** Vessel collision is a threat to many whale species, and the risk has increased with expanding maritime traffic. This compromises international conservation efforts and

requires urgent attention from the world's maritime industry. Humpback whales (Megaptera novaeangliae) are at the top of the death toll, and although Central America is a wintering area for populations from both the Northern and Southern Hemispheres, existing efforts to reduce ship-whale collisions are meager. Herein, we evaluated the potential collisions between vessels and humpback whales wintering off Pacific Panama by following the movements of 15 whales tagged with satellite transmitters and comparing these data with tracks plotted using AIS real-time latitude-longitude points from nearly 1,000 commercial vessels. Movements of whales (adults and calves) in the Gulf of Panama coincide with major commercial maritime routes. AIS vessel data analyzed for individual whale satellite tracks showed that 53% (8 whales) of whales had 98 encounters within 200 m with 81 different vessels in just 11 d. We suggest implementing a 65 nmi Traffic Separation Scheme and a 10 kn maximum speed for vessel routing into the Gulf of Panama during the wintering season. In so doing, the area for potential whale-vessel collisions could be reduced by 93%.
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**Hale, Jason A., Chris D. Cormack, Linos Cotsapas, Todd M. Montello, Owen Langman, Jeremy J. Gabriel, Jacqueline Michel.** 2011. Relationships Between Key Indicators of Environmental Condition and Degrees of Oiling in Sediments in Salt Marsh Habitats: a Balance Between Contamination and Ecological Recovery by Natural Processes. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs213.
**Keywords:** ecological recovery/ Gulf War oil spill/ salt marsh habitat/ intertidal habitat/ remediation/ sediment contamination/
**Abstract:** Many sheltered intertidal habitats along Saudi Arabia's east coast impacted by the 1991 Gulf War oil spill still exhibit signs of ecological degradation. Lack of plant and animal biomass recovery is evident, with presumed loss of many ecosystem functions attributed to intertidal habitats. While natural processes have restored some ecosystem health and integrity, large-scale remediation is required to accelerate this recovery process - such a project is underway. The challenge of this project is to apply remediation efforts which accelerate natural recovery of impacted habitats.
Ecological indicators for salt marshes included the abundance and distribution of key species; morphology of cyanobacteria mats; ponding of the marsh surface between tides, and use of tidal channel banks as habitat. The degree of sediment contamination was indicated by visual descriptors and chemical confirmation. These indicators were chosen because they can be readily observed; they integrate historical monitoring efforts; and, when considered together, represent several attributes of healthy or fully restored marsh ecosystems.
An evaluation of these data produced four conditions: (a) areas of heavier oiling where ecological conditions are severely degraded; (b) areas of light oiling where ecological conditions are not degraded; (c) areas of light oiling where ecological conditions are severely degraded; and (d) areas of heavy oiling where ecological conditions are not degraded. The latter condition is particularly informative since it identifies areas where persistent oil contamination may no longer be the principle or only stressor, and, therefore, remediation actions focused on removal of oil may not only be unsuccessful, but also unnecessary. This paper describes how using both types of data should

improve efficiency and efficacy of a remediation program where one or more stressors may have an effect on the rate of ecological restoration.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-213
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**Hanley, Patrick., Thomas Healy, Nancy Shannon.** 2014. Con Edison's Success in Reducing Risk: Applying Real-World Lessons Learned to Broaden Spill Planning and Response Programs and Build Personnel Competencies. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1910-1921.
**Keywords:** response capabilities and capacity/ spill cleanup/ spill response planning/
**Abstract:** Con Edison's service territory covers more than 1,000 miles of inland and coastal shoreline in one of the most heavily regulated and scrutinized areas of the Unites States: New York City. In November 2009, the company experienced a catastrophic failure of a large transformer at a high-voltage electric substation, resulting in approximately 200 gallons of dielectric oil impacting the Bronx River. While the volume of oil was relatively small, the duration of the cleanup lasted nearly one month with costs of approximately $1.75 million, plus a nearly $1 million compliance order issued by New York State for violation of state regulations. Following this event, and through a study of all historical spill incidents, it was clear that the primary risk of spills to the environment came from the more than 30 million gallons of oil contained in the company's high-voltage transformers and oil-filled electric transmission and distribution system, which were not covered by existing Facility Response Plans developed as part of implementing OPA 90. Given these results, the company sought to refine existing spill response program elements to further reduce risks and enhance environmental stewardship.
Using the existing Spill Management Team (SMT) model in the OPA 90 program, a company-wide SMT approach was created to better prepare for and reduce the risks associated with potential spills from all company sources. The team consists of more than 50 personnel from the various business units of the company, providing direct access to a wide spectrum of skill-sets and specialties. In addition, the company has developed Oil Spill Contingency Plans (OSCP)—also covered under OPA 90—with detailed response tactics for over 300 locations.
On the heels of the program implementation, a large spill of dielectric oil from an underground high-voltage electric distribution line resulted in more than 2,000 gallons impacting the Hutchinson River. While the impact to the waterway was greater than in the 2009 event, the response duration was only 6 days with clean-up costs just over $300,000 with no state issued compliance order, a significant improvement. This result was due, in large part, to implementation of the OSCP and SMT programs. Through these experiences, the many benefits of establishing a company-wide SMT and the OSCP's were realized, including developing spill response and Incident Command System expertise, refined coordination, and improved cost management. These efforts have significantly reduced the company's spill risk exposure by improving response capabilities.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1910
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**Hannam, M. L., S. D. Bamber, A. J. Moody, T. S. Galloway, M. B. Jones.** 2010. Immunotoxicity and Oxidative Stress in the Arctic Scallop *Chlamys islandica*: Effects of Acute Oil Exposure. *Ecotoxicology and Environmental Safety* 73: 1440-1448.
**Keywords:** Arctic scallop/ Chlamys islandica/ Immunotoxicity/ Oxidative stress/ Oil
**Abstract:** With increasing oil exploration in Arctic regions, the risk of an accidental oil spill into the environment is inevitably elevated. As a result, concerns have been raised over the potential impact of oil exposure on Arctic organisms. This study assessed the effects of an acute oil exposure (mimicking an accidental spill) on the immune function and oxidative stress status of the Arctic scallop *Chlamys islandica*. Scallops were exposed to the water accommodated fraction of crude oil over 21 d (maximum ΣPAH 163 μg $l^{-1}$) and immune endpoints and oxidative stress parameters were measured. Mortalities were recorded during the exposure and reductions in immune competence were observed, with significant impairment of phagocytosis and cell membrane stability. Scallops were also subjected to oxidative stress, with a significant reduction in glutathione levels and induction of lipid peroxidation. After the acute oil exposure had subsided ,no recovery of immune function was observed indicating potential for prolonged sublethal effects.
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**Hansen, Kurt A., Leo Guidroz, Bill Hazel, and Dr. Gregory W. Johnson.** 2011. Designing a Submerged Oil Recovery System. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs94.
**Keywords:** submerged oil recovery/ submerged oils/
**Abstract:** For spills of submerged oil, current methods are inadequate to find and recover the oil with responders having to reinvent the techniques on each occasion. The Coast Guard R&D Center (RDC) has embarked on a multi-year project to develop a complete approach for recovery of spills of submerged oils. This paper describes the multi-phased approach which addresses detection of oil on the bottom and development of a recovery system. The designs for three vendors are presented for recovery systems. Prototypes are currently being built and will be tested later in 2011.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-94
Accessed 11/9/2014.

**Harrill, Joshua A., Shawn M. Wnek, Ram B. Pandey, Dave Cawthon, Paul Nony, Phillip T. Goad.** 2014. Strategies for Assessing Human Health Impacts of Crude Oil Releases. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1668-1685.
**Keywords:** crude oil/ human health impacts/ spill response planning/
**Abstract:** Oil spills create unique challenges in regards to the assessment of potential exposures to response workers and members of the public, and in assessing the potential environmental impacts of the release. This presentation discusses the use of breathing zone air samples taken above or in the direct vicinity of freshly released product for the establishment of air (personal and ambient) monitoring strategies. Air samples collected directly in the vicinity of freshly released and weathered product can provide critical information regarding the potential for work-site and off-site community exposure monitoring. The relative levels in air of volatile organics emitted from fresh

product can be used to focus analytical sampling efforts on those constituents with the greatest potential for exceeding occupational exposure levels and community exposure guidelines, and which have the potential for impacts on human health. Finally, analytical methods for evaluation of air samples should include reporting of tentatively identified compounds (TICs), as the primary constituents of crude oil are often not included as target analytes in commonly-employed analytical methods and will likely vary based on the type of crude oil released.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1668
Accessed 11/8/2014.

**Hay, D. and P. B. McCarter.** 2000. Status of the Eulachon *Thaleichthus pacificus* in Canada. Fisheries and Oceans Canada, Science Branch. Canadian Stock Assessment Secretariat.
**Keywords:** eulachon/ *Thaleichthus pacificus*/ dredging/ habitat alteration/ smelt/ forage fish/ pollution/
**Abstract:** The anadromous eulachon (*Thaleichthys pacificus*) is a small species of smelt that spawns in the lower reaches of coastal rivers and streams from northern California to the southern Bering Sea. Nearly all eulachon spawning runs have declined from California to south-eastern Alaska in the last 20 years, especially since the mid-1990's. The causes of the declines are uncertain, and this paper reviews and comments on the main suggestions and explanations. Climate change is implicated as a cause of a general decline, but other factors cannot be overlooked, including local habitat alterations and bycatch in commercial trawl fisheries. The decline of eulachons is a concern for many First Nations, for whom the eulachon is of major cultural significance, especially as a source of an important traditional staple called 'grease'. The status of eulachons also concerns fisheries managers and the commercial fishing industry because eulachons are common as bycatch in shrimp trawls in some areas. The decline of eulachons has prompted specific management actions to limit eulachon bycatch, and such actions may reduce potential shrimp catches in some areas. The available biological information on eulachons is fragmentary and previously has not been synthesized into a single document. This paper attempts to pool and summarize the available biological information on eulachons prior to commenting on their biological status. Genetic evidence, which is subject to confirmation, indicates that eulachons constitute a single ESU (evolutionary significant unit) throughout their entire range. Other biological data, including data on meristic analyses and river-specific spawning times indicate that there is substantial local stock structure. This may indicate that although different eulachon stocks are genetically coupled, presumably through straying or mixing, different rivers (or estuaries) probably represent demographically uncoupled stocks. Therefore we point out that probably it is precautionary to assume that stock structure is geographically fine, until shown otherwise. The significance of the genetic data to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) is that classification applies at the level of the ESU, or a significant part of it. Available evidence suggests that several rivers in the central coast of BC may be extirpated, while others have declined severely. Only the Nass maintains normal or near-normal runs, although the Fraser, while markedly lower in recent decades and especially since 1994, still has regular, but diminished runs. The Columbia River, with the world's largest

eulachon run, declined sharply in 1993, and has remained low since. Apparently all runs in California have declined and several runs that once were large have not been seen for more than 20 years. Based on these observations, we suggest that the widespread decline in the southern part of the range warrants a COSEWIC classification of 'threatened' in Canadian waters. We further point out, however, that this status could change rapidly as the abundance of immature eulachons in southern offshore waters is substantially greater in 2000 than in the previous decade. If this offshore abundance is indicative of stronger spawning runs in future years, then the classification of 'threatened' may be too severe. On the other hand, the abundant offshore eulachons appear to be mainly from the 1999-year class, which probably will spawn in 2002, and may not contribute to stronger spawning runs in year 2001. We conclude with a plea for the development and implementation of policy for eulachon management, which will cover issues such as commercial fisheries for eulachons, forest industry interactions, dredging and habitat alteration in spawning areas, pollution of spawning rivers and bycatch in offshore trawl fisheries. In this regard, as a potential policy template, we include a short section of recommendations, modified to suit eulachons, from the recent draft of the DFO 'Wild Salmon Policy' paper.
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**Henkel, L. A., H. Nevins, M. Martin, S. Sugarman, J. T. Harvey, and M. H. Ziccardi.** 2014. Chronic Oiling of Marine Birds in California by Natural Petroleum Seeps, Shipwrecks, and Other Sources. 2014. *Marine Pollution Bulletin* 79:155-163.
**Keywords:** Seabirds/ Oil fingerprinting/ Monterey Formation
**Abstract:** We assessed temporal and spatial patterns of chronic oiling of seabirds in California during 2005-2010, using data on: (1) live oiled birds reported to the Oiled Wildlife Care Network (OWCN) from throughout the state, and (2) dead oiled birds found during systematic monthly beached-bird surveys in central California. A mean of 245 (±141 SD) live miscellaneous oiled birds (not associated with known oil spills) were reported to the OWCN per year, and 0.1 oiled dead birds $km^{-1}$ per month were found on beach surveys in central California. Chemical fingerprinting of oiled feathers from a subset of these birds (n = 101) indicated that 89% of samples tested were likely from natural petroleum seeps off southern and central California. There was a pronounced peak during late winter in the number of oiled birds reported in southern California, which we theorize may be related to large storm waves disturbing underwater seeps.
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**Holmström, Katrin., Charlotte Gyllenhammar, Ingrid Håstad, Oscar Fogelberg, Niklas Törneman.** 2014. PRACTICAL, ENVIRONMENTAL AND STRATEGICAL EXPERIENCES FROM TWO SPILLS IN 2011 OF CRUDE OIL AND CTO ALONG THE SWEDISH COASTLINE. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 673-685.
**Keywords:** communications/ crude oil spill/ natural resource damages/ oiled shoreline/
**Abstract:** In 2011, the Swedish coastline suffered two major oil spills. About 500 tonnes of bunker oil occurred in the marine waters of the west coast, in the waters of Skagerrak, on to the coastline of the Tjörn archipelago. The second spill, about 800 tonnes of CTO (crude tall oil) occurred from a land based tank farm on the east coast,

into the Söderhamn archipelago in the brackish Baltic Sea. Both impacted areas exhibit a high ecological value and are frequently used for outdoor recreation. In Söderhamn, many private properties were impacted as opposed to Tjörn, where the archipelago is common land.
The affected coastal area at Tjörn comprise rocky beaches with varying degrees of cracks, bays, rock pools, etc. At Tjörn, remediation has been made through manual labor combined with experimental methods facilitating faster manual removal; such as mineral oil degreasers, coconut oil, rapeseed oil, and heating up the oil by means of a torch. Manual labor through scraping with various tools (e.g. spatulas, knives, cloths) has however been the main method. The remediation was difficult and dangerous due to the slippery rocks and tough weather conditions.
The shores of the Söderhamn Bay consist mainly of rocky beaches, large rocks as well as very small pebble stones. Since the oil also got into jetties, the entire clean-up process has been difficult and time consuming, also due to the cold weather conditions in the north. Remediation of the shores and stone coffins, inside the jetties, has been made through manual labor.
The impacts to the bird population were minimal in both incidents since most birds had migrated for the winter. At Tjörn, some short-term impact could be noted on indicator species like the Blue mussel. The incident happened during late fall, when the biological activity in marine organisms is low; hence low impact on the marine organism's active reproductive periods.
In Söderhamn, fatty acids, recin acids and sterols have been sampled in sediments, fish muscle, and mussels. Limited impact could be noted, however, established test methods are missing for CTO. Degradation time of the CTO was longer than expected. Extensive and hardcore cleanup usually causes more damage to nature; removal of important microorganisms, increased soil erosion and diminishes the possibilities for the vegetation recovery. It is cucial to start the communication process with public and property owners as early as possible to set expectations on how clean is clean.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.673
Accessed 11/8/2014.

**Holt, M. M., D. P. Noren, R. C. Dunkin, T. M. Williams.** In press. Vocal performance affects metabolic rate in dolphins: implications for animals communicating in noisy environments. *Journal of Experimental Biology.*
**Keywords:** marine mammals/ oxygen consumption/ metabolic cost/ bottlenose dolphin/ vocal modification/ noise
**Abstract:** Many animals produce louder, longer or more repetitious vocalizations to compensate for increases in environmental noise. Biological costs of increased vocal effort in response to noise, including energetic costs, remain empirically undefined in many taxa, particularly in marine mammals that rely on sound for fundamental biological functions in increasingly noisy habitats. For this investigation, we tested the hypothesis that an increase in vocal effort would result in an energetic cost to the signaler by experimentally measuring oxygen consumption during rest and a two-min vocal period in dolphins that were trained to vary vocal loudness across trials. Vocal effort was quantified as the total acoustic energy of sounds produced. Metabolic rates (MRs) during the vocal period were, on average, 1.2× and 1.5× resting (RMR) in Dolphin A and

B, respectively. As vocal effort increased, we found that there was a significant increase in metabolic rate over resting during the 2-min following sound production in both dolphins and in total oxygen consumption (metabolic cost of sound production plus recovery costs) in the dolphin that showed a wider range of vocal effort across trials. Increases in vocal effort, as a consequence of increases in vocal amplitude, repetition rate, and/or duration, are consistent with behavioral responses to noise in free-ranging animals. Here, we empirically demonstrate for the first time in a marine mammal, that these vocal modifications can have an energetic impact at the individual level and importantly, these data provide a mechanistic foundation for evaluating biological consequences of vocal modification in noise-polluted habitats.
**We Address:**
http://www.nwfsc.noaa.gov/publications/scipubs/display_doctrack_allinfo.cfm?doctrackmetadataid=4538 Accessed 4/14/2015.

**Honarvar, Sfshin., J. Rozhon, D. Millington, T. Walden, C. A. Murillo.** 2011. *Economic Impacts of Staged Development of Oil Sands Projects in Alberta (2010-2035)*. Canadian Energy Research Institute.
**Keywords:** pipeline/ rail/ oil sands operations/ oil sands exports/
**Portion of Executive Summary:** The worldwide economic recession that hit in 2008 affected the Canadian oil sands significantly. But close to three years later the industry is once again expanding, with a number of major projects under development and still more proposed for the future. Pipelines, or other transportation means such as increased rail haulage, will soon be required to ship new product to destinations in the United States and elsewhere. Three major transportation projects are being planned and have received considerable attention from government, stakeholders, and the general public:
1) TransCanada's Keystone XL Pipeline which, if approved by the United States State Department, will ship Alberta bitumen to the refineries of the United States Gulf Coast.
2) Enbridge's Northern Gateway Pipeline from Bruderheim, Alberta to the port of Kitimat, British Columbia, and
3) Kinder Morgan's Trans Mountain Pipeline system Northern Leg expansion to Kitimat, British Columbia.
These pipeline proposals face opposition, and the possibility exists that one, two, or all three may not be realized. This study examines the impacts of oil sands operations (existing and future) limited by pipeline export capacity. Four capacity scenarios, or cases, are documented within this report.
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**Hooper-Bui, Linda M., Nancy N Rabalais, Annette S Engel, R Eugene Turner, G McClenachan, B Roberts, Edward B Overton, Dubravko Justic, Kersey Strudivant, Ken Brown, Jennifer Conover.** 2014. Overview of Research into the Coastal Effects of the Macondo Blowout from the Coastal Waters Consortium: A GoMRI Consortium. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 604-617.
**Keywords:** biotic impacts/ marshes/ natural resource damages/ oiled shoreline/ oiled wildlife/ salinity/

**Abstract:** The Coastal Waters Consortium (CWC) led by Louisiana Universities Marine Consortium is one of eight Gulf of Mexico Research Initiative research consortia. The CWC focuses on: oil transport and fate, chemical evolution and biological degradation, and environmental effects.The following is an overview of a portion of the research conducted within the consortium. The consortium works in a system that was impacted by the Deepwater Horizon oil disaster and additionally impacted by freshwater diversions resulting in changes in salinity, tropical storms, and hurricanes. First, we conducted model simulations assessing oil transport into the Barataria Bay estuary, which indicate that easterly winds and feeding of the anticyclonic gyre in the Louisiana Bight pushed the oil into Barataria Bay. In subtidal sediments adjacent to oiled marshes, marsh detritus from eroding marsh edges eventually became entrained in the sediment column.
Biotic impacts vary. The above-ground plant biomass appears healthy at the individual sampling sites; overall the most seaward (i.e., likely oil-impacted) areas of Terrebonne and Barataria Bay have shown, via satellite data, a distinct decline in marsh vegetation coverage since 2010. Oysters appear to be affected by predation and salinity variation. Microbial diversity from marsh-edge sediments is distinct from before and after the spill, and between unoiled and oiled marshes, with lower diversity in oiled marshes; but the greatest community composition shifts are in marshes affected by the freshwater diversions. Changes in microbial diversity in the water column at the stream-side edge of oiled marshes are extensive and are related to marsh edge erosion. In contrast, oiling of marshes had no impact on ammonia oxidizer or denitrifier abundances and on soil biogeochemical process rates 2+ years post-spill. Analysis of long-term offshore phytoplankton community and hypoxia data indicate some signal of the Macondo oil, but these components of the ecosystem remain mostly influenced by the fresh water and nutrients delivered by the Mississippi River. The consortium continues to work to tease apart oil impacts, effects of salinity, natural variation, and disturbance from tropical storms and hurricanes to determine the trajectory for health of shelf waters and Louisiana's marshes.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.604
Accessed 11/8/2014.

**Hoverspill consortium, The.** 2014. Hoverspill: a new amphibious vehicle for responding in difficult-to-access sites. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 649-659.
**Keywords:** natural resource damages/ spill planning/ spill preparedness/ spill response/
**Abstract:** Oil spill experience often shows that response activities are hampered due to the absence of operative autonomous support capable of reaching particular sites or operate in safe and efficient conditions in areas such as saltmarshes, mudflats, river banks, cliff bottoms… This is the purpose of the so-called FP7 Hoverspill project (www.hoverspill.eu), a 3-year European project that recently reached completion: to design and build a small-size amphibious vehicle designed to ensure rapid oil spill response. The result is an air-cushion vehicle (ACV), known as Hoverspill, based on the innovative MACP (Multipurpose Air Cushion Platform) developed by Hovertech and SOA. It is a completely amphibious vehicle capable of working on land and on water, usable as a pontoon in floating conditions. Its compactness makes it easy to transport

by road. The project also included the design and building of a highly effective integrated O/W Turbylec separator developed by YLEC. Spill response equipment will be loaded on-board based on a modular concept enabling the vehicle to carry out specific tasks with just the required equipment.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.649
Accessed 11/9/2014.

**Incardona, J. P., C. A. Vines, B. F. Anulacion, D. H. Baldwin, H. L. Day, B. L. French, J. S. Labenia, T. L. Linbo, M. S. Myers, O. P Olson, C. A. Sloan, S. Sol., F. J. Griffin, K. Menard, S. G. Morgan, J. E. West, T. K. Collier, G. M. Ylitalo, G. N. Cherr, and N. L. Scholz.** 2012. Unexpectedly High Mortality in Pacific Herring Embryos Exposed to the 2007b *Cosco Busan* Oil Spill in San Francisco Bay. *Proceedings of the National Academy of Sciences* 109(2): E51-E58.
**Keywords:** embryology/ heart development/ free radical/ forensic chemistry/ natural resource injury assessment
**Abstract:** In November 2007, the container ship Cosco Busan released 54,000 gallons of bunker fuel oil into San Francisco Bay. The accident oiled shoreline near spawning habitats for the largest population of Pacific herring on the west coast of the continental United States. We assessed the health and viability of herring embryos from oiled and unoiled locations that were either deposited by natural spawning or incubated in subtidal cages. Three months after the spill, caged embryos at oiled sites showed sublethal cardiac toxicity, as expected from exposure to oil-derived polycyclic aromatic compounds (PACs). By contrast, embryos from the adjacent and shallower intertidal zone showed unexpectedly high rates of tissue necrosis and lethality unrelated to cardiotoxicity. No toxicity was observed in embryos from unoiled sites. Patterns of PACs at oiled sites were consistent with oil exposure against a background of urban sources, although tissue concentrations were lower than expected to cause lethality. Embryos sampled 2 y later from oiled sites showed modest sublethal cardiotoxicity but no elevated necrosis or mortality. Bunker oil contains the chemically uncharacterized remains of crude oil refinement, and one or more of these unidentified chemicals likely interacted with natural sunlight in the intertidal zone to kill herring embryos. This reveals an important discrepancy between the resolving power of current forensic analytical chemistry and biological responses of keystone ecological species in oiled habitats. Nevertheless, we successfully delineated the biological impacts of an oil spill in an urbanized coastal estuary with an overlapping backdrop of atmospheric, vessel, and land-based sources of PAC pollution.
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**Irvine, L. M., B. R. Mate, M. H. Winsor, D. M. Palacios, S. J. Bograd, et al.** 2014 Spatial and Temporal Occurrence of Blue Whales off the U.S. West Coast, with Implications for Management. PLoS ONE 9(7): e102959. doi:10.1371/journal.pone.0102959.
**Keywords:** Blue whales/ foraging/ marine mammals/ predation/ vessel strikes/
**Abstract:** Mortality and injuries caused by ship strikes in U.S. waters are a cause of concern for the endangered population of blue whales (*Balaenoptera musculus*) occupying the eastern North Pacific. We sought to determine which areas along the

U.S. West Coast are most important to blue whales and whether those areas change inter-annually. Argos-monitored satellite tags were attached to 171 blue whales off California during summer/early fall from 1993 to 2008. We analyzed portions of the tracks that occurred within U.S. Exclusive Economic Zone waters and defined the 'home range' (HR) and 'core areas' (CAU) as the 90% and 50% fixed kernel density distributions, respectively, for each whale. We used the number of overlapping individual HRs and CAUs to identify areas of highest use. Individual HR and CAU sizes varied dramatically, but without significant inter-annual variation despite covering years with El Niño and La Niña conditions. Observed within-year differences in HR size may represent different foraging strategies for individuals. The main areas of HR and CAU overlap among whales were near highly productive, strong upwelling centers that were crossed by commercial shipping lanes. Tagged whales generally departed U.S. Exclusive Economic Zone waters from mid-October to mid-November, with high variability among individuals. One 504-d track allowed HR and CAU comparisons for the same individual across two years, showing similar seasonal timing, and strong site fidelity. Our analysis showed how satellite-tagged blue whales seasonally used waters off the U.S. West Coast, including high-risk areas. We suggest possible modifications to existing shipping lanes to reduce the likelihood of collisions with vessels.
**Web Address:**
http://www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0102959 Accessed 11/23/2014.

**Jensen, Hans V., Jørn Harald, S. Andersen, Steinar Lodve Gyltnes.** 2011. Oil Spill Response Technology Development through Industry Commitments - The Norwegian Way. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs344.
**Keywords:** spill response/ offshore oil recovery/ dispersant application technology/ remote sensing technology/ coastal and shoreline response/ spill preparedness/
**Abstract:** Through a unique collaboration between NOFO (the Norwegian petroleum industry oil spill responder) and NCA (the national oil spill responder) a 14 million US $ technology development program "Oil Spill Response 2010" was launched in 2009. The program addresses the continuous need for better and more effective oil spill response technology in general, but also particular emergency response challenges related to oil exploration in northern waters. The first Norwegian oil field in the subarctic Barents Sea region will start production in 2013, and crude oil transport along this environmentally vulnerable coast is increasing. The kick-off event of the program was a broad announcement of 18 technical challenges divided into 4 categories: 1) Offshore oil spill recovery, 2) Dispersant application technology, 3) Remote sensing technology and 4) Coastal and shoreline response. This announcement resulted in some 170 white papers (project ideas). Based on the evaluation by a team of 30 experts from NOFO, NCA, oil companies and consultants, about 50 enterprises were invited to submit more detailed project proposals. Today some 20 projects are in progress, ranging from multi-barrier oil booms, paravane based dispersant application, oil detection systems using drones (Unmanned Air Vehicles), low-cost aerostat, to portable HF radar surface current monitoring systems and Archimedean screw vehicle for shoreline operations. The program demonstrates how we try to stimulate private enterprises and R&D funds to

work together within the field of oil spill preparedness. This paper presents some promising and innovative projects within the four different categories.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-344
Accessed 11/9/2014.

**Jézéquel, Ronan., Florence Poncet.** 2011. The Erika Oil Spill, 10 Years After: Assessment of the Natural Weathering of the Oil and Natural Recovery of Vegetation. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs165.
**Keywords:** Erika oil spill/ natural recovery of littoral plant communities/ vegetation phytosociological indices/ oil persistence/ degradation of oil/
**Abstract:** On December the 12th, 1999, the tanker Erika broke up and sank off the coast of Brittany (France) leading to the spill of 20,000 tons of a heavy fuel oil. 400 km of the French Atlantic coastlines were polluted. Because of the characteristics of the oil (a very heavy fuel oil with a high content of heavy chemical compounds) and the severe weather conditions (a centennial storm with spring tides) when the oil came on shores, the Erika spill was one of the most severe accidental release of oil along the French coastlines, all types of habitat were concerned, pollution reached the supratidal zone affecting terrestrial vegetation and lichens.
During five years after the spillage, in the frame of a monitoring program on Erika oil spill consequences, initiated by the French Ministry of Environment, Cedre was in charge of a study on the natural degradation of oil remaining in different locations selected according to their environmental conditions (solar exposure, wave action, …) and of second one, on the natural recovery of littoral plant communities in sixty locations in which a hundred plots representing main vegetation types, various degrees of oiling and treatments applied were established. Vegetation phytosociological indices, monitored during five years, suggest moderate short or medium term impact even if oil persistence was observed. At the end of monitoring program, impact is still observable on slow growing communities (lichens) or where clean-up has induced severe degradation.
Ten years after the wreckage, locations selected were revisited: vegetation indices were examined (species composition, vegetation coverage) and samples of oil were collected for analyses.
Samples of weathered oil were collected in triplicate, extracted with methylene chloride and then purified through alumina-silica microcolumn. After extraction, GC-MS/MS analyses were performed in order to assess the degradation of alkanes and PAH compounds.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-165
Accessed 11/9/2014.

**Kelway, Paul., Rob Holland, Saskia Sessions, Hugo Nijkamp.** 2014. Towards a Tier 3 Infrastructure for Oiled Wildlife Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 972-985.
**Keywords:** oiled wildlife/ oil spill planning/ oil spill preparedness/
**Abstract:** With increased international shipping, offshore oil exploration, and interest in remote regions and challenging environments, there is growing recognition within

government and industry of the need to improve global oiled wildlife preparedness as part of oil spill prevention and response planning. In early 2012, an international gathering of industry, government and non-governmental stakeholders gave their support to further integrate oiled wildlife planning and to develop a Tier 3 wildlife response capacity; currently the biggest gap in wildlife preparedness. The Tier 3 system will utilise the expertise and track record of the world's leading oiled wildlife response organisations. Since 2012, discussions have continued and a process for developing and implementing a global oiled wildlife response system has been established and will be initiated in late 2014. This paper will explain the steps towards developing a multi-stakeholder global infrastructure for wildlife preparedness and share updates on the timeline and progress of the project to date.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.972
Accessed 11/9/2014.

**Khan, R.A.** 1990. Parasitism in Marine Fish after Chronic Exposure to Petroleum Hydrocarbons in the Laboratory and to the Exxon Valdez Oil Spill. *Bulletin of Environmental Contamination and Toxicology* 44:759-763.
**Keywords:** chronic exposure to petroleum hydrocarbons/ histopathological effects in fish/ parasitism/ trichodinid infections/ Exxon Valdez oil spill/
**Abstract:** Crude oil or its water soluble components are known to induce histopathological effects in fish following chronic exposure (McCain et al. 1978; Solangi and Overstreet 1982; Haensly et al. 1982; Khan and Kiceniuk 1984). Fish tend to harbor a variety of parasites, most of which under natural conditions cause little or no apparent harm. However, after chronic exposure to petroleum hydrocarbons, the prevalence and intensity of parasitism increases substantially (Skinner 1982; Khan 1987; Khan and Kiceniuk 1988). Trichodinid ciliates are mainly ectoparasitic protozoans on the gills of fish. Since a previous study showed that chronic exposure to crude oil fractions resulted in increased parasitism (Khan and Kiceniuk 1988), a study was initiated to ascertain the relationship between trichodinid infections and exposure of fish to crude oil or its fractions in the laboratory and subsequently, in the Gulf of Alaska following the Exxon Valdez oil spill.
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**Kirby, Mark F., Rosalinda Gioia, Robin J. Law.** 2014. The Principles of Effective Post-spill Environmental Monitoring and their Application to Preparedness Assessment. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 572-587.
**Keywords:** fate and effects/ Monitoring Preparedness Assessment Score/ spill planning/ spill preparedness
**Abstract:** Understanding the fate and effects of spilled oil or chemicals in the marine environment is essential if the scientific and response communities are to develop best practices for the future. The timely and successful deployment of survey specialists, sampling strategy and scientific techniques to monitor the environmental consequences of an incident can be a complex challenge and, in the same way as for spill response and clean-up, requires effective planning and coordination. However, the delivery of the

necessary guidance, skilled personnel and coordinated management are often not pre-identified, are rarely in the same organisation and the levels of preparedness to undertake complex monitoring programmes are often low. This paper identifies the 8 principles of effective post-spill monitoring programmes as; Scientific Guidance, Skills & Knowledge, Equipment, Funding, Responsibility & Management, Integration & Coordination, Support & Buy-in and Practice. Drawing on experience from the Premiam (Pollution Response in Emergencies: Marine Impact Assessment and Monitoring; www.cefas.defra.gov.uk/premiam) programme in the United Kingdom these principles are described and the approaches taken and challenges faced in the UK to improve post-spill monitoring practices are outlined.
This paper goes on to describe how these principles can be used as the basis for the assessment of monitoring preparedness through the generation of a Monitoring Preparedness Assessment Score (MPAS). This assessment approach can be used by local, regional or national authorities to establish the level of environmental monitoring and impact assessment preparedness for incidents in their areas and to highlight areas for improvement. In addition it is of use to responders, policy makers, environmental scientists and planners as a tool through which to assess preparedness and capability for specific scenarios. The use of the approach is demonstrated through the assessment of previous incidents and potential future scenarios.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.572
Accessed 11/8/2014.

**Knutson, Scott., Craig Dougans, Gary Reiter, Don Rodden, Erik Kidd.** 2014. CANADA – UNITED STATES (SALISH SEA) SPILL RESPONSE ORGANIZATIONS: A COMPARISON. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 299-313.
**Keywords:** Canada-United States Joint Marine Contingency Plan/ Salish Sea/ Puget Sound/ oil spill preparedness/ comparability analysis/ spill response resources/
**Abstract:** The Salish Sea comprises the inland marine waters of Washington and British Columbia and is intersected by an international border between Canada and the United States. Planning for oil spills that threaten to cross the international border is under the jurisdiction of the Canadian Coast Guard and the United States Coast Guard as described in the Canada-United States Joint Marine Contingency Plan. As Canadian companies gain approval to construct new pipelines in order to move oil sands from Alberta, Canada, to Vancouver, British Columbia, and westward, governments, agencies and citizens are publicly questioning whether current levels of oil spill preparedness and response equipment will be adequate for the increased tanker traffic from Canadian ports. This paper will be a single document that contains a snapshot of regulations, actual inventories and current philosophies that make up the 2014 response picture for the Salish Sea. It does not seek to denigrate either nation's response posture but rather to provide hard numbers as a common foundation for future discussions.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.299
Accessed: 11/3/2014.

**Kontovas, C. A., H. N. Psaraftis, N. P. Ventikos.** 2010. An empirical analysis of IOPCF oil spill cost data. Marine Pollution Bulletin 60, 1455-1466.
**Keywords:** Environmental risk/ oil pollution/ oil spill cost
**Abstract:** This paper reports on recent analysis of oil spill cost data assembled by the International Oil Pollution Compensation Fund (IOPCF). Regression analyses of clean-up costs and total costs have been carried out, after taking care to convert to current prices and remove outliers. In the first place, the results of this analysis have been useful in the context of the ongoing discussion within the International Maritime Organization (IMO) on environmental risk evaluation criteria. Furthermore, these results can be useful in estimating the benefit of regulations that deal with the protection of marine environment and oil pollution prevention.
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**Kulekeyev, Zh. A., G.Kh. Nurtayeva, E.S. Mustafin, A. M. Pudov, Gani Zharikessov, Peter Taylor, Peter Mark Taylor, Alun Lewis.** 2014. Studies in support of the regulation of dispersant use in the Kazakhstan Sector of the Caspian Sea (KSCS). International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 463-475.
**Keywords:** dispersant/ oil spill dispersant/ salinity/ spill planning/ spill response/
**Abstract:** The use of oil spill dispersants is often regulated by national authorities to ensure that products approved for use as dispersants on spilled oil in national waters are of reasonable effectiveness and of low inherent toxicity. KING (Kazakh Institute of Oil & Gas) undertook a study to assess the use of oil spill dispersants on spilled oils in the Kazakhstan sector of the Caspian Sea (KSCS) to support decision-making for such regulations in the RoK (Republic of Kazakhstan).
The KSCS has some characteristics that are unlike open ocean conditions in other parts of the world; the salinity is much lower than in the open sea. The shallow waters of the northern Caspian Sea have very low salinity (9 psu (practical salinity units) or less) due to the inflow of freshwater from the River Volga, and are frozen in winter. The deeper water in the southern part of the KSCS has a salinity of up to 14 psu. The effectiveness of oil spill dispersants is known to be affected by water salinity.
Different countries around the world have developed different test methods to assess dispersant effectiveness. The project examined the options and decided to modify the WSL (Warren Spring Laboratory) LR 448 dispersant effectiveness test method, as used in the UK. The method was adapted by KING and testing was conducted by Karaganda State University (KSU) to test a variety of dispersants under Caspian Sea conditions.
Dispersant effectiveness testing should be conducted with a test oil that is representative of oils that might be spilled in the area being considered. Kashagan crude oil was distilled to 200°C to simulate the evaporative loss that would occur shortly after the oil was spilled at sea and the residue used as the test oil in the dispersant effectiveness testing.
Several commercially-available dispersants were tested using the modified LR 448 method with the 200°C+ Kashagan test oil under a variety of conditions with salinities ranging from 0 psu to 35 psu and at temperatures of 5°C and 25°C. The results indicate that some internationally recognized dispersants could be suitable for use in the KSCS.

**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.463 Accessed 11/8/2014.

**Lage-Yusty, M. A., S. Alvarez-Perez, and M. O. Punin-Crespo.** 2009. Supercritical fluid extraction of polycyclic aromatic hydrocarbons from seaweed samples before and after the *Prestige* Oil Spill. *Bulletin of Environmental Contamination and Toxicology* 82:158-161.
**Keywords:** Seaweed/ Polycyclic aromatic hydrocarbons/ Prestige/ SFE–HPLC–FL
**Abstract:** Samples of seaweed which are used for human consumption were collected along the Galician coast (NW Spain), in order to determine the level of contamination from polycyclic aromatic hydrocarbons, by supercritical fluid extraction and liquid chromatographic analysis. No detection was made of benzo[*a*]pyrene, benzo[*a*]anthracene, benzo[*b*]fluoranthene, benzo[*ghi*]perylene and dibenzo [*ah*]anthracene. PAHs were found and quantified in only two samples. The PAHs found were the following: anthracene, chrysene, fluoranthene, fluorene and pyrene. The levels found were below maximum limits established by the Spanish Food Safety authority (<200 mg/kg dry weight). Here we show that no relevant effects were detected in terms of PAHs contamination in seaweed.
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**Lammers, M. O., A. A. Pack, E. G. Lyman, L. Espiritu.** 2013. Trends in collisions between vessels and North Pacific humpback whales (*Megaptera novaeangliae*) in Hawaiian waters (1975–2011) *J. CETACEAN RES. MANAGE.* 13(1): 73–80
**Keywords:** Humpback whale/ Northern Hemisphere/ Pacific Ocean/ Ship strikes/ Statistics/ Trends/ SHIP STRIKES; STATISTICS; TRENDS; PACIFIC OCEAN; NORTHERN HEMISPHERE
**Abstract:** Injury from collisions with vessels is a growing threat worldwide for many species of whales. Thirty seven years of historical records were examined for evidence of vessel collisions with humpback whales in the main Hawaiian Islands. Between 1975 and 2011, 68 collisions between vessels and whales were reported including 59 witnessed collisions and 9 observed whale injuries that were consistent with a recent vessel collision. No collisions were immediately lethal. The waters between Maui, Molokai, Lanai and Kahoolawe, which are known to have one of the highest concentrations of humpback whales in the Hawaiian Islands, had the highest incidence of collisions. Over 63% of the collisions involved calves and subadults, suggesting a greater susceptability towards collisions among younger animals. The rate of collisions increased significantly over the final twelve breeding seasons of the study and was greater than predicted by the estimated annual increase in the whale population, suggesting that the rising number of reported collisions cannot be explained solely by the annual increase in whale abundance. Although the total number of registered vessels and shipping traffic in Hawaii remained relatively constant between 2000 and 2010, there was a significant increase in the number of vessels between 7.9m and 19.8m in length. Vessels within this size range were also the most commonly involved in collisions during the study period, accounting for approximately two thirds of recorded incidents. It is concluded that from 1975‐2011, there was a significant increase in reports of non-lethal collisions between vessels and humpback whales, especially

calves and subadults, in the main Hawaiian Islands that likely reflects a combination of factors including the recovery of the population of North Pacific humpback whales, increases in traffic of particular vessel types, and increased reporting practices by operators of vessels.
**Web Address:**
http://www.pacificwhale.org/sites/pacificwhale.org/files/Lammers%20et%20al%20(2013)-%20Trends%20in%20collision%20between%20vessels%20and%20NP%20HBW%20(2).pdf Accessed 1/12/2015.

**Lawson, J. W. and V. Lesage.** 2013. A draft framework to quantify and cumulate risks of impacts from large development projects for marine mammal populations: A case study using shipping associated with the Mary River Iron Mine project. DFO Can. Sci. Advis. Sec. Res. Doc. 2012/154 iv + 22 p.
**Keywords:** climate change/ invasive species/ marine mammal risks/ mortality risks/ noise/ vessel strikes/
**Abstract:** The abundance and distribution of marine mammal populations is influenced by a variety of factors, including ice structure and presence, resource availability, reproductive status, predator distribution, or more generally, mortality risks. While mortality incorporates natural and anthropogenic sources, for most managed populations the latter source has focused non population losses due to hunting effort. Recently, anthropogenically-related, non-harvest removals are being considered for managed marine mammal populations, such as the role of climate change as a population-level factor that might reduce carrying capacity and/or increase mortality. More "proximal" negative consequences to marine mammal populations could arise from industrial activities and associated noise, vessel strikes, or introduction of new predators or other invasive species. There is currently no national approach as to how impacts of marine development projects should be evaluated by Fisheries and Oceans Canada (DFO) Science, which may lead to a perception of inconsistency and unfairness in the reviews. Given the recent increase in the number of large marine development projects requiring DFO reviews of potential impacts, there is a pressing need to develop a national approach to impact assessment, threshold setting, and monitoring standards, and to develop guidelines for the industry outlining the information needed for adequate impact assessment, and proposed methodologies for evaluating and mitigating impacts. Here, we outline a general framework to quantify and cumulate risks of impacts on marine mammal populations associated with marine development project, and which has been used to assess marine mammal risks from exposure to vessel noise or ship strikes associated with the Mary River Iron Mine project. We believe this framework could be extended to encompass other types of anthropogenic activities, and would benefit from further expert review to refine threshold values of impact and to determine if it is sufficiently precautionary.
**Web Address:** http://www.dfo-mpo.gc.ca/Library/348009.pdf Accessed 1/12/2015.

**Lee, R. F. and D. S. Page.** 1997. Petroleum hydrocarbons and their effects in subtidal regions after major oil spills. *Marine Pollution Bulletin* 34: 928-940.
**Keywords:** oil/ spills/ subtidal/ effects/ petroleum/ hydrocarbons/

**Abstract:** The question often arises after large oil spills as to the extent and effect of oil entering the subtidal zones adjacent to heavily oiled shorelines. Estimates for a number of large spills suggest that I to 13% of the spilled oil can enter subtidal regions. Hydrocarbon concentrations in these subtidal zones are generally orders of magnitude lower than shoreline sediments. For example, in the *Exxon Valdez* oil spill, subtidal sediment hydrocarbon concentrations attributable to the spill were very low in the first year after the spill and barely detectable in the second year. The conditions necessary to produce high concentrations of hydrocarbons in the subtidal region include large amounts of oil in a semienclosed estuary or bay and high concentrations of fine particulate matter to associate with hydrocarbons to allow them to disperse and sink. Such conditions do not often occur after spills, with some exceptions, such as low energy tidal estuaries in the *Amoco Cadiz* spill in Brittany, France. More commonly sea floor sediment hydrocarbon concentrations, where sediment-associated hydrocarbons have settled, are generally near to background levels, due to dilution and weathering. A number of methods have been used to evaluate the biological effects of oil spills on subtidal fauna. These include toxicity to amphipods, increases in the concentrations of fluorescent aromatic metabolites in the bile of fish, histopathology of fish, increases in opportunistic species and infaunal succession. Sediments collected from the subtidal zone below heavily oiled shorelines of the *Exxon Valdez* spill showed low toxicity using standard amphipod bioassays. Well documented effects on the subtidal biota adjacent to heavily oiled shorelines are the increases in the number of hydrocarbon degrading microbes which are fed on by opportunistic species of meiofauna which in turn are food for macrofauna. The documented biological effects of oil in the subtidal region are generally of short duration and recovery back to an equilibrium or 'normal' condition is typically quite rapid.
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**Lehto, Jason., Ben Shorr, Dan Doty, Rebecca Post, Jill Petersen.** 2011. Using Risk Analysis to Prepare for Natural Resource Damage Assessment (NRDA) In Washington State. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs80.
**Keywords:** natural resources damage assessment/ risk analysis/ Trajectory Analysis Planning/ Washington State/
**Abstract:** Much of the critical data needed to determine the extent of natural resource damage after an oil spill is ephemeral. Therefore it is vital to have plans prepared before a spill occurs and to have the right equipment and trained personnel ready to collect the data. To assist in the planning effort NOAA, Washington Department of Fish and Wildlife, and Washington Department of Ecology performed an analysis to determine where the highest risk for natural resource damages is likely to occur in the State of Washington after an oil spill.
The risk of natural resource damages is highest where the probability of large spills is highest, where the products spilled are more persistent and where the natural resources are most sensitive and abundant. We used a risk analysis documents published in 2009 to narrow down the areas that would most likely have a large spill event.
We used a Trajectory Analysis Planning (TAP) tool to determine if a spill occurred in a high risk area, which shorelines would most likely be impacted. Using Geographic

Information System (GIS) data from Washington State and NOAA's Environmental Sensitivity Index (ESI) (Petersen 2002) we determined which shoreline types and resources at risk would be impacted. The resource data we chose was related to determining exposure, the pathway of exposure and an adverse change to a natural resource or service. This analysis can guide the determination of types of data we need to collect before the spill to determine baseline conditions and after a spill to quantify injury. We can also use this information to determine what type of data collection techniques we need to use and what equipment and materials we need on hand. Furthermore this information will be useful in developing plans and to conduct training so that we are prepared to respond quickly and effectively.
Because time and budgets are limited it is important that we use this type of analysis to drive where we devote time and resources. We also submit that this may be an effective way for Joint Assessment Teams (JAT) to prioritize their technical working group (TWG) development.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-80
Accessed 11/9/2014.

**Lundgren, Scott R., Ryan Green, Louis Armstrong.** 2011. International Mutual Aid: Enhanced Use of Joint Contingency Plan Authority for Mutual Aid Spill Response Across an International Border Pays off in SONS 2010 Exercise and in Deepwater Horizon Response. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs303.
**Keywords:** cross-border oil spill response/ Joint Marine Pollution Contingency Plan/ Mutual Aid Spill Response
**Abstract:** The benefit of international mutual aid under the Joint Marine Pollution Contingency Plan (JCP) was demonstrated in exercise Canada-United States Atlantic (CANUSLANT) 2009 and the Spill of National Significance Exercise 2010 (SONS 2010) in the Gulf of Maine. The benefits of applying this concept for spills not directly impacting the border was further evidenced by the mobilization of the Canadian aircraft used as a mutual aid resource in SONS 2010 to the Gulf of Mexico within 10 days of the DEEPWATER HORIZON (DWH) sinking where it supported the DWH incident response for over two months.
The Canada-United States (CANUS) Joint Marine Pollution Contingency Plan (JCP) is a bilateral agreement between the Canadian and U.S. Coast Guards authorized by international treaty. This agreement gives great latitude to conduct regional planning and execute responses under its broad framework; it further has a clause providing for nation-to-nation assistance for spills in the contiguous waters, although this is generally exercised for threats at the border. Outside of the cross-border response context, however, the JCP is a valuable tool for garnering mutual aid where only one nation is threatened by providing the efficient mobilization of specialized resources across the border within the JCP contiguous waters. This benefit was illustrated during SONS 2010, which involved a simulated spill off Portland, Maine, far from the international border but within the JCP-defined Atlantic contiguous waters. Under the JCP assistance clause, the U.S. was able to call upon the highly capable Transport Canada National Aerial Surveillance Program's pollution surveillance aircraft. This aircraft physically mobilized to Maine and flew as the signature international asset as part of SONS 2010.

Early and extended utilization in DWH, although handled as a commercial transaction with the Spill Management Team, was facilitated by the networking and planning involved in the CANUSLANT/SONS 2010 experience. The Atlantic Geographic Annex to the JCP now explicitly speaks to mutual aid, and future planning will address particular specialized resources and processes in greater detail.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-303
Accessed 11/9/2014.

**Maccarone, A. D., J. N. Brzorad.** 2000. Wading Bird Foraging: Response and Recovery from an Oil Spill. *Colonial Waterbirds* 23(2):246-257.
**Keywords:** Ardeids/ egrets/ foraging/ habitat selection/ herons/ ibises/ oil spills/ wading birds/
**Abstract:** In 1990, >5 million L. of oil was accidentally discharged into the Arthur Kill, a narrow waterway that separates New York City from New Jersey. This oil had both immediate and long-term effects on the local estuary. It affected reproductive success at a large wading bird colony, caused changes in foraging habitat quality and food availability and may have caused birds to change foraging locations. In 1989, the year before the spills, we made 51 h of observations of foraging flights by wading birds nesting on the Isle of Meadows, a small dredge-spoil island located in the Arthur Kill. In 1998, we made 40 h of flight line observations at this same island colony. Glossy Ibises (*Plegadis falcinellus*) showed significant differences between 1989 (pre-spill) and 1998 (post-spill) in flight line patterns; however, flight patterns for piscivorous Snowy Egrets (*Egretta thula*), Great Egrets (*Casmerodius albus*) and Black-crowned Night Herons (*Nycticorax nycticorax*) did not differ significantly between these years. In both 1998 and 1999, we made censuses by automobile and boat to locate major feeding sites used by wading birds nesting on the Isle of Meadows, and made >900 feeding observations of Great Egrets and Snowy Egrets. Based on these ground censuses and feeding observations, it appears that birds have returned to once-contaminated estuarine foraging locations, and feeding success has returned to patterns documented before the oil spills.
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**Maj, G., M. Laurent, M. Mastrangeli, Y. Lecoffre.** 2014. TURBYLEC: DEVELOPMENT AND EXPERIMENTAL VALIDATION OF AN INNOVATIVE CENTRIFUGAL OIL – WATER SEPARATOR. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 634-648.
**Keywords:** oil water separator/ spill planning/ spill preparedness/ spill response/
**Abstract:** An innovative oil/water separator (TURBYLEC) has been developed in the frame of the HOVERSPILL™ European project (Fast Air Cushion platform for Oil Spill Remediation), partly funded by the European Commission's 7th Framework Program. Conventional separation solutions are not appropriate to the remediation scenarios targeted by the HOVERSPILL™ project, mainly because low weight and compactness are absolutely required for transportation on a hovercraft. Namely, high separation efficiency, imposed to satisfy environmental legislation for water release, is particularly difficult to achieve with a compact separator when skimmed flow rate, oil content and density contrast are submitted to large variations.

This paper describes the development of a customized patented centrifuge separator devoted to the specific needs of the HOVERSPILL™ project. Conceptual studies, prototype manufacturing and experimental validation are described.
The TURBYLEC prototype tested at CEDRE's facilities has a bulk (size and weight) compatible with its integration on the HOVERSPILL™ platform. Tests results show that TURBYLEC matches with expected use (i.e. downstream of a non-selective skimmer). In this configuration, TURBYLEC separator shows very good oil / water separation performances for inlet oil contents up to 25%. In this range of operating conditions its cut diameter has been evaluated to 60 µm. In order to achieve the same separation performances as with TURBYLEC, which weighs only 70 kg (with liquids), it would be necessary to install an 8 $m^3$ gravity separator.
TURBYLEC separator has been developed for a very specific duty (i.e. for integration on an Hovercraft for Oil Spill remediation). Nevertheless, its proven performances render it particularly attractive, as a standalone system, for many other specific tasks in the field of oil spill remediation. It could also interest various other water treatment applications.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.634 Accessed 11/9/2014.

**Matkin, C.O., J. W. Durban, E. L. Saulitis, R. D. Andrews, J. M. Straley, D. R. Matkin, G. E. Ellis.** 2012. Contrasting abundance and residency patterns of two sympatric populations of transient killer whales (*Orcinus orca*) in the northern Gulf of Alaska. Fishery Bulletin, 110(2):143-155.
**Keywords:** Killer whales/ 'Exxon Valdez' oil spill/ EVOS/ Southern Alaska/ Fishery interactions/ Residents/ Transients
**Abstract:** Two sympatric populations of "transient" (mammal-eating) killer whales were photo-identified over 27 years (1984–2010) in Prince William Sound and Kenai Fjords, coastal waters of the northern Gulf of Alaska (GOA). A total of 88 individuals were identified during 203 encounters with "AT1" transients (22 individuals) and 91 encounters with "GOA" transients (66 individuals). The median number of individuals identified annually was similar for both populations (AT1=7; GOA=8), but mark-recapture estimates showed the AT1 whales to have much higher fidelity to the study area, whereas the GOA whales had a higher exchange of individuals. Apparent survival estimates were generally high for both populations, but there was a significant reduction in the survival of AT1 transients after the *Exxon Valdez* oil spill in 1989, with an abrupt decline in estimated abundance from a high of 22 in 1989 to a low of seven whales at the end of 2010. There was no detectable decline in GOA population abundance or survival over the same period, but abundance ranged from just 6 to 18 whales annually. Resighting data from adjacent coastal waters and movement tracks from satellite tags further indicated that the GOA whales are part of a larger population with a more extensive range, whereas AT1 whales are resident to the study area.
**Web Address:** http://www.whalesalaska.org/docs/publications/matkin-et-al-2012-fish-bull.pdf Accessed: 11/4/2014.

**Matkin, C.O., E. L. Saulitis, G. M. Ellis, P. Olesiuk, S. D. Rice.** 2008. Ongoing population-level impacts on killer whales *Orcinus orca* following the 'Exxon Valdez' oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series, 356:269-281.
**Keywords:** Killer whales/ 'Exxon Valdez' oil spill/ EVOS/ Southern Alaska/ Fishery interactions/ Residents/ Transients
**Abstract:** Killer whales were photographed in oil after the 1989 'Exxon Valdez' oil spill, but preliminary damage assessments did not definitively link mortalities to the spill and could not evaluate recovery. In this study, photo-identification methods were used to monitor 2 killer whale populations 5 yr prior to and for 16 yr after the spill. One resident pod, the AB Pod, and one transient population, the AT1 Group, suffered losses of 33 and 41%, respectively, in the year following the spill. Sixteen years after 1989, AB Pod had not recovered to pre-spill numbers. Moreover, its rate of increase was significantly less than that of other resident pods that did not decline at the time of the spill. The AT1 Group, which lost 9 members following the spill, continued to decline and is now listed as depleted under the Marine Mammal Protection Act. Although there may be other contributing factors, the loss of AT1 individuals, including reproductive-age females, accelerated the population's trajectory toward extinction. The synchronous losses of unprecedented numbers of killer whales from 2 ecologically and genetically separate groups and the absence of other obvious perturbations strengthens the link between the mortalities and lack of recovery, and the 'Exxon Valdez' oil spill.
**Web Address:** http://www.whalesalaska.org/docs/publications/matkin-et-al-2008-meps.pdf Accessed: 11/4/2014.

**Mattox, Andrew., Elise DeCola, Tim Robertson.** 2014. ESTIMATING MECHANICAL OIL RECOVERY WITH THE RESPONSE OPTIONS CALCULATOR. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1759-1771.
**Keywords:** EDRC/ estimated daily recovery capacity/ oil spill modeling/ Response Options Calculator/ spill response planning/
**Abstract:** Forecasting the actual effectiveness of mechanical oil spill response forces is known to be very difficult. Frequently, linear calculations such as estimated daily recovery capacity (EDRC) are used to predict the volume of oil that a response system can recover. While EDRC provides a standard approach to estimating on-water oil recovery based on a percentage of the skimming efficiency, this approach does not account for all of the real-world factors that may impact the actual recovery capacity of a given response force.
We have developed a method using the Response Options Calculator (ROC) program to estimate the on-water recovery capacity for a defined response force under various oil spill scenarios, incorporating transit times, spill timing, seasonality, and simplified environmental conditions. This provides more realistic recovery estimates than EDRC, and can be developed using a publicly available modeling tool that does not require a technical background.
This paper describes our recent experience applying the ROC to a series of hypothetical oil spills along the Pacific Coast of the U.S. and Canada. We explore the capabilities and limitations ROC, and explain the method we have developed. Our treatment includes a discussion of factors such as secondary storage, transit times, spill timing, seasonality and daylight, as well as model shortcomings and how to interpret the

final outputs. The results produced by the ROC analysis may be used to inform oil spill contingency planning, response readiness assessments, and risk management.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1759
Accessed 11/9/2014.

**Mearns, Alan J., Gary Shigenaka, Buffy Meyer, LTJG Alice Drury.** 2014. Contamination and Recovery of Commercially-Reared Mussels Exposed to Diesel Fuel from a Sunken Fishing Vessel. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1686-1705.
**Keywords:** natural resource damage/ oiled wildlife/ mussels/ *Mytilus trossulus*/ PAH/ polycyclic aromatic hydrocarbons/
**Abstract:** Following the sinking of a derelict fishing vessel near a commercial mussel farm in Penn Cove, Washington, mussels ((*Mytilus trossulus*), suspended 1-3 m below the sea surface, were sampled to determine if they were contaminated with diesel fuel and if so, how long it took for the contamination to depurate. Composite mussel samples were collected from 6 culture floats and two intertidal beach stations on four occasions and analyzed for 43 polycyclic aromatic hydrocarbons ($PAH_{43}$), and a suite of alkanes and petroleum biomarkers. Mussel mean total $PAH_{43}$ concentrations in µ/kg (parts per billion, ppb) dry weight (dw), declined from 6462 on day 5; to 4574 on day 51; 2615 on day 186; and 1097 one year later. A market sample from the same commercial operation collected January, 2012 and analyzed by the Battelle Pacific Northwest National Laboratory had a value of 839 ppb dw for the sum of 42 PAHs. The affected mussels required between 6 and 12 months to return to this total PAH concentration putative background. The whole-soft tissue total $PAH_{43}$ half-life was about 5 months, far longer than the days or few weeks expected based on past literature. During the incident the commercial mussel grower voluntarily shut-down harvest, and on May 15, the Washington Department of Health (WA DOH) closed all of Penn Cove to both commercial and recreational harvest. Although individual PAH concentrations never exceeded thresholds for human consumption, samples did not initially pass sensory testing. The Penn Cove commercial and recreational harvesting was subsequently re-opened in stages to give the shellfish time to depurate and return to an untainted state. Additionally, all the concentrations of total PAHs measured in Penn Cove float and shoreline mussels during this study were within the range of concentrations reported in mussels from other monitoring sites in Puget Sound and other marine coastal areas of Washington. This relatively simple but sustained monitoring effort showed that submerged as well as inter-tidal bivalves can be contaminated by a nearby diesel spill, and that recovery may take longer than generally expected.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1686
Accessed 11/9/2014.

**Metcalf, Stuart.** 2014. Developing Location-based Oil Spill Waste Management Plans. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1633-1646.
**Keywords:** oiled shoreline/ spill cleanup waste/ spill response planning/ waste management/

**Abstract:** The management of waste arising from offshore and in particular on-shore oil spill response activities can often incur more cost and resources than the responses themselves. Careful pre-planning can deliver more efficient and effective implementation, minimising both impact and cost and providing the opportunity for improved stakeholder engagement and media interaction.
Current practice necessarily focuses much effort and resource on two goals:

- the development of comprehensive plans to prevent oil releases from offshore oil exploration and production facilities
- detailed planning of effective responses if they do arise.

In many cases, detailed planning for the management of wastes appears to have been left largely until after a release has occurred. This is understandable when a vessel is the source of the spill as none of the critical variables can be defined in advance. However, when releases originate from offshore oilfield infrastructure it is possible to define many of these variables with reasonable accuracy and to use them as the basis for detailed and focused pre- incident planning, yet oil spill planners still seem to have been reluctant to address this issue. This is possibly due to the inherent complexity, cost and lack of perceived benefit of pre- incident waste management planning – it is hoped this paper will stimulate rethinking of this approach.
A significant number of the factors which influence the preparation of an effective waste management plan derive from the impacted location, (forecast using trajectory modelling). This information (shoreline substrate, clean up techniques, logistics, resources etc.) can be used to develop models that estimate waste arising from individual sections of shoreline - these can then be consolidated with data from other shoreline sections to determine waste stream types and quantities on a local and regional basis. Options for reuse/recycling/treatment and disposal and the resources required can also be assessed, allowing the development of strategies for delivery of the selected options. Assessments can also be made of the need/benefit for providing stockpiles of materials and/or equipment.
Considering key issues before an incident arises enables these to be reviewed more comprehensively in a non-crisis situation. The development of models facilitates review of alternative scenarios and quick adjustment to the plans if an actual release occurs and more accurate details become available. The approach proposed can be applied to any geographical location. The paper outlines this process, examples of the results and the benefits of its adoption.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1633
Accessed 11/8/2014.

**Michel, Jacqueline., Christine Boring, John Tarpley, Gary Shigenaka, Frank Csulak.** 2011. SCAT: Improving the Process, Training, Tools, Data Management, and Products. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs40.
**Keywords:** natural resource damage/ oiled shoreline/ SCAT/ Shoreline Cleanup Assessment Technique/ spill preparedness planning/ spill response planning/
**Abstract:** The Shoreline Cleanup Assessment Technique (SCAT) program is an integral component of spill response, operated under the Environmental Unit of the Planning Section under the Incident Command System. The benefit of SCAT is that it is

flexible yet follows systematic processes for collecting and providing information to support cleanup operations. NOAA has provided SCAT training to large numbers of Federal and State responders in the U.S. and often manages the SCAT program during spills of all sizes. NOAA has taken the initiative to update and refine the SCAT process based on lessons learned during recent spills. This initiative includes the following components: 1) Formalization of the SCAT Process to reflect the different phases of SCAT support of Operations; 2) Application of the concept of Response Typing (in terms of the degree of complexity) as part of the SCAT Process to guide procedural SCAT needs, tools, and products for varying response complexity; 3) Development of the SCAT Data Management Plan to streamline data entry and reporting using standard templates to generate useful SCAT products and information during the response; 4) Development of a SCAT course catalogue, training curriculum, and position qualifications standards based on functional SCAT roles; and 5) Revision of the SCAT manuals and job-aids. These improvements will provide greater consistency in SCAT training across the country, improve response efficiencies in the Environmental Unit, and strengthen National Preparedness.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-40
Accessed 11/9/2014.

**Michel, Jacqueline., Zachary Nixon, Miles O. Hayes, Gail V. Irvine, Jeffrey W. Short.** 2011. The Distribution of Lingering Subsurface Oil from the *Exxon Valdez* Oil Spill. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs27.
**Keywords:** *Exxon Valdez* Oil Spill/ oil persistence/ shoreline remediation/ subsurface oil/
**Abstract:** This study used field data and a suite of geospatial models to identify areas where subsurface oil is likely to still be present on the shorelines of Prince William Sound (PWS) and the Gulf of Alaska (GOA) affected by the *Exxon Valdez* oil spill, as well as the factors related to continued presence of such oil. The goal was to identify factors and accompanying models that could serve as screening tools to prioritize shorelines for different remediation methods. The models were based on data collected at 314 shoreline segments surveyed between 2001 and 2007. These field data allowed us to identify a number of geomorphologic and hydrologic factors that have contributed to the persistence of subsurface oil within PWS and GOA two decades after the spill. Because synoptic data layers for describing each of these factors at all locations were not available, the models developed used existing data sets as surrogates to represent these factors, such as distance to a stream mouth or shoreline convexity. While the linkages between the data used and the physical phenomena that drive persistence are not clearly understood in all cases, the performance of these models was remarkably good. The models simultaneously evaluate all identified variables to predict the presence of different types of subsurface oiling in a rigorous, unbiased manner. The refined model results suggest there are a limited but significant number of as-yet unsurveyed locations in the study area that are likely to contain subsurface oil. Furthermore, the model results may be used to quantitatively prioritize shoreline for investigation with known uncertainty.

**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-27
Accessed 11/9/2014.

**Michel, Jacqueline., Zachary Nixon, William Holton, Mark White, Scott Zengel, Frank Csulak, Nicolle Rutherford, Carl Childs.** 2014. Three Years of Shoreline Cleanup Assessment Technique (SCAT) for the *Deepwater Horizon* Oil Spill, Gulf of Mexico, USA. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1251-1266.
**Keywords:** natural resource damage/ oiled shoreline/ shoreline cleanup/ SCAT/ Shoreline Cleanup Assessment Technique Program/
**Abstract:** The oil from the 2010 *Deepwater Horizon* spill in the Gulf of Mexico was documented as stranding on 1,773 kilometers (km; 1,102 miles) of shoreline as of May 2013. Of the shorelines oiled, beaches comprised 50.8%, marshes 44.9%, and other shoreline types 4.3%. One year after the spill began, oil remained on 830 km; two years later, oil remained on 685 km and three years later, oil remained on 632 km, with 74% of the shoreline classified as trace (<1%) oiling degree. Shoreline cleanup activities were authorized on 660 km, or 73.3% of oiled beaches. Because the oil stranded over a three-month period and at a period in time when the beaches were in a relatively eroded condition, the oil became deeply buried and posed many challenges to its removal. The continued remobilization of oil buried in both intertidal and nearshore habitats resulted in the chronic re-oiling of sand beaches at trace levels for over three years, thus the slow rate of decline in the shoreline oiled lengths. Treatment of sand beaches in the first year focused on use of mechanical beach cleaners and excavation and sifting of deeply buried oil to minimize clean sediment removal. Later treatments were mostly manual except for mechanical excavation of deeply buried oil in Louisiana beaches in 2012 and 2013. Passive, manual, and mechanical treatments were authorized on 71 km, or 8.9% of oiled marshes and associated habitats, though actual treatment was conducted in smaller zones within these segments. Intensive marsh cleanup treatments were limited to ~1-2% of oiled marshes Gulf-wide and focused on areas with thick persistent marsh oiling. The Shoreline Cleanup Assessment Technique (SCAT) Program was the most complex and long lasting of any past spill. The SCAT Program evolved as needed to support the changing requirements and many challenges over the duration of the response. Many of the tools and products developed and used will be of value for future spill responses.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1251
Accessed 11/8/2014.

**Miles, M. Scott., Ronald F. Malone, John E. Supan.** 2014. Evaluation of Triploid Oysters as a Tool to assess Short- and Long-term Seafood Contamination of Oil Spill-impacted Areas. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1958-1971.
**Keywords:** *Crassostrea virginica*/ PAH/ polynuclear aromatic hydrocarbon contamination/ seafood contamination/ triploid Eastern oysters/
**Abstract:** The objective of this field and laboratory study was to evaluate the use of triploid Eastern oysters, *Crassostrea virginica*, as a bioindicator of polynuclear aromatic hydrocarbon (PAH) contamination in oil spill-impacted areas. Bivalve mollusks have

shown to be valuable tools for assessing the short-term (weeks to months) bioavailability and impact of hydrophobic contaminants following oil and chemical spills. Approximately 1-year after the initial Deepwater Horizon spill, PAH concentrations were measured in sediment and caged oysters at sites within the Northern Barataria Bay. Two (2) seven-week large-scale mesocosm studies were conducted with diploid and triploid oysters to assess the effects of multiple whole South Louisiana crude (SLC) oil concentrations and seasonal water temperature variation on the PAH bioaccumulation and depuration rates within the test populations. Tissue analyses from the mesocosm study showed that PAH concentrations were generally higher and less variable in triploids than diploids. The studies showed that triploid *Crassostrea virginica* can be an appropriate organism to serve as a bioindicator of PAH contamination as they are abundant, stationary filter-feeders that provide ample tissue for analysis, and accumulate PAHs in response to contamination. Although diploid oysters are more representative of ecological impacts, triploid oysters are the only ploidy to have the capability to accurately assess oil and chemical spill impacts during oyster breeding season.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1958
Accessed 11/9/2014.

**Minter, Thomas G., Jason A. Hale, Christopher D. Cormack, Linos Cotsapas, Jacqueline Michel.** 2014. Tidal Flat and Sand Beach Remediation: Choosing Remediation Techniques to Speed Ecological Recovery of Habitats Still Impacted 20 Years after the Gulf War Oil Spill. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1719-1733.
**Keywords:** Gulf War Oil Spill/ natural resource damage/ oiled shoreline/ spill cleanup/
**Abstract:** After nearly 20 years of limited natural recovery following the Gulf War oil spill, surveys were conducted in 2009-2010 to identify where oil has persisted and ecological recovery has been slow along the Arabian Gulf coastline of Saudi Arabia. In 2011-2013, large-scale remediation projects were executed on 3 locations totaling 155 hectares of tidal flats and sand beaches to speed ecological recovery. Targeted remediation techniques were used as tools to meet the following goals: 1) increase suitable habitat for grazers and burrowing infauna; 2) reduce total petroleum hydrocarbon levels; and 3) improve physical processes (drainage) and reduce associated stressors such as ponding. Three principal techniques were developed and utilized along sheltered and moderately exposed tidal flats: 1) tilling of oiled sediments using tines (rake) or disc harrow attachment, followed by manual removal of remaining surface oil; 2) complete physical removal and disposal of the surface or cohesive subsurface oiling layers; and 3) tilling areas contained within berms while flooded to liberate liquid oil that was subsequently recovered by skimming/vacuuming. The first technique was considered appropriate when there was a well-defined gradient between hardened surface oiling and lightly oiled subsurface sediments, within sandy tidal flats, and where sediment conservation was a priority. This technique resulted in 20% additional oiled surface residue cover, which was removed manually. Resulting sediment loss was minimal. Goals 1, 2 and 3 were met. The second technique was preferred when there was a dry cohesive oiled layer either on the surface or beneath a layer of clean sand and where sediment conservation was not a priority. Excavation of

oiled sediments resulted in high sediment loss by physical removal; however, goals 1 and 2 were clearly achieved. Additional re-grading including possible sediment replacement was required to achieve goal 3. The third technique was considered the optimal method when there was a high level of subsurface liquid oiling within tidal flats, and if sediment conservation was a priority. Goal 1 was achieved by breaking up surface barriers. To achieve goals 2 and 3, multiple tilling passes were required to liberate and remove liquid oil. Monitoring results show that while oil levels varied across remediated sites, a trend in reduction was common throughout. Short- and long-term ecological responses are being monitored.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1719 Accessed 11/8/2014.

**Monnahan, C. C., Branch, T. A., A. E. Punt.** 2014. Do ship strikes threaten the recovery of endangered eastern North Pacific blue whales?. Marine Mammal Science. doi: 10.1111/mms.12157
**Keywords:** blue whale/ *Balaenoptera musculus*/ ship strikes/ recovery/ eastern North Pacific/ Santa Barbara Channel/
**Abstract:** Blue whales were targeted in the North Pacific from 1905–1971 and are listed as endangered by the IUCN. Despite decades without whaling, abundance estimates for eastern North Pacific (ENP) blue whales (Balaenoptera musculus) suggest little evidence for a recent increase. One possible reason is fatal strikes by large ships, which have affected populations of other cetaceans and resulted in mitigation. We used a population dynamics model to assess the trends and status of ENP blue whales, and the effects of ship strikes. We estimate the population likely never dropped below 460 individuals, and is at 97% of carrying capacity (95% interval 62%–99%). These results suggest density dependence, not ship strikes, is the key reason for the observed lack of increase. We also estimate future strikes will likely have a minimal impact; for example, an 11-fold increase in vessels would lead to a 50% chance the long-term population would be considered depleted. Although we estimate ship strike mitigation would have minimal impacts on population trends and status, current levels of ship strikes are likely above legal limits set by the U.S. The recovery of ENP blue whales from whaling demonstrates the ability of blue whale populations to rebuild under careful management.
Web Address: http://onlinelibrary.wiley.com/doi/10.1111/mms.12157/pdf Accessed 11/24/2014

**Morgan, Andrew David., Katherine Shaw-Brown, Ian Bellingham, Anna Lewis, Mitch Pearce, Kellie Pendoley.** 2014. Global Oil Spills and Oiled Wildlife Response Effort: Implications for Oil Spill Contingency Planning. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1524-1544.
**Keywords:** Oiled Wildlife Response/ Oil Spill Contingency Plan/ First Strike/ Mobilisation Model/ Maritime Oil Spills/
**Abstract:** Over the last century there has been a significant increase in the number and size of oil spills to the marine environment due to the global proliferation of oil and gas extraction as well as the number of tankers and other maritime transport infrastructure associated with increased production. Efforts have traditionally been focussed on

containment and deflection of oil rather than responding to wildlife. The present study examines total oiled wildlife effort in response to maritime spills for 286 recorded globally. Between 1910 and 1961 there was an average of 1.23 ± 0.43 incidents per year, spilling an average of 114,062 ± 352,512 tonnes of oil per year. These averages increased to 3.83 ± 2.65 events with 123,277 ± 166,735 tonnes of oil spilt per year from 1962 to 1990, and again, from 1991 to 2012 to 6.50 ± 5.17 events with 164,299 ± 290,655 tonnes of oil spilt per year. Offshore platform and tanker spills have accounted for 37% and 27% of this total, respectively. Of the 104 recorded instances where wildlife interactions occurred (40%), spill volume was not related to the total number of animals caught, oiled or pre-emptively; however, it was related to the number of carcasses collected. A lack of planning for Oiled Wildlife Response (OWR) was identified as a contributing factor exacerbating the impact of a spill on wildlife and for resourcing a response. Inadequacies within operator and government contingency planning, to prepare for and sustain a wildlife response for extended periods, can be overcome by using a mobilisation model that integrates wildlife carer networks, government regulatory agencies and operator resourcing *via* an independent coordinating organisation consisting of a small group of personnel highly experienced and trained in maritime operations and marine science with access to a network of persons with experience in responding to wildlife and their handling, treatment and rehabilitation.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1524
Accessed 11/8/2014.

**Muskat, Judd.** 2014. The Evolution of Applied Geographic Information Systems for Oil Spill Response in California: Rapid Data Dissemination for Informed Decision Making. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1583-1595.
**Keywords:** Geographic Information Systems/ GIS/ incident situational awareness/ spill response planning/ web-based data dissemination/
**Abstract:** Computing technology has advanced to the point where it is now standard practice to employ complex Geographic Information Systems (GIS) within the Incident Command Post (ICP). Simultaneously, field data collection has been migrating to mobile computing applications which output GIS files that are quickly displayed for real-time situational awareness. From the initial emergency response through clean-up and sign-off much data with a spatial component is generated and many disparate data sets are collected. More efficient data integration, management and visual analysis affords Incident Commanders and Section Chiefs the ability to make informed and timely planning, operational and strategic decisions.
Traditionally GIS maps were created in the ICP from field sketches, field notes and verbal reports. Processing of these data by the GIS Unit is very time consuming and prone to error. Preliminary efforts to streamline and automate field data collection by the California Department of Fish and Wildlife (CDFW, formerly the California Department of Fish and Game), Office of Spill Prevention and Response (OSPR) utilized Global Positioning System (GPS) receivers to record waypoints and track lines. Since then more elegant electronic field data collection applications installed on small, handheld computers have been developed including those for “Wildlife Recovery and Transport”, “Resources at Risk” over flights, and the “Shoreline Cleanup and Assessment

Technique" (SCAT). Other recent advancements allow for real-time aerial remote sensing for oil slick detection and detailed mapping of its properties, and displaying the output from coastal High Frequency (HF) radar installations for real-time visualization of local ocean surface current fields. These field data collection applications are explained in more detail in the body of this paper.
Once these data are incorporated into the GIS a web-based Common Operational Picture (COP) is utilized for timely dissemination of relevant geospatial data. OSPR has worked closely with the National Oceanic and Atmospheric Agency (NOAA) to develop "Southwest ERMA" (Environmental Response Management Application) as California's COP for web-based data dissemination and incident situational awareness.
At the Deepwater Horizon (MC-252) Incident Command Post (ICP) in Houma, Louisiana many responders were from outside of the region and unfamiliar with the local geography. Area base maps with a standardized coast line and place names were not readily available for several days which added unnecessary confusion to the mix. As a lesson learned and in order to avoid this situation for an oil spill response in California, OSPR and NOAA have pre-loaded Southwest ERMA with pertinent base maps, charts and spill response planning data from the three California Area Contingency Plans (ACPs). These data are deliberately made freely available to the general public via the Southwest ERMA web-viewer without any user login credentials required.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1583
Accessed 11/8/2014.

**Newton, L. C. and J. D. McKenzie.** 1995. Echinoderms and Oil Pollution: A potential Stress Assay Using Bacterial Symbionts. *Marine Pollution Bulletin* 31: 453-456.
**Keywords:** echinoderms/ oil pollution/ symbiotic sub-cuticular bacteria/
**Abstract:** Oil pollution is a problem in the North Sea. Important sources of oil pollution are spills and drill cutting. Echinoderms are a major component of the macrobenthos in the North Sea (and elsewhere). They tend to be very sensitive to various types of marine pollution. Many species of echinoderms contain symbiotic sub-cuticular bacteria (SCB). The response of Amphiura filiformis, A. chiajei and Ophiothrix fragilis, all of which contain SCB, to oil pollution was studied in laboratory experiments, mesocosms and in the field. Sublethal stress was monitored by examining changes in the tissue loading of SCB. When subjected to hydrocarbon insult, there was a decline in the number of SCB. The potential use of SCB abundance to detect sublethal stress is discussed.
**Web Address:** Please contact islandersforsafeshipping@gmail.com

**Nijkamp, H. and S. Sessions.** 2011. Oiled Wildlife Response: Structural Planning and Response Boosted by Regional Agreements. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs356.
**Keywords:** pre-spill planning/ oiled wildlife/ European wildlife response planning/ Helsinki Convention/ Bonn Agreement/ Barcelona Convention/
**Abstract:** During an oil spill, public attention focuses on animal welfare and care, primarily channelled through powerful media imagery and commentary. In a number of countries, strategic-operational plans are in place enabling a well-coordinated and effective wildlife response carried out by animal welfare organisations in close

cooperation with leading Government agencies and the responsible party and if possible the suspected polluter. Case histories continue to demonstrate that pre-spill planning is the best guarantee for a successful wildlife response. This insight is shared by many professionals who frequent international oil spill conferences and by authority officials from countries which have had significant experiences with oiled wildlife. Coastal countries in Europe work closely together as part of regional agreements in their efforts to develop the right levels of response preparedness. Some of the most productive and effective agreements, e.g. the Helsinki Convention, the Bonn Agreement and the Barcelona Convention have recently started to integrate wildlife response planning in their Contingency Plans. This has already resulted in a significant increase in awareness in many of the 27 coastal European countries (including European Member States, Croatia, Iceland, Norway, Russia and Turkey), and will further improve Europe's preparedness for oiled wildlife treatment. This experience from Europe can help other regions in the world to start looking into the issue and put useful tools and regulations in place for effective oiled wildlife response.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-356
Accessed 11/9/2014.

**Niu, Haibo., Zhengkai Li, Kenneth Lee, Paul Kepkay, Joseph Mullin.** 2011. Modeling the Long Term Fate of Oil-Mineral-Aggregates (OMAs) in the Marine Environment and Assessment of Their Potential Risks. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs170.
**Keywords:** oil-mineral-aggregates (OMAs)/ spill mapping/ spill modeling/
**Abstract:** Spilled oil can interact with suspended particles (mineral or organic) in marine environments and form aggregates, including oil-mineral-aggregates (OMAs). Some OMAs with densities greater than seawater can settle to the seedbed and pose potential risks to benthic organisms. To understand the transport and fate of oil associated with OMAs and evaluate their potential risks, researchers recently developed an integrated hydrodynamic, fate/transport and risk assessment modeling system, and conducted several case studies. One of the limitations of these studies was the use of a conservative approach which neglected biodegradation processes. Although this approach is acceptable for the study of short term effects of settled oil, the long term effects cannot be studied. It is the objective of this paper to improve the existing modeling approach in order to simulate the long term fate/transport and potential risk of settled oil associated with OMAs. The improved approach used the DREAM model developed by SINTEF and a number of case studies under different combinations of oil, sediment type, wave and current conditions were conducted.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-170
Accessed 11/9/2014.

**Nixon, Zachary.** 2014. Tactical Predictions of Shoreline Oiling Probability via Machine Learning Models and Satellite-Derived Surface Oil Analysis Products. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 660-672.
**Keywords:** natural resource damages/ satellite/ SCAT/ Shoreline Cleanup Assessment Technique/ surface oil analysis/ oiled shoreline/ spill planning/ spill preparedness/ spill response/

**Abstract:** For significant oil spills in remote areas with complex shoreline geometry, apportioning Shoreline Cleanup Assessment Technique (SCAT) survey effort is a complicated and difficult task. Aerial surveys are often used to select shoreline areas for ground survey after an initial prioritization based upon anecdotal reports or trajectory models, but aerial observers may have difficulty locating cryptic surface shoreline oiling in vegetated or other complex environments. In dynamic beach environments, stranded shoreline oiling may be rapidly buried, making aerial observation difficult. A machine learning-based model is presented for estimating shoreline oiling probabilities via satellite-derived surface oil analysis products, wind summary data, and shoreline habitat type and geometry data. These inputs are increasingly available at spatial and temporal scales sufficient for tactical use, enabling model predictions to be generated within hours after satellite remote sensing products are available.
The model was constructed using SCAT data from the *Deepwater Horizon* oil spill, satellite-derived surface oil analysis products generated during the spill by NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) using a variety of satellite platforms of opportunity, and available shoreline geometry, character, and other preexisting data. The model involves the generation of set of spatial indices of relative over-water proximity of surface oil slicks based upon the satellite-derived analysis products. The model then uses boosted regression trees (BRT), a flexible and relatively recently developed modeling methodology, to generate calibrated estimates of probability of subsequent shoreline oiling based upon these indices, wind climatological data over the time period of interest, and other shoreline data. The model can be implemented via data preparation in any Geographic Information System (GIS) software coupled with the open-source statistical computing language, R. The model is entirely probabilistic and makes no attempt to reproduce the physics of oil moving through the environment, as do trajectory models. It is best used in concert with such models to make estimates at different spatial scales, or when time and data requirements make implementation of fine-scale trajectory modeling impractical for tactical use. The details of model development implementation and assessments of model performance and limitations are presented.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.660
Accessed 11/8/2014.

**Odell, Jessica., Travis Coley.** 2014. Lessons Learned Developing the Universal Best Management Practices Index for the Deepwater Horizon Endangered Species Act Biological Assessment. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1004-1010.
**Keywords:** Endangered Species Act Biological Assessment/ oiled wildlife/ natural resource damage/ spill planning/ spill preparedness/
**Abstract:** In an oil spill emergency situation, how do you simultaneously protect listed species, track important events, and plan for a post-emergency Endangered Species Act Biological Assessment? This was the daunting question faced by hundreds of environmental regulators, field biologists, and technology developers during the Deepwater Horizon (DWH) Incident Response. With the help of mobile technology, legacy expertise, and a dedicated field presence, they answered with a system of Best Management Practices (BMPs). During the response, factors such as urgency,

expansive geography, response duration, and technical experience disparity threatened to compromise the integrity of the BMP datasets. Because of these factors, over one hundred separate BMP lists were issued, and highly accurate field data collection was often sacrificed for after-hours web entry or paper records. For the purposes of the Endangered Species Act Biological Assessment, the Universal BMP (UBMP) Index was created to retroactively track the implementation of these various lists and properly credit responders with conservation efforts. The development of this index yielded lessons from practical BMP implementation and documentation in a response environment to constructing sophisticated database architecture needed for consumption. Here we present the evolution of UBMPs, their role in the Effects Analysis of the Deepwater Horizon Biological Assessment, and a plan for a better way.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1004
Accessed 11/8/2014.

**Odell, Jessica., Travis Coley, Douglas Anderson.** 2014. Lessons Learned Developing the Response Action Record for the Deepwater Horizon Endangered Species Act Biological Assessment. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1011-1018.
**Keywords:** Endangered Species Act Biological Assessment/ oiled wildlife/ natural resource damage/ Shoreline Treatment Recommendations/ spill planning/ spill preparedness/
**Abstract:** In an oil spill response environment, urgency looms, and virtually every action is geared toward immediate needs. Clean-up, safety, and listed species protection are at the forefront of the collaborative efforts carried out by an incident management team. However, these needs do not complete the obligation of the Federal Action Agency responsible for the event. This agency must also complete an Endangered Species Act (ESA) Biological Assessment (BA). To do that for a spill of national significance, it is paramount that response personnel track certain details about their daily operations. Unfortunately, in the BA for the Deepwater Incident Response, the action record had to be reconstructed forensically. Although operational permits to work, otherwise known as Shoreline Treatment Recommendations, used standard geographic references and response action terms, they are merely prescriptions for activity and provide only maximum default assumptions. To gain vital insight into more specific temporal elements such as frequency, intensity, and duration, daily response reports were required. These reports were not gathered into a central geodatabase along the way. They were printed to paper, boxed, shipped to a documentation unit, and scanned into image files. These files were organized into approximately 30,000 document sets of up to 4,000 pages each. Qualitative document content analysis was used to distill the needed details from these image sets into a database. This technique for generating the needed data for an effects analysis is arduous. However, the process of its development has produced valuable lessons learned. Here we present the needed schema design and architecture to promote a seamless transition on future responses from the urgency of immediate need to inevitability of post-spill ESA obligation.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1011
Accessed 11/8/2014.

**Owens, Edward H., Robert W. Castle, Duncan M. FitzGerald, and Helen (Chapman) Dubach.** 2014. TIDAL INLET PROTECTION STRATEGIES (TIPS) FIELD GUIDE FOR SHORELINE PROTECTION. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2112-2126.
**Keywords:** natural resource damage/ oiled shoreline/ spill cleanup/ spill response preparedness/ tidal inlets/
**Abstract:** Tidal inlets are complex systems that provide pathways for oil to enter sheltered and typically environmentally sensitive bays, tidal flats, and wetland complexes. Because of their dynamic nature, attempts to protect these features from oil spills have not always been successful historically, often due to a lack of understanding of how the inlet system operates and where protective actions may be practical. This Field Guide has been prepared to assist oil spill planners and responders to better understand how tidal inlets function and where conditions may exist that permit control actions.
Improving understanding of how tidal inlets work can help ensure that realistic expectations and appropriate tactics and equipment are available for deployment locations where they have some potential for success. During a response operation, the Field Guide can be used to ensure that available resources are put to best use and that decision makers select practical strategies based on the environmental conditions at the time. The Field Guide provides separate stepwise approaches for preplanning activities and for response decisions.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.2112 Accessed 11/9/2014.

**Owens, Edward H., Helen C. Dubach, Robert W. Castle.** 2014. SHORELINE RESPONSE - A PARADIGM SHIFT. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1315-1328.
**Keywords:** natural resource damage/ oiled shoreline/ shoreline cleanup/ SCAT/ Shoreline Cleanup Assessment Technique Program/ spill response planning
**Abstract:** From time to time an event or a series of events can produce a change in strategic thinking or operating practices. One outcome of the Deepwater Horizon response was to learn from the process by which the shoreline response program was developed while the majority of planning and operational effort was directed towards the multi-faceted and intensive on-water program to recover or eliminate oil on the water before it could reach the coastal zone to minimize the impacts of the spill. This emphasis is typical of most marine and coastal spill response operations even though the duration of on-water operations may be a few days or weeks, whereas the onshore phase typically extends over weeks, months, or even years. The chronic nature of the Deepwater Horizon spill resulted in the on-water phase lasting for several months so that resources that typically would have transferred over to shoreline operations within a short time frame (days to a few weeks) remained committed to offshore and nearshore operation well into the summer of 2010.
Shoreline cleanup is arguably the most intensely scrutinized and potentially expensive, in terms of time and effort, part of any response. Pre-planning shoreline cleanup in detail can be very challenging. Notwithstanding the types and volumes of oil, primary factors affecting shoreline cleanup strategy include potential oil pathways, shore types,

seasonal coastal ecosystem and individual resource sensitivities, stakeholder involvements, and tactical cleanup options and restrictions. Few organizations have dedicated resources for shoreline cleanup: these must be identified and mobilized for a specific scenario (shore type, oil character, volume, etc.). However, a readiness to respond rapidly and expertly to oil on shore is critical as cleanup actions typically are most effective and efficient immediately following deposition, before oil is remobilized, buried or weathers to a state more difficult to clean.
These preplanning challenges often mean that crucial details in a shoreline response plan are developed while oil is heading towards or even is onshore. The development of a Shoreline Response Program (SRP) addresses these challenges. The model SRP is a paradigm shift in the sense that it represents a change in some basic assumptions for spill response planning and first-phase response operations related to shorelines.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1315
Accessed 11/9/2014.

**Parker, Heather A., Josie Clark, Brad H. Martin, Linda Pilkey-Jarvis, Brian MacDonald.** 2014. New Tools for the SCAT Program: An Innovative Approach to Assimilating Newer Responders into the Shoreline Cleanup Assessment Technique Program. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1298-1314.
**Keywords:** natural resource damage/ oiled shoreline/ shoreline cleanup/ SCAT/ Shoreline Cleanup Assessment Technique Program/
**Abstract:** As less experienced responders join spill response operations, concurrent with the loss of experienced responders to retirements and fewer large spills, the need for tools that capture and promote the best practices of spill response functions becomes imminently critical. Better, more practical tools help less-experienced responders assimilate not only the basics of the planning assignments but also provide them with guidance gained from seasoned responders. The Shoreline Cleanup Assessment Technique (SCAT) program within the Incident Command System (ICS) is one assignment that often sees a number of less experienced participants. In many instances, responders participate on SCAT Field Teams and are not adequately exposed to planning or managing the overall SCAT program. Most SCAT tools are oriented towards field work, or focus only on single components of the SCAT process (e.g. treatment recommendations, endpoints). Comprehensive guidance that unites the elements of planning for SCAT, that highlights timing, integration into ICS and best management practices has previously not been available. The Northwest Area Committee (NWAC) in the Pacific Northwest region of the United States created a SCAT Task Force in 2012, comprised of Federal and State agencies, industry and experienced consultants, to develop “smarter” checklists and innovative tools that assist responders from “pre-SCAT” activities through the Treatment Endpoints and Sign Off process, within the ICS framework. Through a collaborative process, this Task Force developed a suite of unique products designed to guide new and less experienced responders to walk through the process of establishing a comprehensive SCAT program and empower them with best practices learned over many years of spill response experience, including those gleaned from some of the larger responses around the United States in the last ten years. This paper will describe this NWAC suite

of SCAT checklists and products in greater detail, and describe how they might be used in other regions to help less experienced responders expedite their working knowledge in performing the range of SCAT program tasks, responsibilities and functions.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1298
Accessed 11/8/2014.

**Pasquevich, M. Y., M. S. Dreon, J. N. Gutierrez Rivera, C. Vásquez Boucard, H. Heras.** 2013. Effect of Crude Oil Petroleum Hydrocarbons on Protein Expression of the Prawn *Macrobrachium borellii*. *Comparative Biochemistry and Physiology* 157: 390-396.
**Keywords:** Biomarkers/ Crustacean/ Protein differential expression/ Hydrocarbon pollution/ Proteome
**Abstract:** Hydrocarbon pollution is a major environmental threat to ecosystems in marine and freshwater environments, but its toxicological effect on aquatic organisms remains little studied. A proteomic approach was used to analyze the effect of a freshwater oil spill on the prawn *Macrobrachium borellii*. To this aim, proteins were extracted from midgut gland (hepatopancreas) of male and female prawns exposed 7 days to a sublethal concentration (0.6 ppm) of water-soluble fraction of crude oil (WSF). Exposure to WSF induced responses at the protein expression level. Two-dimensional gel electrophoresis (2-DE) revealed 10 protein spots that were differentially expressed by WSF exposure. Seven proteins were identified using MS/MS and *de novo* sequencing. Nm23 oncoprotein, arginine methyltransferase, fatty aldehyde dehydrogenase and glutathione S-transferase were down-regulated, whereas two glyceraldehyde-3-phosphate dehydrogenase isoforms and a lipocalin-like crustacyanin (CTC) were up-regulated after WSF exposure. CTC mRNA levels were further analyzed by quantitative real-time PCR showing an increased expression after WSF exposure. The proteins identified are involved in carbohydrate and amino acid metabolism, detoxification, transport of hydrophobic molecules and cellular homeostasis among others. These results provide evidence for better understanding the toxic mechanisms of hydrocarbons. Moreover, some of these differentially expressed proteins would be employed as potential novel biomarkers.
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**Pearson, W. H. and J. R. Skalski.** 2010. Factors Affecting Stranding of Juvenile Salmonids by Wakes from Ship Passage in the Lower Columbia River. *School of Aquatic & Fishery Sciences, University of Washington* 27:926-936.
**Keywords:** stranding/ deep-draft vessels/ juvenile salmonids/ wakes/ Lower Columbia River/ vessel traffic/
**Abstract:** The effects of deep-draft vessel traffic in confined riverine channels on shorelines and fish are of widespread concern. In the Pacific Northwest of the United States, wakes and subsequent beach run-up from ships transiting the Lower Columbia River have been observed to strand juvenile salmon and other fish. As part of a before-and-after study to assess stranding effects that may be associated with channel deepening, we measured 19 variables from observations of 126 vessel passages at three low-slope beaches and used multiple logistic regression to discern the significant factors influencing the frequency of stranding. Subyearling Chinook salmon were 82% of the fish stranded over all sites and seasons. Given a low-slope beach, stranding

frequencies for juvenile salmon were significantly related to river location, salmon density in the shallows, a proxy for ship kinetic energy, tidal height and two interactions. The beach types selected for our study do not include all the beach types along the Lower Columbia River so that the stranding probabilities described here cannot be extrapolated river-wide. A more sophisticated modelling effort, informed by additional field data, is needed to assess salmon losses by stranding for the entire lower river. Such modelling needs to include river-scale factors such as beach type, berms, proximity to navigation channel, and perhaps, proximity to tributaries that act as sources of outmigrating juvenile salmon. At both river and beach scales, no one factor produces stranding; rather interactions among several conditions produce a stranding event and give stranding its episodic nature.
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**Pettit, Don J., Steven M. Jett, and Jeff Christensen.** 2011. New Tools Simplify Oil Spill Response Mapping in Oregon and Highlight the Need for National Standards. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs123.
**Keywords:** Geographic Response Plans (GRPs)/ oil spill response mapping/ oil spill response planning/ oil spill response preparedness/
**Abstract:** The Oregon Department of Environmental Quality (DEQ) was an early leader in developing some of the first Oil Spill Response Plans in the Pacific Northwest, dating back to the mid-1970s. Early work culminated in the development of Geographic Response Plans (GRPs) for the Oregon Coast and major estuary systems. However, since their development in the mid-1990s, the GRPs have not been significantly updated due to a lack of resources to overcome technological hurdles and shortages of field and office personnel. Additionally, the collection of natural resource data used for plan development has lagged in Oregon. Improvements in GIS technology have made it possible for Oregon to create a state-wide platform for emergency response information (the Oregon Incident Response Information System or OR-IRIS), which can also serve as an information base for the development and revision of GRPs. With the ESRI file geodatabase as the repository for useful legacy data and newly collected geographic information, the process to create and maintain GRPs has been substantially simplified, and the required resources have been reduced. However, with these changes in the ability to store large amounts of data comes the need to organize and streamline output. The Deepwater Horizon Spill presented a unique challenge to quickly gather, process and utilize vast amounts of geographic data to satisfy response planning needs within the Gulf of Mexico response, and highlighted the need for coordinated and organized GIS services to responders. The time is now to develop regional or national GRP production templates utilizing a common spatial database structure and common map symbology, thus assuring that incident mapping needs are able to be met when a large spill such as a Spill of National Significance, or a spill which crosses state boundaries, draws multi-agency, multi-state or regional personnel to a response.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-123 Accessed 11/9/2014.

**Pietsch, T. W., and J. W. Orr.** In Press. Fishes of the Salish Sea: A Compilation and Distributional Analysis. NOAA Professional Paper NMFS 00, U.S. Department of Commerce, 313 pp.
**Keywords:**
**Abstract:**
**Web Address:** Please contact islandersforsafeshipping@gmail.com

**Pope, Gary., Kimberly Gordon, James Bragg.** 2011. Using Fundamental Practices to Explain Field Observations Twenty-One Years after the *Exxon Valdez* Oil Spill. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs214.
**Keywords:** PAH/ Polycyclic Aromatic Hydrocarbon/ oil persistence/ subsurface oils/
**Abstract:** Fundamental principles and tools of groundwater flow and mass transport were used to explain: (1) how oil penetrated subsurface shoreline sediments, (2) why, initially, most of it was washed out by tides and occasional storms, and (3) why some residual oil still persists in small, isolated lenses of subsurface sediments on less than 1% of Prince William Sound (PWS) shorelines twenty-one years after the spill. The potential ecological impact of this remaining residual oil has been a concern and it has been extensively studied for this reason. Within the subsurface of impacted shorelines, extreme sediment heterogeneity exists. Where residual oil persists, it is associated with fine-grained sediments that are 100 to 1000 times less permeable than surrounding sediments. Consequently, water flow velocities through these lenses are low resulting in slower natural attenuation of entrained residual oil than in the surrounding, more permeable, sediments. These low water velocities control the bioavailability and degradation state of the residual oil and specifically the concentrations of the Polycyclic Aromatic Hydrocarbon (PAH) in the oil which are the components of greatest ecological concern. Recent measurements of aqueous PAH concentrations in near-shore waters are comparable to background levels even along shorelines identified with the most subsurface residual oil. To understand this and other observations, laboratory experiments and field simulations were conducted. Column experiments performed using field-collected PWS oiled sediments show that the aqueous PAH solubility is extremely low. Three-dimensional simulations of two well-characterized sites with the most remaining subsurface residual oil show limited contact of groundwater with the oiled sediments and rapid dilution of dissolved PAH through tidal infiltration to near background concentrations. Aqueous solubility data measured from the column experiments using sediment from these two sites were essential data in these simulations. Principles and methods used in this study also apply to other sedimentary sites with subsurface non-aqueous phase liquids and provide a useful guide to study and understand such sites in a more complete and quantitative way than previously published studies.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-214 Accessed 11/9/2014.

**Preble, Kristen., Bradford Benggio.** 2014. MANAGING THE RESOURCE CONSULTATION PROCESS: A CASE STUDY FROM THE JIREH GROUNDING

RESPONSE. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 686-696.
**Keywords:** Endangered Species Act/ Magnuson-Stevens Fishery Conservation and Management Act/ National Historic Preservation Act/ Natural Resources Damage/ spill planning/ spill preparedness/
**Abstract:** The grounding of the 202-foot freight vessel JIREH, which occurred on June 21, 2012 on the Mona Island Natural Reserve in Puerto Rico, triggered a three month long response in what is arguably the most environmentally sensitive location in Puerto Rico and much of the Caribbean. Prior to, during, and after the response, the Federal On-Scene Coordinator worked closely with United States Government and Commonwealth of Puerto Rico agencies to ensure all natural and historic resource consultation mandates required under Federal law were initiated properly. This paper explores how the Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, and National Historic Preservation Act consultation requirements were applied before the JIREH response through development of the Puerto Rico and U.S. Virgin Islands Area Contingency Plan, during the response through multiple informal Emergency Consultations, and post-response through Formal Consultations. This examination will serve to highlight, through the lens of the JIREH response, the complexities of pre-planning for resource consultations, the challenges experienced by the Federal On-Scene Coordinator during an event, and provide recommendations to ensure resource consultation requirements are applied consistently and transparently in the future.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.686
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**Purnell, Karen., Ann Zhang.** 2014. What Makes a Good Response?. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1408-1419.
**Keywords:** communications/ spill response/ spill response planning/
**Abstract:** What defines a successful response to an incident? Is it dependent upon satisfying potential critics; does it depend on money saved or received in compensation; is it defined by avoiding or mitigating pollution damage; or is it all of the above? Once an incident has occurred the success or otherwise of the response can be predicted based on relatively few key variables. In this paper. For example:

1. Preparedness & Training – i.e. the extent to which a country is prepared for an incident and whether the roles and responsibilities of individuals expected to be involved in the response are clearly defined.
2. Location of the incident – i.e. the country, the culture and reaction to the incident; whether it has occurred off-shore or near-shore etc.
3. Port of Refuge – i.e. whether or not a clear process for dealing with a casualty is pre-established.
4. Trust & Respect – i.e. the extent to which trust exists between the various parties involved in an incident and the level of knowledge and expertise needed to engender respect.
5. Co-operation – i.e. the extent to which parties are willing to co-operate and work together; the degree of realism about what can be achieved, and the level of confidence exhibited by those with ultimate responsibility.

6. Communication – i.e. the effectiveness of the command structure and the lines of communication between parties; willingness to communicate.
7. Cost-control/accountability – i.e. attitude towards cost control and effective use of resources.
8. Compensation – i.e. whether adequate systems are in place to compensate victims of oil pollution damage promptly and fairly; compensation versus punitive fines.
9. 3 Ps (Politicians, Press, Public) – i.e. the degree to which these are allowed to drive the response.
10. Willingness to Learn – i.e. the extent to which past incidents are used to inform potential future incidents; realism during exercises and debriefs.

This paper will draw upon incidents that ITOPF has attended in its 45 year history to identify patterns of behaviour and the degree to which these variables can influence the outcome of a response. Recognition of the relative importance of these variables ought to form the basis of learning in order to improve the chances of a positive outcome in future incidents.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1408
Accessed 11/9/2014.

**Ratliff, Cameron,. Jordan Gentry, Sharon Schmalz, Kevin Hartke, Karen E. Russell, Mark Acierno, J. Jill Heatley.** 2014. Saving Lives: Critical Blood Analytes for Rehabilitation of Coastal Birds. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 408-416.
**Keywords:** analytes/ avian/ avain deaths in oil spills/ birds/ blood analytes/ oiled wildlife/ water birds/
**Abstract:** Coastal bird species are often affected by oil spills and can suffer damage to the kidneys, adrenal glands, salt glands, and gastrointestinal tract. Although hypothermia is often touted as the proximate cause of avian death in oil spill events, birds can ultimately succumb to these petroleum product-related injuries based on blood electrolyte and acid-base abnormalities caused by multiple organ dysfunction. However detection and treatment of these analyte abnormalities remains challenging because we know little of the nature of analytes in the healthy water bird. Blood samples were obtained from free living and rehabilitated healthy Mottled ducks (*Anas fulvigula)*, Black-bellied whistling ducks *(Dendrocygna autumnalis),* Yellow-Crowned Night Herons *(Nyctanassa violacea)* and Brown Pelicans *(Pelecanus occidentalis)* from 2008–2012. Blood gas, electrolyte, and select biochemical and hematological parameters were determined in the field with a patient side analyzer while complete blood counts, packed cell volumes and osmolalities were determined by standard laboratory methods. Reference intervals and 95% confidence intervals were determined and the effect of age, sex, body condition, time and date of sampling were also assessed for all analytes. Species, lifestyle, environment, and diet all appear to have an effect on “normal” electrolyte and acid base analytes in coastal birds. An increased plasticity of and tolerance to change in blood analytes may be a normal finding in these species which may facilitate care in the response setting. The reference intervals of apparently healthy coastal birds differed from mammalian values in some instances, however these intervals will assist in the appropriate diagnosis and treatment of these species in

rehabilitation and oil spill response. These values can be used to assist biologists, rehabilitators and veterinarians in assessment, management and treatment of avian species in the event of environmental disturbance, such as oil spill, draught, or tropical storm as well as to assess overall ecosystem health via coastal birds as indicator species.
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**Russell, M., J. Holcomb, A. Berkner.** 2003. 30-Years of oiled wildlife response statistics. Proceedings of the 7th International Effects of Oil on Wildlife Conference. International Bird Rescue Research Center (IBRRC), 14–16 October 2003 Hamburg, Germany.
**Keywords:** Bird Oil Spill Response/ Rescue/ Rehabilitation/ veterinary protocols/ release rates/ cost effective responses
**Abstract:** International Bird Rescue Research Center (IBRRC) has responded to and managed the rehabilitation programs in over 150 oil spills and thousands of individual oiled animals during the last thirty-three years.
In the past, wildlife biologists and professional from other fields have discussed the release rates of rehab, efforts without mention of the many variables that contribute to mortality. IBRRC has worked since its inception to develop oiled and non-oiled wildlife, capture, rehabilitation and veterinary protocols to improve the field of oiled wildlife rehabilitation. As new advancements were made and then applied, significantly higher release rates and more efficient, timely and cost effective responses were experienced. This paper will analyze the last thirty years of oil spill statistics from oil spills that IBRRC has responded to and how new protocols were applied which improved release rates.
**Web Address:** http://bird-rescue.org/media/22154/30-years-oiled-wildlife-response-statistics-research-ibr-paper.pdf Accessed 11/9/2014.

**Ryzhik, I. V.** 2012. The Metabolic Activity of Cells of *Fucus vesiculosus* Linnaeus, 1753 (Phaeophyta: Fucals) from the Barents Sea under Conditions of Oil Pollution. *Russian Journal of Marine Biology* 38(1): 96-99.
**Keywords:** metabolic activity/ *Fucus vesiculosus*/ oil pollution/
**Abstract:** The metabolic activity of cells of brown seaweed was studied. The metabolic activity of cells of *F. vesiculosus* increased in an oil-polluted environment. The period of formation of the response to the addition of a toxicant depends on conditions in the algal habitat. Metabolic activity increased during several minutes in samples that were taken from a clean area and on the third day of exposure in samples from an oil-polluted area. The level of metabolic activity of cells of *F. vesiculosus* can be used as an indicator of the presence of stress factors in the algal habitat.
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**Salt, David., Rob Cox, Marty Cramer, Dave Davidson.** 2014. Oil Spill Preparedness Response Capability and Capacity: Do we know what we want and how do we get what we need?. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1869-1880.
**Keywords:** response capability and capacity/ spill response planning/

**Abstract:** The oil industry has relied on the tiered response structure for over forty years to meet its oil spill response and preparedness needs. Over this time there have been significant changes in the oil spill threat potential and the expectations of stakeholders and regulators in respect of what represents acceptable levels of response preparedness and planning. Many of the existing Tier 2 and Tier 3 response equipment bases were developed based on the perceived threat from oil tanker spills, however the following decade saw rapid expansion of offshore exploration and production and the advent of using FPSOs and FSOs to enable rapid development of oil production facilities with limited shore support & infrastructure. The recent offshore incidents in Australia, UK and United States have altered perspectives on spill response and preparedness requirements, in particular in response to offshore operations. Many OSROs have changed little since their inception and the response arrangements have remained fixed to the original design criteria, in spite of changes in their operating and risk environment. Through the OGP-IPIECA Joint Industry Project on Oil Spill Response, an OSRO capability assessment tool has been developed based on the assessment protocols commonly used in military and defence operations, known as "Capability Management" frameworks. In a Capability Management framework, the interlinking functions and activities of an enterprise may be defined under several best-practice paradigms or frameworks, such as the Balanced Scorecard (BSC), the US Department of Defence Architecture Framework (DoDAF), the Ministry of Defence Architecture Framework (MODAF), and many other similar systems. The UK Ministry of Defence uses a similar breakdown of Defence Lines of Development (DLoDs) encompassing Training, Equipment, Personnel, Information, Concepts and Doctrine, Organisation, Infrastructure, and Logistics, known by the acronym **"**Tepidoil". The assessment protocol described in this paper uses the "Tepidoil" methodology, modified for use in an oil spill response context with the addition of a safety component to enable assessment of Tier 2 (and possibly Tier 3) facilities. The purpose of this work was to develop a comprehensive and objective tool that can be used by industry members to ensure that OSRO facilities have the resources and infrastructure to address their current risk profile. In addition, it can potentially be modified for use as an OSRO "self-assessment" tool. The assessment criteria include:

- Training
- Equipment
- Personnel
- Infrastructure
- Doctrine – translates into Response Philosophy
- Organization
- Information
- Logistics
- Safety

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**Sanpera, C., S. Valladares, R. Moreno, X. Ruiz, L. Jover.** 2008. Assessing the effects of the Prestige oil spill on the European shag (*Phalacrocorax aristotelis*): Trace

elements and stable isotopes. Science of the Total Environment. Vol. 407, pp. 242-249. ISBN 0048-9697.
**Keywords:** Prestige oil spill/ Shag seabirds/ oil pollution/
**Abstract:** The Prestige oil spill resulted in the mortality of several seabird species on the Atlantic NW coast of Spain. Shag casualties were particularly relevant, since populations are resident in the area the whole year round and because of several features which make them highly vulnerable to environmental hazards. Ecological catastrophes give us the opportunity of collecting samples which, otherwise, would be difficult to obtain. We examine the potential of shag corpses as bioindicators of inorganic pollution and the possible factors of variability, such as biological traits (sex, age) or nutrition status. We determined trace elements (Hg, Se, Cr, Pb, Zn and Cu) and isotopic signatures ((15)N, (13)C) in soft tissues (muscle, liver) and in primary feathers formed at different times (before and after the Prestige) in individuals of known sex and age, collected at the time of the Prestige disaster. These were compared with data from another group of shags trapped accidentally in fishing gear in 2005. Our results did not seem to be affected by sex or age on any of the analysed variables. The higher nitrogen isotopic signatures in the soft tissues of the Prestige shags may be related to the nutrition stress caused by a poorer body condition, which is also reflected in increasing levels of some metals in the liver. This isotopic enrichment was also observed in newly forming feathers when compared to the old ones. On the other hand, the lower delta(15)N and Hg values in shag feathers from 2005 point to a shift in feeding resources to prey of lower trophic levels. We found that feather features (being an inert tissue and having a conservative composition), if combined with careful dating and chemical analysis, offer a very useful tool to evaluate temporal and spatial changes in seabird ecology in relation to pollution events.
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**Schweigert, Jacob F., J. L. Boldt, L. Flostrand, and J. S. Cleary.** 2010. A Review of Factors Limiting Recovery of Pacific Herring Stocks in Canada. *ICES Journal of Marine Science*, 67: 1903-1913.
**Keywords:** bottom-up/ collapse/ competition/ Pacific herring/ recovery/ top-down/
**Abstract:** On the west coast of Canada, Pacific herring (Clupea pallasi) supported an intensive reduction fishery from the early 1930s until the collapse of all five major stocks in the late 1960s, which then recovered rapidly following a fishery closure. Despite conservative harvests, abundance has declined again recently, with little evidence of recovery. We investigated the effect of bottom-up forcing by zooplankton abundance, top-down forcing by fish and mammal predators, and the effects of sardine abundance as potential competitors on the natural mortality of the herring stock on the west coast of Vancouver Island. Herring mortality was positively related to Thysanoessa spinifera and southern chaetognaths and negatively to pteropod abundance. Estimated predation on herring decreased significantly during the years 1973–2008, with the main consumers changing from fish to mammals. However, the correlation with herring mortality was negative, whereas there was a significant positive relationship with sardine abundance. Population recovery is expected to be facilitated by a combination of factors, including adequate food supply, limited or reduced predation (including fishing), and limited

competition particularly for wasp–waist systems, where different forage species may occupy similar niches.
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**Short, F.T. and S. Wyllie-Echeverria.** 1996. Natural and human induced disturbance in seagrasses. Environmental Conservation 23:17–27.
**Keywords:** Seagrass/ Disturbance/ Marine/ Pollution/ Macrophyte/ Eutrophication/ Die-off/
**Summary:** Many natural and human-induced events create disturbances in seagrasses throughout the world, but quantifying losses of habitat is only beginning. Over the last decade, 90,000 ha of seagrass loss have been documented although the actual area lost is certainly greater. Seagrasses, an assemblage of marine flowering plant species, are valuable structural and functional components of coastal ecosystems and are currently experiencing world-wide decline. This group of plants is known to support a complex trophic food web and a detritus-based food chain, as well as to provide sediment and nutrient filtration, sediment stabilization, and breeding and nursery areas for finfish and shellfish.
We define disturbance, natural or human-induced, as any event that measurably alters resources available to seagrasses so that a plant response is induced that results in degradation or loss. Applying this definition, we find a common thread in many seemingly unrelated seagrass investigations. We review reports of seagrass loss from both published and 'grey' literature and evaluate the types of disturbances that have caused seagrass decline and disappearance. Almost certainly more seagrass has been lost globally than has been documented or even observed, but the lack of comprehensive monitoring and seagrass mapping makes an assessment of true loss of this resource impossible to determine.
Natural disturbances that are most commonly responsible for seagrass loss include hurricanes, earthquakes, disease, and grazing by herbivores. Human activities most affecting seagrasses are those which alter water quality or clarity: nutrient and sediment loading from runoff and sewage disposal, dredging and filling, pollution, upland development, and certain fishing practices. Seagrasses depend on an adequate degree of water clarity to sustain productivity in their submerged environment. Although natural events have been responsible for both large-scale and local losses of seagrass habitat, our evaluation suggests that human population expansion is now the most serious cause of seagrass habitat loss, and specifically that increasing anthropogenic inputs to the coastal oceans are primarily responsible for the world-wide decline in seagrasses.
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**Short, Michael.** 2011. Pacific Adventurer Oil Spill: Big Birds, Sea Snakes and a Couple of Turtles. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs207.
**Keywords:** aquatic birds/ marine reptiles/ mobile response capability/ oiled wildlife/ sea turtles
**Abstract:** On the 11th March 2009 the vessel Pacific Adventurer lost 600 tonne of ammonium nitrate and about 270 tonne of heavy fuel oil 7 nautical miles east of

Moreton Island, Queensland Australia. Seventy five kilometres of habitat were oiled and this included Sunshine Coast beaches, Bribie Island and Moreton island foreshores and coastal wetlands. The incident resulted in a Disaster Declaration being imposed under emergency legislation. Oiled wildlife contingency planning systems were escalated and this activated the mobilisation of response personnel and mobile equipment resources state wide. The oiled wildlife response was integrated directly into the overall oil spill response and this operationally was an important feature. Over 20,000 aquatic birds were observed in the areas adjacent to the oil spill. Less than 100 of these birds were oiled and only 13 Australian Pelicans (*Pelecanus conspicillatus*); 1 Lesser Crested Tern (*Sterna bengalensis*) (*Sterna bengalensis*); 1 wedge tailed shearwater (*Puffinus pacificus*); and 1 sacred Kingfisher (*Todiramphus sanctus*) were responded too. Two oiled sea snakes were collected and taken into captive care. Two green sea turtles (*Chelonia mydas*) were also oiled but were suffering from health issues independent of the spill that contributed to their oiling. Only one bird and two sea snakes were confirmed as most likely to have died as a result of the spill event. Working with large birds such as Pelicans, sea snakes and turtles does create specialised requirements. The wildlife response although small did effectively utilise a mobile system of equipment to establish a high response capability. For Queensland a mobile response capability, given the frequency and type of spill events over the last 18 years, has shown to be an effective approach. This response also highlighted the importance of having a response capability for dealing with non avian fauna including marine reptiles.
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**Shupe, Danielle., Gary Ott, Kristen Preble.** 204. Evaluating Place of Refuge Risk in the Chesapeake Bay. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 814-824.
**Keywords:** oil spill risk analysis/ Place of Refuge/ spill planning/ spill preparedness/
**Abstract:** Worldwide, several tank ships have suffered structural failures at sea and shipping agents were unable to convince port stakeholders to provide the vessel a Place of Refuge. These situations resulted in catastrophic environmental damage to coastal states. They also highlighted the need for better Place of Refuge guidance to address both real and perceived risk within the port community. In coordination with the International Maritime Organization and the National Response Team, the U.S. Coast Guard established policies that encourage risk-based planning and decision-making to assist stakeholders in evaluating risks. The Coast Guard policy included a risk evaluation job aid to facilitate planning and serve as a response tool for a port faced with a Place of Refuge request from a stricken vessel. The Port Community of Hampton Roads continued this planning effort through the Area Committee. A “Steering Committee” was established and charged with drafting a Place of Refuge annex to the Virginia Area Contingency Plan. Port Community involvement was achieved through a series of workshops held by the Steering Committee. The workshop objectives were successfully met by reviewing historic local case studies, identifying critical stakeholders and working through the Places of Refuge process using the job aid. The Place of Refuge annex outlines the process used to communicate risk to stakeholders within the human health and safety, environmental and economic communities, with the goal of

achieving consensus on a Place of Refuge decision. This paper will expand on the steps that led to the development of the Place of Refuge Plan and some of the key lessons learned regarding risk assessment and risk communication in the Port of Hampton Roads.
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Accessed 11/8/2014.

**Silliman, Benjamin Douglas.** 2014. Guidelines to Prepare for Oil Sands Product Spills in Varied Aquatic Environments. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 426-433.
**Keywords:** bitumen/ diluted bitumen/ oil sands/ recovery equipment/ spill preparedness/ spill response/ spill planning/ submerged oils/
**Abstract:** On July 24, 2007, the Westridge Transfer Line in Burnaby, British Columbia, ruptured spilling 1,400 barrels of oil sands product into the area's storm water systems and eventually into the Burrard Inlet at Vancouver Harbor. The response to this spill was considered successful and there is no record of oil sinking. Several years later, in July of 2010, the Line 6B pipeline operated by Enbridge Energy Partners LLP ruptured spilling 20,082 barrels of oil sands product into the Kalamazoo River. In contrast to the Burnaby spill, this response was extremely difficult due to the sinking of large quantities of oil. The variance in fate and behavior of the oil sands products in these two spills demonstrates how environmental factors can result in different response challenges. Many environmental factors affect the fate of spilled oil sands products in aquatic environments because bitumen, a large component of oil sands products, has a density greater than freshwater. By analyzing specific factors in areas at risk, responders can better prepare for, and expect, submergence in oil sands product spills. Areas identified to have low salinity, rough sedimentation, high turbidity, strong sunlight exposure, high temperatures, and strong currents have a high risk of submergence. Response teams in these areas of high risk should have submerged oil recovery equipment readily available for rapid deployment.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.426
Accessed 11/3/2014.

**Skinner, L. and S. Sweeney.** 2012. The Impacts of Tar Sands Pipeline Spills on Employment and the Economy. A report by Cornell University Global Labor Institute.
**Keywords:** economic oil spill impacts/ employment oil spill impacts/ Kalamazoo River pipeline oil spill/ tar sands oil spills/
**Abstract:** This report examines the potentially negative impacts of tar sands oil spills on employment and the economy. It draws attention to economic sectors at risk from a tar sands pipeline spill, particularly in the six states along Keystone XL's proposed route—Montana, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. This report also shows how Michigan's Kalamazoo River spill in 2010—to date the largest tar sands oil spill in the U.S.—caused significant economic damage and negatively impacted the quality of life of local communities. The information was collected from employment and economic data in the pipeline states, as well as from interviews with businesspeople, landowners, farmers, and ranchers who live and work along the proposed route for the Keystone XL or near the Kalamazoo River oil spill.

**Web Address:** https://www.ilr.cornell.edu/sites/ilr.cornell.edu/files/GLI_Impact-of-Tar-Sands-Pipeline-Spills.pdf Accessed 12/8/2014.

**Slabbekoorn, H., N. Bouton, I. van Opzeeland, A. Coers, C. ten Cate, and A. N. Popper.** 2010. A Noisy Spring: The Impact of Globally Rising Underwater Sound Levels on Fish. *Trends in Ecology and Evolution* 25(7):419-427.
**Keywords:** fish survival and reproduction impacts/ underwater noise/ vessel noise/
**Abstract:** The underwater environment is filled with biotic and abiotic sounds, many of which can be important for the survival and reproduction of fish. Over the last century, human activities in and near the water have increasingly added artificial sounds to this environment. Very loud sounds of relatively short exposure, such as those produced during pile driving, can harm nearby fish. However, more moderate underwater noises of longer duration, such as those produced by vessels, could potentially impact much larger areas, and involve much larger numbers of fish. Here we call attention to the urgent need to study the role of sound in the lives of fish and to develop a better understanding of the ecological impact of anthropogenic noise.
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**Snyder, R., Williams, D.R., and Peterson, G.P.** 2003. Culture loss and sense of place in resource valuation: economics, anthropology, and indigenous cultures. in: S. Jentoft, H. Minde, R. Nilsen (Eds.) Indigenous peoples: resource management and global rights. Eburon, Delft, The Netherlands; 2003
**Keywords:** culture loss/ environmental resource damage assessment (ERDA)/ resource valuation/
**Abstract:** Past attempts by economists and anthropologists to conceptualize and value culture loss suggest that greater effort is needed to open up new dialogues that recognize the perspectives of all actors present in resource valuation processes. Economic methods employed to value social and material goods associated with indigenous peoples' "sense of place" in the Arctic region develop only a portion of a more holistic problem of resource valuation for indigenous peoples practicing subsistence based livelihoods. Anthropological approaches to culture loss and valuation attempt a more holistic understanding a indigenous peoples' sense of place, highlighting the uneven power relations embedded in the politics of resource valuation. These issues are discussed in the context of economic efforts to conduct an environmental resource damage assessment (ERDA) of the Exxon-Valdez oil spill for value of the losses suffered by indigenous cultures affected by the spill.
**Web Address:**
http://www.fs.fed.us/rm/value/docs/culture_sense_place_resource_valuation.pdf
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**Spikkerud, Catherine., Geir Morten Skeie, Urban Williams, Robert Farestveit.** 2011. From Quantitative Risk and Oil Spill Assessment to Strategic Environmental Oil Spill Response Plan. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs243.
**Keywords:** environmental risk assessment/ oil spill response planning/ oil spill response preparedness/

**Abstract:** Reducing the consequences for the environment is the main purpose of oil spill response. In many areas of the world, there is a wealth of information on vulnerable resources. Combining this with sophisticated tools for oil drift simulations and environmental damage assessment allows quantitative risk assessments to be transformed to an oil strategic oil response plan that can be used to manage a range of possible outcomes of an oil release scenario, but there is a challenge when all the data generated through these analyses are to be used in practical oil spill response plans. This paper presents how the results from a tiered, systematic and integrated environmental risk assessment can be translated into a strategic environmental oil spill response plan, including net environmental benefit assessments of alternative strategies and priorities. The approach is presented through a case study from the drilling of an exploration well on the Norwegian Continental Shelf (NCS).
Geographical areas of resources exposed to a potential for environmental damage are identified from the environmental risk assessment. For these areas, arrival times, quantities and properties of oil emulsion for individual scenarios are defined. For selected areas of high potential impact and/or risk, sensitive resources and ecosystem components are mapped and described in terms of geographical and temporal presence. For each component, potential impact mechanisms are identified, and response strategies for protection and restoration are specified. This information is then linked back to the assessment of alternative combat strategies, evaluating both chemical and mechanical combat methods, and resulting in a detailed response plan. For the selected geographical areas, spatial information is presented, including geotagged photos of sites, areas and shoreline segments of relevance to oil spill response. Additional relevant information is presented in combination of textual and graphical formats. This information is structured in a way to be applicable in the preparation of oil spill response plans for other activities.
The results from this approach provides the operator with a comprehensive basis for response planning, as well as a documented support for decisions on measures and priorities in an oil spill incident.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-243
Accessed 11/9/2014.

**Stronach, James A., Aurelien Hospital.** 2014. Simulating the Behaviour and Fate of an Oil Spill Using a Coupled Three-Dimensional Hydrodynamic Model. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 901-918.
**Keywords:** hydrodynamic/ oil spill fate and transport modeling/ three-dimensional model/ spill modeling/ spill planning/ spill preparedness/
**Abstract:** Oil behavior and fate have been simulated extensively by several spill models. These simulations can be greatly enhanced by the use of a coupled three-dimensional model of currents and water properties to determine oil transport and weathering, both on the water surface and in the water column. Several physical and chemical processes such as vertical dispersion in response to wave action, resurfacing when waves die down, sinking through loss of volatiles and dissolution are essential in assessing the impact of an oil spill on the environment. Dissolution is especially important, considering the known toxicity of several of the constituents of liquid hydrocarbons. For this study, a three-dimensional hydrodynamic model of coastal

British Columbia was coupled to an oil trajectory and weathering model in order to simulate the complete fate and behaviour of surface, shoreline-retained, dissolved, sunken and dispersed oil. Utilization of a three-dimensional model is the key to adequately modelling the transport of a spill in an estuarine region such as in the Strait of Georgia, B.C., where the distribution of currents and water properties is strongly affected by estuarine processes: the Fraser River enters at the surface and oceanic waters from the Pacific enter as a deep inflow.
Three-dimensional currents and water properties were provided by the hydrodynamic model, H3D, a semi-implicit model using a staggered Arakawa grid and variable number of layers in the vertical direction to resolve near-surface processes. Waves were simulated using the wave model SWAN. Winds were obtained from the local network of coastal light stations and wind buoys. Stochastic modelling was conducted first, using only surface currents, to determine probabilistic maps of the oil trajectory on water and statistical results were extracted, such as the amount of shoreline oiled and the amount of oil evaporated, both for the ensemble of simulations constituting the stochastic simulation, as well as for any particular individual simulation. Deterministic scenarios were then selected and the fate of the oil, such as the dissolved and sunken fractions, was tracked over a 14 day period on the three-dimensional grid. This method has been used for environmental impact assessment and spill response planning.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.901
Accessed 11/8/2014.

**Tarpley, John., LTJG Alice Drury, Doug Helton.** 2014. Implementing Lessons Learned for NOAA's Emergency Response Division. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1420-1430.
**Keywords:** NOAA Emergency Response Division/ spill response planning/ spill response preparedness/
**Abstract:** NOAA's Office of Response and Restoration Emergency Response Division (ERD) is committed to continually improving their response capabilities to hazardous material releases that affect life, property and natural resources. One way of achieving this is by capturing and implementing Lessons Learned from spills and exercises. Following an incident, the ERD reviews their contributions and actions to an incident via an internal “Hotwash” using a standard template, followed by documenting the results in an incident-specific report. Twice a year the Lessons Learned Team (LLT) reviews all incident hotwash reports from the previous period and identifies specific action items to address issues/problems that arose during the recent spill responses. The LLT reviews the action items and assigns a rating for importance, difficulty to implement, and time it would take to implement. These action items are also rated on their importance to improving the overall effectiveness of the ERD to respond to spills. The LLT generates an evaluation report of action items, which is submitted to the ERD's management for determination of whether these action items will be pursued, and if so, how assigned. Health and safety items are implemented immediately. Other items are incorporated into the ERD's Operational Plan and assigned a lead and due date, generally within six months to one year. Using this process has increased confidence in staff that the division has the capability to capture significant issues, effectively manage corrective

actions into direct implementation, and improve response products and support capabilities.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1420
Accessed 11/8/2014.

**Tarpley, John., Jacqueline Michel, Scott Zengel, Nicolle Rutherford, Carl Childs, Frank Csulak.** 2014. Best Practices for Shoreline Cleanup and Assessment Technique (SCAT) from Recent Incidents. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1281-1297.
**Keywords:** natural resource damage/ oiled shoreline/ SCAT/ shoreline cleanup/ Shoreline Cleanup and Assessment Technique/
**Abstract:** The Shoreline Cleanup and Assessment Technique (SCAT) process, from initial reconnaissance, to generation of Shoreline Treatment Recommendations (STRs) and signoff, is an integral part of oil spill response operations. It is and should remain flexible and scalable based on spill conditions. Several challenging spill responses have contributed to the continuing evolution of the SCAT program. This review examines best practices and unique applications for the SCAT process, coordination within the Incident Command System (ICS), field implementation and tools, and data management. While the basic SCAT process remains the same, the detailed steps can vary greatly from spill to spill. STRs and incident specific forms may be required, additional review procedures for documents and shorelines may occur, endpoints and signoff can become extremely complex, intermediate plans may be generated to manage complexity, and various regulatory consultations may be necessary. Within the ICS, the SCAT program is typically part of the Environmental Unit under the Planning Section, but requires close coordination with the Operations Section. The use of SCAT- Operations Liaisons (both as having Operations on SCAT teams during surveys and as having SCAT team members work with Operations during actual cleanup) is a best practice to improve coordination and treatment effectiveness throughout the response. Field forms, data collection tools, and SCAT staff roles are evolving. The trials of electronic data collection with field computers continue; use of imagery, GPS, and GIS are ever increasing and necessary; and the roles and coordination of various types of field monitors/observers during cleanup operations need to be carefully defined. SCAT team members need to be well-trained, and field calibration should occur regularly within and among teams. SCAT data management now requires dedicated staff and computer data management systems in all but the smallest of spills. The need for high quality data, rapid analysis, and generation of useful products to a varied audience is becoming the expected standard. However, with these expectations come new procedures and specialized skills. QA/QC of field data is critical to all evaluations and products. Specialized databases have become robust enough to handle the most complex SCAT data and output requirements, and GIS tools can quickly generate a variety of necessary map products for multiple users. These functions require skills not found with typical SCAT field team members. In this paper, we will examine some of the recent advances and unique applications to the SCAT process.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1281
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**Thuring, Allen R..** 2014. Oil Spill Response Under the NCP and the NRF/Stafford Act - Incompatible Regimes?. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1050-1058.
**Keywords:** “Makris-Suiter” Agreement of 1998 between EPA and FEMA/ National Contingency Plan/ National Response Framework/ responsible party/
**Abstract:** This paper examines oil pollution response during disaster situations when the Stafford Act is invoked by the President and the National Response Framework provides funding under ESF-10.
The interrelationship between the National Contingency Plan (NCP), created by various pollution statues (Clean Water Act/CWA, Comprehensive Environmental Response, Compensation, and Liability/CERCLA, Oil Pollution Act/OPA) and the National Response Framework (NRF), created to deal with declared disasters under the Stafford Act, is becoming more fractious as time passes and the financial scope of disasters grows. The paradigm that existed when Hurricane Katrina made landfall in 2005 was not in evidence when Hurricanes Isaac and Sandy made landfall in the fall of 2012.
The NCP envisions oil and chemical spill response in the context of a single spill, ideally with a known responsible party (RP), who takes action to respond to the spill. That RP is liable for costs and damages resulting from the spill. Action commences when the spill occurs and the Federal On-Scene Coordinator (FOSC) determines that federal action is required. If the federal funds (Oil Spill Liability Trust Fund/OSLTF, CERCLA/SUPERFUND) are used, the federal government seeks cost recovery afterwards.
The NRF envisions the federal government acting like a “no-fault insurance” regime, providing federal resources/funds to states when their capabilities are overwhelmed and their citizens require immediate succor. FEMA action commences when the State requests and the President approves aid. The states agree to a cost share – not to exceed 25% of Federal funding. There is no private party liability when actions are complete.
The Homeland Security Act established the NRF, and operationally subsumes the NCP under it. However, the Homeland Security Act does not address what fund (Stafford or the pollution funds) will be used when a declared disaster occurs. Furthermore, the Stafford Act structure (State requests, Presidential approvals, Federal Emergency Management Agency Federal Coordinating Officer (FEMA FCO) appointment, area surveys, mission assignments) becomes sclerotic in a large incident when compared to the much more nimble NCP process (spill, FOSC decision, immediate funding). The effect for Coast Guard (CG) and Environmental Protection Agency (EPA) field responders is to lean forward with NCP processes to protect the public. FEMA, faced with dwindling resources, observes this tendency and declines to provide disaster funding when the other federal funds “can be used”.
The paper proposes a new paradigm for the “Makris-Suiter” Agreement of 1998 between EPA and FEMA.
The opinions stated in this paper are the author's alone, and do not reflect the official policies of the United States Coast Guard.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1050
Accessed 11/9/2014.

**Torlapati, Jagadish., Xiaolong Geng, Tom King, Michel Boufadel, Kenneth Lee.** 2014. Shoreline Bioremediation Model (SBM) - A Graphical User Interface for Simulating the Biodegradation of Beached Oil. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1099-1112.
**Keywords:** biodegradation/ oil spills/ graphical user interface/ GUI/ beach biodegradation/ shoreline contamination/
**Abstract:** We developed a user-friendly numerical model, Shoreline Bioremediation Model (SBM), to simulate the biodegradation and bioremediation of oil entrapped within shorelines. The model takes oil properties and environmental conditions as input and produces variation of oil concentration with time, up to several years from the time of the spill. SBM is equipped with a user-friendly graphical user interface (GUI). The accessibility and easy-to-use interface allow the user to quickly produce several biodegradation and bioremediation scenarios before they are implemented at the contaminated shoreline. The model has been calibrated to predict the biodegradation rate of saturates and aromatics, but it can be also used to predict the biodegradation rates of individual oil components and to decide on bioremediation studies in shorelines based on the enhancement due to biostimulation (addition of nutrients) or bioaugmentation (addition of hydrocarbon degrading organisms). The GUI provides the oil concentration with time along with best case and worst case scenarios, which is commonly needed for decision making.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1099 Accessed 11/8/2014.

**Venosa, Albert D., Pablo Campo, Makram T. Suidan.** 2011. Biodegradability of Lingering EVOS Oil 19 Years After the Spill. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs74.
**Keywords:** biodegradation/ EVOS/ Exxon Valdez Oil Spill/ geospatial survey/ oil spill/ oil weathering/
**Abstract:** In 2001 and 2003, NOAA scientists conducted geospatial surveys of lingering oil in Prince William Sound (PWS) and concluded areas were still contaminated with substantial subsurface oil from the 1989 Exxon *Valdez* oil spill (EVOS). In 2007, a mass weathering index (MWI) was developed by Exxon-Mobil consultants based on the degree of weathering of PAHs normalized to conserved biomarkers, suggesting that if the degree of weathering of oil is 70% or more, further attempts at bioremediation would be unjustified. The objective of our study was to measure the biodegradability and biodegradation rate of the 19-year lingering oil under conditions where nutrients and oxygen are not limiting. Samples of beach substrate were collected in the summer of 2008 from representative sites in PWS contaminated with oil residues of varying weathering states according to the MWI model. Enough sacrificial microcosms were set up to accommodate two treatments for each site (natural attenuation and biostimulation). Results indicated that lingering oil is still biodegradable. Nutrient addition significantly stimulated biodegradation ($p < 0.01$) compared to natural attenuation in all treatments regardless of the degree of weathering. Non-linear regression analyses were conducted to calculate first-order biodegradation rate coefficients. The most biodegradable oil was the one most weathered according to the MWI. A surprising finding was that substantial biodegradation occurred in the natural

attenuation microcosms due to the high Total Kjeldahl Nitrogen (TKN) content of the sediments. Most of the observed biodegradation in all microcosms was due to the presence of dissolved oxygen, absent in the field because of sequestration of the oil in low permeability sediment layers. Nitrogen was also a limiting factor but overshadowed by oxygen.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-74
Accessed 11/9/2014.

**Wadsworth, Tim.** 2014. Comparison and Assessment of Waste Generated during Oil Spills. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1647-1658.
**Keywords:** oiled shoreline/ spill cleanup waste/ spill response planning/ waste management/
**Abstract:** Experience has shown that the most time-consuming and costly component of a response to an oil spill is often the treatment or disposal of collected waste. The amount of waste generated is dependent on many factors, some which may be controlled more readily during the response.
This paper analyses a number of important incidents as a result of which spilled oil affected shoreline resources with significant resultant clean-up effort. Spills of crude oil and of heavy fuel oil carried as cargo in tankers are reviewed to determine the types and volumes of waste generated and the clean-up methods undertaken to generate that waste. A comparison of the incidents will allow the most effective response methods to be determined, to show the techniques that generated the least volumes of waste. Data from DEEPWATER HORIZON is included to allow a discussion of the associated response.
To achieve a practical comparison, the amount of waste is balanced against the amount of oil spilled to determine the oil:waste ratio. This ratio has evolved over many years into a long held guideline, used often for the purpose of contingency planning, that the amount of waste generated during an incident is approximately ten times the amount of oil spilled. This paper shows that with appropriate response actions, the guideline can be upheld.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1647
Accessed 11/8/2014.

**Walker, Ann Hayward.** 2011. Risk Communications during Response to Large Oil Spills. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs432.
**Keywords:** communications/ media/ oil spill risks/ oil spill response risks/ Risk Communications for Oil Spill Response/
**Abstract:** The National Response Team (NRT) issued a fact sheet on Risk Communications for Oil Spill Response in 1997, outlining important principles to guide the development of strategies during oil spill response. The fact sheet also notes that specific guidance on specific oil spill response techniques could be needed. Particularly on large oil spills which encompass a sizable geographic area, a multitude of stakeholders, including response workers, the media and the public, want to know about possible risks associated with the oil and the response techniques which are

implemented. While communications is typically a function of the Joint Information Center (JIC), risk communications requires substantial involvement and explanation by technical specialists. This presentation identifies the response techniques and related issues which could benefit from risk communications and the types of technical specialists who are appropriate to assess possible risks for those issues. The presentation also offers organizational suggestions for implementing a risk communication program within the Incident Command System during large oil spills.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-432
Accessed 11/9/2014.

**Walker, Ann Hayward., Ann Bostrom.** 2014. Stakeholder Engagement and Survey Tools for Oil Spill Response Options. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1149-1162.
**Keywords:** communications/ dispersant decision model/ dispersants/ dispersant use/ risk communication/
**Abstract:** Oil spill stakeholders, including decision makers and other groups, have expressed concerns about and questioned the use of dispersants and other non-mechanical response options for years. Concerns in past decades were primarily ecological, but during the Deepwater Horizon oil spill some individuals and communities in the Gulf of Mexico states also articulated perceptions of public health risks associated with the use of dispersants. Effective risk communication is essential to manage the potential risks associated with oil spills. Stakeholders concerned about risks want or need information in the form of communications products, such as guides or briefs. Because people process new information within the context of their existing beliefs, such communication products are likely to be more effective and useful for their intended audiences if they are designed to: (1) take into account the communication recipients' existing beliefs; and (2) directly address the decisions/judgments faced by recipients by providing them with the information they want and need to make those decisions. Stakeholder engagement is essential to learn about risk perceptions, to learn about what information stakeholders want and need to make decisions effectively, and to develop communication products to that end.
This paper builds upon a mental models approach to dispersant risk communications research from the 1990s. It describes and presents results from an industry-government collaborative project to develop risk-based tools designed to communicate the subject of dispersants to local level stakeholders among others. This project includes an expanded science-informed dispersant decision model, two stakeholder open houses, and two surveys (interactive and online) to gather data-driven insights about local stakeholder knowledge and understanding of dispersants, as well as their perceptions of the risks and benefits associated with dispersant use during a spill in relation to other response options. The surveys were distributed at two open houses for local stakeholders on the Eastern Shore of Virginia (Wallops Is.) and the Pacific Northwest (Port Townsend, WA). Both open houses were co-sponsored with USCG-led Area Committees. The Virginia workshop was also co-sponsored by The Nature Conservancy and the Virginia Shore Keeper. It is expected that the surveys may be incorporated into future meetings and open houses involving stakeholders at any level, e.g., local, state, regional or national. The data from the surveys can guide the improvement of future communication efforts

about dispersants, as well as provide support for enhanced stakeholder engagement during preparedness and response.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1149
Accessed 11/9/2014.

**Walker, Ann Hayward., Debra Scholz, Gary Ott.** 2014. Local Level Stakeholder Coordination and Communications to Support Oil Spill Preparedness and Response. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1172-1185.
**Keywords:** communications/ National Response System/ NRS/ spill response planning/
**Abstract:** Effective response to oil spills can be challenging, especially when multiple levels of government are involved. When an oil spill threatens the coast, local officials and communities are concerned about response strategies and potential impacts, which could affect their area. Local government authorities are responsible for addressing concerns of elected officials and other stakeholders at the community level. In the US and UK, a National Response System (NRS) provides oil spill coordination at the national level down to state level. The NRS can be strengthened by improving the capacity to effectively engage at the local level during preparedness. New opportunities to coordinate could improve response management going forward, by leveraging the relationships developed in emergency preparedness among local government, elected officials, and communities. Relationships and dialogue established during preparedness also support crisis communications with the public at large during response through traditional media, the Internet and social media.
Stakeholder engagement is process which can benefit the response organization and those affected by pollution incidents and other emergencies, e.g., storms. Stakeholder engagement and risk communication methodologies are ways to help cultivate realistic expectations and develop consensus about response options, before, during, and after an incident. Coordination and collaboration between the Incident Management Team (IMT) and affected communities can lead to shared objectives and improved information exchange. This is accomplished through traditional media and direct engagement to address emerging risk perceptions, questions, and concerns, especially about issues that spark social conflict, such as dispersant use in the US. Dialogue is necessary to learn about stakeholder and community risk perceptions associated with an incident, to assess the situation in relation to those perceptions, and then develop appropriate responses to their questions, concerns and perceptions.
This paper explores ways to enhance existing NRS processes to improve interactions and communications at the local level during preparedness, and the response and post response phases of an oil spill.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1172
Accessed 11/9/2014.

**Washington Department of Fish & Wildlife (WDFW) Forage Fish Unit,** Surf Smelt Fact Sheet, Biology and Fisheries. 2010, updated 2013.
**Keywords:** fisheries/ *Hypomesus pretiosus*/ surf smelt/
**Notes:** Surf smelt (*Hypomesus pretiosus*) are important food for marine mammals, birds, and fishes, including Pacific salmon. Unlike other local forage fish species, the

surf smelt also supports significant human-consumption fisheries in many areas of Washington State. Surf smelt are fished commercially with beach seines with average annual landings of 95,000 pounds since 2000 in Puget Sound.
**Web Address:** http://wdfw.wa.gov/publications/pub.php?id=01219 Accessed 11/7/2014.

**West, J. E., S. M. O'Neill, G. M. Ylitalo, J. P. Incardona, D. C. Doty, and M. E. Dutch.** 2014. An evaluation of background levels and sources of polycyclic aromatic hydrocarbons in naturally spawned embryos of Pacific herring (*Clupea pallasii*) from Puget Sound, Washington, USA. *Science of the Total Environment* 499:114-124.
**Keywords:** Herring/ Embryos/ PAHs/ Contaminants/ Puget Sound/ Maternal transfer/
**Abstract:** Pacific herring embryos spawned in nearshore habitats may be exposed to toxic contaminants as they develop, from exogenous sources in spawning habitats and from maternal transfer. Determining baseline concentrations of these toxic contaminants is important for evaluating the health of this species, especially during this sensitive life stage. In this study we compared concentrations of polycyclic aromatic hydrocarbons, or PAHs, in naturally spawned herring embryos from five spawning areas across Puget Sound. The summed values of 31 PAH analytes ($\Sigma_{31}$PAH) in early- to late-stage development embryos ranged from1.1 to 140 ng/g,wet weight. $\Sigma_{31}$PAH concentrations increased with development time in embryos from one spawning area where the greatest concentrations were observed, and the relative abundance of PAH chemicals in late-stage embryos was similar to those in nearby sediments, suggesting accumulation from local environmental sources. PAHs in both sediments and late-stage embryos appeared to exhibit a pyrogenic pattern. Although maternal transfer of PAHs appeared to be a negligible source to embryos in spawning areas with the greatest embryo PAH concentrations, maternal transfer may have been the dominant source in embryos from spawning areas where the lowest levels of embryo-PAHs occurred. Chronic embryo mortality has been reported in spawning habitats where we observed the greatest concentration of PAHs in embryos, and necrotic tissue in herring embryos from one such location was similar in description to phototoxic PAH necrosis reported elsewhere for embryonic zebrafish.
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**Whitman, T., A. MacLennan, P. Schlenger, J. Small, S. Hawkins, J. Slocomb.** 2012. Strategic salmon recovery planning for San Juan County Washington: the pulling it all together (PIAT) project. Prepared by Friends of the San Juans, Coastal Geologic Services, Confluence Environmental and Anchor QEA for the SJC Lead Entity for Salmon Recovery and the Washington State Salmon Recovery Funding Board. Final report RCO #10-1789.
**Keywords:** salmon recovery/ nearshore habitat/ coastal processes/ shoreline restoration/ shoreline protection/
**Abstract:** Located at the confluence of Puget Sound, Georgia Strait and the Strait of Juan de Fuca, the 400 lineal miles (650 Km) of nearshore marine habitats of San Juan County play an important role in regional salmon recovery efforts, providing feeding, refuge and migration corridors for out-migrating juvenile salmon and their prey. Until now, comprehensive identification and prioritization of restoration and protection actions in the county and elsewhere in the region have been limited by a lack of data on

salmon habitat utilization of nearshore habitat as well as the location and extent of shoreline modifications. Rapid population growth rates and increasing demand for shoreline development in San Juan County demands a strategic and process-based approach to the identification of priority conservation and restoration actions. To fully understand the current level of degradation to nearshore processes across all geomorphic shoretypes, and to identify where to focus habitat protection and restoration efforts, degradation to eight nearshore processes were assessed within each of the ten shoretypes identified in the study area. This assessment of process degradation was based on the presence of stressors known to impact the subject process. The processes assessed included: Coastal Sediment Dynamics, Wind and Waves, Fluvial Sediment Dynamics, Freshwater Hydrology, Tidal Hydrology, Detritus Import and Export and Solar Radiation. Stressors used to assess process degradation included: shoreline armor, tidal barriers, breakwaters and jetties, roads, marinas, overwater structures, culverts, groins, boat ramps, dams, impervious surfaces and artificial shoreforms.
The shoreform was the fundamental unit of analysis of this study, which enabled full integration of recently completed nearshore habitat fish utilization research in WRIA 2 (Fresh et al and Beamer et al). This approach also applied key conceptual approaches from Puget Sound Nearshore Ecosystem Restoration Project's (PSNERP) strategic needs assessment and the Puget Sound Recovery Implementation Technical Team's (RITT) shore form and key ecological attribute-based adaptive management framework.
New data collected to support the analysis included an inventory of riparian vegetation, pocket beach mapping and current and historic geomorphic mapping.
Methods and results of the broad scale restoration and protection prioritization will be presented including: Countywide geographic prioritization of priority habitat based on juvenile Chinook salmon, rearing forage fish and forage fish spawning habitat utilization, and Process based countywide evaluation of degradation by shore form to identify restoration and conservation priorities.
**Web Address:** Please contact islandersforsafeshipping@gmail.com

**Whitman, T., D.E.. Penttila, P. Dionne, K. Krueger, K. Pierce Jr.. and T. Quinn.** 2014. Tidal elevation of surf smelt spawn habitat study for San Juan County, Washington. Friends of the San Juans, Salish Sea Biological and Washington Department of Fish and Wildlife. Final report to WDFW and the U.S. EPA, Friday Harbor, WA.
**Keywords:** forage fish/ Surf Smelt/ *Hypomesus* pretiosus/ marine food webs/ beach spawning habitat/ cumulative impacts/ shoreline armoring/ sea level rise/
**Summary:** The Surf Smelt, *Hypomesus pretiosus,* is an important "forage fish" link in the marine food webs of the Puget Sound/Salish Sea basin (Penttila 2007). Forage fish play a key role in marine food webs, with a small number of species providing the trophic connection between zooplankton and larger fishes, squids, seabirds and marine mammals, including Endangered Species Act (ESA) listed species such as Chinook salmon and the marbled murrelet (Simenstad et al. 1979, Bargmann 1998). Surf Smelt are obligate upper intertidal spawners on mixed sand-gravel beaches, and are presently estimated to use about 10% of the Puget Sound shoreline for spawning (Penttila 2007). With just ten miles of document forage fish spawning habitat in San Juan County, improved understanding of habitat utilization and protections are needed.

Most assessment of Surf Smelt spawning habitat in Puget Sound has been limited to presence/absence surveys to document site use and spawning habitat distribution, with substrate collected from one elevation along a transect oriented parallel to the waterline. This study investigated the vertical distribution of incubating Surf Smelt eggs at known spawning sites in San Juan County.
Project results were used to assess likely impacts of rising sea levels on surf smelt spawning habitat assuming shoreline armoring limited landward migration of habitat, commonly referred to as the "coastal squeeze" (Huppert et al. 2009, Griggs 2005). Improved understanding of the vertical extent of intertidal habitat utilized by Surf Smelt has direct application to forage fish habitat management decisions such as shoreline development project review, quantification of cumulative effects and the potential impacts to spawning beaches of rising sea levels, as well as restoration and protection project design and effectiveness monitoring.
A total of 6,115 Surf Smelt eggs were collected across 26 surveys and 15 sites. Eggs were observed in samples from elevations ranging from as low as 3.7 feet to as high as 9.2 feet MLLW. As seen in previous studies of vertical egg distribution of Surf Smelt (Krueger et al. 2010, Penttila 2011) the majority of eggs occurred in the upper intertidal zone. Over 80% of eggs were located in the upper third of the local tide range, at or above 6.2 feet MLLW, and over 30% occurred at or above MHHW (7.6 MLLW for Friday Harbor).
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**Williams, R., C. W. Clark, D. Ponirakis, E. Ashe.** 2014. Acoustic quality of critical habitats for three threatened whale populations. Animal Conservation 17:174-185.
**Keywords:** noise/ marine mammal/ whale/ critical habitat/ stressor/ marine spatial planning/
**Abstract:** Habitat loss is a leading cause of biodiversity loss in terrestrial ecosystems. For marine species that rely on acoustic cues to navigate, find food or select mates, sound is a key element of their environment. Chronic forms of human-generated ocean noise have the potential to mask communication signals over substantial fractions of their functional areas for substantial fractions of the year, which makes acoustic masking a qualitatively similar stressor to habitat loss. International policy decisions on chronic ocean noise are evolving, which creates an opportunity to advance the scientific foundation of decision-making. We measured ocean noise levels at 12 sites, chosen for current and predicted intensities of anthropogenic activities and importance to three endangered whale species in Canada's Pacific Ocean: fin, humpback and killer whales. Canada includes sound as a key element of resident killer whale critical habitat, but not for other species. In the frequency bands that killer whales use for social communication, noise levels were highest in legally designated killer whale critical habitats. In contrast, noise levels were generally lower in habitats known to be important for baleen whales, but these quieter areas are not yet given special legal protection. These noise levels translate into potentially serious fractions of lost opportunities for acoustic communication. Median noise levels are high enough to reduce the communication spaces for fin, humpback and killer whales under typical (median) conditions by 1, 52 and 62%, respectively, and 30, 94 and 97% under noisy conditions. As countries begin to articulate their policies to protect acoustic attributes of marine

habitats under their jurisdiction, we recommend quantifying loss of communication space, but quantitative targets need to be set. We see two ways forward. Managers could specify limits of acceptable change in terms of population-level impacts, which can be modelled through effects from communication masking and/or disturbance on prey intake. Alternatively, managers can specify targets reflecting amount of habitat to protect for each species, adjusting upward to account for habitat effectively lost from chronic ocean noise.
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**Young, Jaclyn (Petty Officer 2 Class).** 2014. Assuring your agency's Area Contingency Plan is equipped with an effective Joint Information Center Model. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 2127-2133.
**Keywords:** communications/ Joint Information Center/ spill response planning/
**Abstract:** Public trust in joint agency oil spill responses is generated or broken based on how well the Joint Information Center (JIC) communicates. Since the Deepwater Horizon spill response in 2010, responders recognize the importance of communicating with the public and stakeholders about response efforts. Despite this, the development of comprehensive plans to organize an effective Joint Information Center at an Incident Command Post is often overlooked.
Area Contingency Plans (ACP) are designed to ensure effective management and organization during an incident response. However, a review of a sampling of ACPs reveals an overall lack of planning for the organization of JIC operations. Including a pre-designed JIC model within the ACP will help initial Public Information Officers (PIO) avoid errors that can cause disorganized messaging early in the response. Quick organization within a JIC helps participating agencies to speak with one voice and release timely and accurate information.
Using data and experience collected during responses, exercises, and Area Contingency Plans, this paper outlines: the role of a Joint Information Center Plan, the elements of a Joint Information Center Plan, how to be involved in the planning process, and how to better evaluate your plan.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.2127 Accessed 11/8/2014.

**Zengel, Scott., Nicolle Rutherford, Brittany Bernik, Zachary Nixon, Jacqueline Michel.** 2014. Salt Marsh Remediation and the *Deepwater Horizon* Oil Spill, the Role of Planting in Vegetation and Macroinvertebrate Recovery. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 1985-1999.
**Keywords:** natural resource damage/ oiled shoreline/ restoration/ spill cleanup/
**Abstract:** The *Deepwater Horizon* oil spill resulted in persistent heavy oiling in salt marshes, particularly in northern Barataria Bay, Louisiana. Oiling conditions and several ecological variables were compared among reference plots and three types of heavily oiled plots located along a continuous shoreline area in northern Barataria Bay: oiled control plots, mechanical treatment plots, and mechanical treatment plots coupled with vegetation planting (*Spartina alterniflora*). Data were collected more than three years following initial oiling and two years following cleanup treatments and planting. Salt

marsh oiling and associated impacts were apparent across all oiling/treatment classes relative to reference conditions. Mechanical treatment with planting showed the most improvement in oiling conditions and was also effective in re-establishing vegetation cover and plant species composition similar to reference conditions, in contrast to the oiled controls and mechanical treatment plots without planting. Marsh periwinkle (*Littoraria irrorata*) recovery was limited across all oiling/treatment classes relative to reference. Impacts to fiddler crabs (*Uca* spp.) were also documented in the heavily oiled plots. Positive influences of mechanical treatment and planting on macroinvertebrate recovery were observed; however, invertebrate recovery may lag the return of *Spartina alterniflora* by several years. Vegetation planting should be considered as a spill response and emergency restoration option for heavily oiled salt marshes where vegetation impacts are substantial, natural recovery may be lacking or delayed, intensive cleanup treatments are used, or where marsh shorelines are at risk of erosion.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.1985
Accessed 11/9/2014.

**Zhao, Lin., Jagadish Torlapati, Thomas King, Brian Robinson, Michel C. Boufadel, Kenneth Lee.** 2014. A numerical model to simulate the droplet formation process resulting from the release of diluted bitumen products in marine environment. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 449-462.
**Keywords:** bitumen/ diluted bitumen/ numerical model/ oil spill model/ wave action/ wave tank experiment/
**Abstract:** A numerical model that simulates the dispersion of oil due to the action of waves in the marine environment is presented. Model validations were performed in association with the wave tank experiments conducted in the Department of Fisheries and Oceans (DFO) Canada. Two dilbit products were considered: Access Western Blend and Cold Lake Blend. The oil droplet size distribution in the subsurface water column obtained from the experimental observations was reproduced using the droplet formation model. Special consideration was made for the simulation of wave effects on surface oil spills. Modeling results show the successful use of droplet formation model in the simulation of oil spills due to wave actions.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.449
Accessed 11/8/2014.

**Ziccardi, M., R. Golightly, S. E. W. De La Cruz, J. Y. Takekawa, K. Spragens, L. Henkel, R. S. Larsen, Courtney Lockerby, J. G. Massey.** 2011. Behavior and Survival of Rehabilitated Surf Scoters (Melanitta Perspicillata) Oiled during the Cosco Busan Spill on San Francisco Bay. International Oil Spill Conference Proceedings: March 2011, Vol. 2011, No. 1, pp. abs281.
**Keywords:** oiled wildlife/ *Melanitta perspicillata*/ rehabilitation protocols/ surf scoters
**Abstract:** Following the spill of bunker oil from the M/V *Cosco Busan* into San Francisco Bay, California on 7 November 2007, we evaluated the foraging characteristics, survival and movements of surf scoters (*Melanitta perspicillata*) that had been rehabilitated following formal rehabilitation protocols through the use of intracoelomic implants of radio transmitters and aerial/land based tracking. We

compared these behavioral attributes of oiled surf scoters to surf scoters that were not oiled, but instead captured and released or put through the same rehabilitation procedure (thus separating the rehabilitation/captivity effects from the oiling). Initial behavioral observations have shown that mean home range size was greatest for unrehabilitated birds, and oiled birds were observed closer to shore than either the un-oiled rehabilitated or control group. Survival was also seen to differ among treatment groups and over encounter occasions, with cumulative winter survival estimates being lowest for oiled birds (37.1%), and similar between un-oiled, rehabilitated (62.2%) and un-oiled, non-rehabilitated scoters (73.0%). These preliminary results show distinct differences between treatment groups, but possibly stronger effects based on captivity and/or rehabilitation versus overt effects of oiling.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2011-1-281
Accessed 11/9/2014.

**Ziccardi, Michael., Sarah Wilkin, Teresa Rowles.** 2014. Modification of NOAA's National Guidelines for Oiled Marine Mammal Response as a Consequence of the Macondo/Deepwater Horizon Oil Spill. International Oil Spill Conference Proceedings: May 2014, Vol. 2014, No. 1, pp. 986-997.
**Keywords:** cetaceans/ dolphins/ National Guidelines for Oiled Marine Mammal Response/ natural resource damage/ oiled marine mammal response/ spill planning/ spill preparedness/ whales/
**Abstract:** The *Macondo/Deepwater Horizon* response was the United States' first Spill of National Significance and, as such, had significant challenges over a “normal” oil spill response effort. One complex issue in this response was the potential for a large numbers of cetaceans (dolphins and whales), manatees, and sea turtles to be impacted by the oil, as these animals were abundant in the area of oil and at great risk because of their life history, including large amounts of time spent at the surface. To address this risk and provide for response for these species, the Marine Mammal and Sea Turtle (MMST) Group within the Wildlife Branch officially became operational on April 30, 2010, enhancing the operations of the pre-existing marine mammal and sea turtle stranding response network in the northern Gulf of Mexico. Throughout the response, the Group used previously-developed National Guidelines for Oiled Marine Mammal Response, drafted in 2005, to help focus animal collection and care activities in the field as well as within established facilities and to direct collection of samples and data for assessment of the impacts of the spill, with potential use by resource trustees in criminal and civil litigation. While having pre-existing, reviewed and approved protocols to refer to greatly improved response efficiency, significant gaps became apparent in this protocol document due to the challenges associated with coordination across such a complex response and the lack of previous knowledge on how oil can affect the species impacted. Since the conclusion of the MMST effort, NOAA and associated experts have revised and updated this document to institute a more robust command-and-control system within the Wildlife Branch, to better delineate roles and responsibilities for personnel involved in future oiled marine mammal responses, and to provide more detailed information to allow local regions to better prepare for recovering and caring for pinnipeds and cetaceans should they be affected. This paper will detail these changes to this aspect of the Wildlife Branch, and provide attendees a better

appreciation for what readiness and training marine mammal responders will be striving towards for future responses.
**Web Address:** http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-2014.1.986
Accessed: 11/9/2014.