

CHAPTER ONE: TECHNICAL WORKSHOP ON IMPACTS TO COASTAL FISHERIES HABITAT FROM NONFISHING ACTIVITIES

Introduction

A technical workshop was hosted by the Northeast Region Essential Fish Habitat Steering Committee on January 10-12, 2005 in Mystic, CT, to seek the views and recommendations of approximately 40 scientists, resource managers, and other marine resource professionals on threats to fishery habitat from nonfishing activities in the northeast coastal region. The participants of the workshop, entitled *Technical Workshop on Impacts to Coastal Fishery Habitat from Nonfishing Activities*, were federal and state environmental managers and regulators, as well as individuals from academic institutions and other organizations that have expertise and knowledge of various human-induced impacts on coastal environmental resources. A list of workshop participants and their affiliations is provided in the appendix of this report. The workshop's primary purpose was to convene marine resource professionals to review and evaluate existing information on nonfishing impacts for the purpose of updating, as necessary, fishery management plans under the New England and Mid-Atlantic Fishery Management Councils. In addition, the National Marine Fisheries Service sought to develop a nonfishing impacts reference document for use by professionals engaged in marine habitat assessment, permitting agencies, and state and federal marine resource managers. The information gathered during the workshop was used by the Northeast Region's Habitat Conservation Division staff to prepare selected chapters in the report. In general, the activities and effects contained within the various chapters of this report reflect the categories of activities and effects evaluated and discussed during the workshop.

The specific goals/tasks of the workshop included:

1. Identify all known and potential adverse effects for each category of nonfishing activity by life history strategies or stages (i.e., benthic/demersal and pelagic) and ecosystem strata (i.e., riverine, estuarine, and marine). This list of activities may also include adverse impacts to identified prey species or other specific life history requirements for species.
2. Create a matrix of nonfishing impacts for life history strategies/stages and ecosystem strata and ask the participants of the workshop to score the severity of each impact by using a relative scoring method.
3. Develop a suite of conservation measures and best management practices (BMPs) intended to avoid and minimize the adverse effects on fishery habitat and resources.
4. Identify possible information and data limitations and research needs in assessing impacts on fishery habitat or measures necessary to avoid and minimize those impacts.

Conservation measures were, to the extent possible, based on methods and technologies that have been evaluated through a scientific, peer-reviewed process. The intent was to develop recommendations that provide resource managers and regulators with specific methods and technologies yet have flexibility in their applications for various locations or project types. Ideally, providing a suite of conservation measures appropriate for various activities would give the end user several options of recommendations to consider.

Based upon the results of the workshop and effects scoring, some recommended research needs were developed. Identified research needs included basic life history requirements for some

species and habitat types, physiological and biochemical responses of organisms to various physical and chemical perturbations and stressors, and technological advances in understanding or solutions to impact assessment and mitigation. Refer to the Conclusions and Recommendations chapter at the end of this report for a discussion on recommended research.

The format of the two-day workshop consisted of a series of breakout sessions, attended by the workshop participants, which represented the primary categories of nonfishing activities believed to threaten fishery resources and habitats in the northeast coast. There were ten separate breakout sessions conducted during the workshop, which are reflected in the chapters of this report. For each of the breakout sessions, a matrix of activities and known or potential adverse effects to fishery habitat, prepared by the workshop organizers, was reviewed by the workshop participants. The participants were encouraged to openly discuss and evaluate the relevance and significance for each of the activities and effects and to provide any additional activities and effects not included in the matrix. A large number of nonfishing activities occur within the coastal region and have a wide range of effects and intensities on fishery habitat. Each activity type and effect identified was evaluated in the context of life history strategies or stages (i.e., benthic and demersal) and ecosystem type or strata (i.e., riverine, estuarine/nearshore, and marine/offshore), in order to identify the importance of those factors. Following an open discussion, the participants were asked to score, by life history strategies/stages and ecosystem strata, the various activities and adverse effects on the impact matrix. In addition, participants were asked to include specific and relevant “conservation recommendations” and BMPs to avoid and minimize adverse effects to fishery habitat and resources.

On the last day of the workshop, the participants engaged in an informal discussion on the significance of cumulative effects and how multiple and additive effects can influence impacts to fishery habitat and resources. While the discussions were general in nature and few specifics of cumulative effects were discussed, there was a general agreement that cumulative effects are important and should play a larger role in assessment of habitat impacts. We found that the scores provided by the participants in the impact matrices for most breakout sessions to be relatively consistent throughout. While the variability in scores for some impact categories was high, we believe that the mean and median values for most effects’ scores provide an accurate reflection of professional judgment by the participants. The relatively high variability in the scores of some activity types and effects may be due to varying interpretations of ecosystem strata and life history strategies or stages by the participants.

Effects Scoring System

Because one workshop goal was to assess the severity or degree of threat for known and potential impacts to fishery habitats, the workshop organizers strived to develop a semiquantitative scoring system that could measure the relative impacts for each activity and effect based upon the professional judgment of the participants. Developing defined values for measuring the significance of adverse effects for an activity is difficult and can depend upon the type of habitat being affected; the characteristic, intensity, and duration of the activity and disturbance; and a number of natural physical, chemical, and biological processes that may be occurring in the area and at the time of the activity. For this reason, the workshop organizers chose a semiquantitative scoring system with a range from 0 to 5, with a 1 being the lowest impact and a 5 being the highest impact. A “0” was used if an impact is not expected to occur or is not applicable, and a “UN” (unknown) was used if the participant does not know the degree of impact for a particular activity.

We believe that a relative scoring method that allows for flexibility and professional judgment in assigning a value for an effect is better than an absolute scoring system that has discreet and predefined values. Using a relative scoring range of 0 through 5 provided the participants a choice from a continuum of impact values for each effect and avoids the difficulty in finding consensus for the definition of predefined values. We then calculated the mean and median values of each effect and assigned a qualitative value of the threat for each effect by using the following criteria:

If either the mean or median value was greater than or equal to 4.0, a “high” index score was assigned; if the mean value was between 2.1 and 3.9, a “medium” index score was assigned; and if the mean value was less than or equal to 2.0, a “low” index score was assigned.

Note: We defined the “high” index score to include either mean or median values in order to be risk averse in identifying activities that are known to be or may be a potentially high threat. Only mean values were used in assessing “medium” and “low” index scores.

Workshop Summary

The results of the workshop scoring in each session are listed in Table 1 through 10. “High,” “medium,” and “low” index scores are notated as H, M, and L, respectively. As might be expected, there were positive correlations between the highest scoring effects and the ecosystem types in which those activities generally occur. For example, the high scoring effects in the alteration of freshwater systems and agriculture and silviculture sessions were generally all in the riverine ecosystem. Except for the offshore dredging and disposal session, there were fewer effects that were scored high in the marine/offshore ecosystem compared to the riverine and estuarine/nearshore ecosystems. This suggests the participants viewed the intensity of effects from nonfishing impacts to decrease as the distance from the activity increases. As one might expect, many of the far field effects that scored high were those activities that affect the water column (e.g., ocean noise, impacts to water quality) or effects that are capable of being transported by currents (oil spills or drilling mud releases). In addition, the global effects and other impacts session had high scores more evenly distributed across all ecosystems because of the nature of the impacts discussed in this session (e.g., climate change, atmospheric deposition, ocean noise). The number of activities and threats identified in the coastal development session were greater than other sessions because of the cross cutting nature of activities associated with human coastal development. Because of this, some activity types and effects assessed in the coastal development session were discussed to some degree in other sessions.

Some sessions had index scores with relatively high variability. For example, the scores for all activity types of the offshore dredging and disposal session had relatively low mean values and high standard deviations for effects in the estuarine/nearshore ecosystem. About half of the participants in this session either did not provide a score for impacts in the riverine or estuarine/nearshore ecosystems, or they marked them as “not-applicable.” Participants who provided a score for these two ecosystems generally scored them relatively high. This suggests a difference in participants’ interpretation of where “offshore” activities are located. Specifically, some individuals may consider the “offshore” area to be within close enough proximity of the nearshore and estuarine environments to adversely affect these areas, while others may perceive the “offshore” area to be too far removed to have a noticeable effect. There were activities in other sessions, such as beach nourishment in coastal development, with scores with high standard deviations. The high variability in perceived threats may be a reflection of regional perspectives. While the majority of the participants involved in this workshop were from the New England

region, about one-quarter of the participants were from the mid-Atlantic or southeast regions where beach nourishment projects are much more common. The associated impacts to benthic habitats from beach nourishment are also generally thought to be greater in the New England (where cobble or hard bottom habitats may be present) and south Atlantic (where live bottom habitats may be present) regions than in the mid-Atlantic. However, because the responses of the workshop participants were anonymous, it was not possible to test this hypothesis.

Many of the effects that were scored as high in the workshop sessions were those that are well documented in the literature as having adverse effects on coastal resources. For example, nutrient enrichment and siltation/sedimentation effects were scored as high in nearly all workshop sessions, demonstrating the widely accepted views that these impacts translate to general reductions in the quality and quantity of fishery resources and habitats. Some of the more unexpected results of the workshop session scores are those effects that had high mean and/or median values but may be a topic that does not have a wealth of research documenting those impacts. Some of these results may be based upon a collective judgment by the participants that these activities or effects require additional scientific investigations to resolve the perceived risks and concerns. In several of these effects or activities, the authors of the associated report chapters were unable to locate information in the scientific literature regarding those threats. For example, release of pharmaceuticals and endocrine disruptors were two effects that were scored high in the workshop session, and yet the potential scope and intensity of adverse effects that these chemicals have on fishery resources has not been thoroughly investigated.

Those activities and effects considered by the workshop participants to have “high” threats to fishery habitat warrant further investigations, including research in characterizing and quantifying these impacts on fishery resources, as well as investigating methods for avoiding and/or minimizing the impacts. Refer to the Conclusions and Recommendations chapter for further discussions regarding the workshop results.

Table 1. Habitat impact categories in coastal development workshop session (N=14)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Nonpoint Source Pollution and Urban Runoff	Nutrient loading/eutrophication	H	H	M	H	H	M
	Loss/alteration of aquatic vegetation	H	H	L	H	H	L
	Release of petroleum products	M	M	M	M	M	M
	Alteration of water alkalinity	M	M	L	M	M	L
	Release of metals	H	H	M	M	H	M
	Release of radioactive wastes	M	M	L	M	M	L
	Release of pesticides	H	H	M	H	H	M
	Release of pharmaceuticals	H	M	L	H	H	L
	Alteration of temperature regimes	H	M	L	H	M	L
	Sedimentation/turbidity	H	H	L	H	H	L
	Altered hydrological regimes	M	M	L	M	M	L
	Introduction of pathogens	M	M	L	M	M	L
Road Construction and Operation	Release of sediments in aquatic habitat	H	M	L	M	M	L
	Increased sedimentation/turbidity	H	H	L	H	H	L
	Impaired fish passage	H	M	L	H	H	L
	Altered hydrological regimes	H	H	L	H	H	L
	Altered temperature regimes	H	M	L	H	M	L
	Altered stream morphology	H	M	L	H	M	L
	Altered stream bed characteristics	H	M	L	H	M	L
	Reduced dissolved oxygen	H	H	L	H	H	L
	Introduction of exotic invasive species	M	M	L	M	M	L
	Loss/alteration of aquatic vegetation	H	H	L	H	H	L
	Altered tidal regimes	H	H	L	H	M	L
	Contaminant releases	M	M	L	M	M	L
	Fragmentation of habitat	H	M	L	H	H	L
Altered salinity regimes	M	M	L	M	M	L	
Flood Control/ Shoreline Protection	Altered hydrological regimes	H	H	L	H	M	L
	Altered temperature regimes	M	M	L	M	M	L
	Altered stream morphology	H	M	L	H	M	L
	Altered sediment transport	H	H	L	H	H	L
	Alteration/loss of benthic habitat	H	H	L	M	M	L
	Reduction of dissolved oxygen	M	M	L	M	M	L
	Impaired fish passage	H	M	L	H	M	L
	Alteration of natural communities	H	M	L	M	M	L
	Impacts to riparian habitat	H	M	L	H	M	L
	Loss of intertidal habitat	H	H	L	M	H	L
	Reduced ability to counter sea level rise	H	H	L	M	H	L
	Increased erosion/accretion	H	H	L	H	H	L
Beach Nourishment	Altered hydrological regimes	M	M	L	M	M	L
	Altered temperature regimes	L	L	L	L	L	L
	Altered sediment transport	M	M	L	M	M	L
	Alteration/loss of benthic habitat	M	M	L	L	M	L
	Alteration of natural communities	M	M	M	L	M	L
	Increased sedimentation/turbidity	M	M	L	M	M	L

Table 1 (continued). Habitat impact categories in coastal development workshop session (N=14)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshor	Riverine	Estuarine/ Nearshore	Marine/ Offshor
Wetland Dredging and Filling	Alteration/loss of habitat	H	H	L	H	H	L
	Loss of submerged aquatic vegetation	H	H	L	M	H	L
	Altered hydrological regimes	H	H	L	H	H	L
	Reduction of dissolved oxygen	M	M	L	M	M	L
	Release of nutrients/eutrophication	M	M	L	M	M	L
	Release of contaminants	M	M	L	M	M	L
	Altered tidal prism	M	M	L	M	M	L
	Altered current patterns	M	M	L	M	M	L
	Altered temperature regimes	M	M	L	M	M	L
	Loss of wetlands	H	H	L	H	H	L
	Loss of fishery productivity	H	H	L	H	H	L
	Introduction of invasive species	M	M	L	M	M	L
	Loss of flood storage capacity	H	H	L	H	H	L
Increased sedimentation/turbidity	M	M	L	M	M	L	
Overwater Structures	Shading impacts to vegetation	M	M	L	M	M	L
	Altered hydrological regimes	M	M	L	M	M	L
	Contaminant releases	M	M	L	M	M	L
	Benthic habitat impacts	M	M	L	M	M	L
	Increased erosion/accretion	M	M	L	M	M	L
	Eutrophication from bird roosting	M	M	L	M	M	L
	Shellfish closures because of bird roosting	H	M	L	M	M	L
	Changes in predator/prey interactions	H	H	L	H	H	L
Pile Driving and Removal	Energy impacts	M	M	L	M	M	L
	Benthic habitat impacts	M	M	L	M	M	L
	Increased sedimentation/turbidity	M	M	L	M	M	L
	Contaminant releases	M	M	L	M	M	L
	Shading impacts to vegetation	M	M	L	M	M	L
	Changes in hydrological regimes	M	M	L	M	M	L
	Changes in species composition	M	M	L	M	M	L
Marine Debris	Entanglement	M	M	L	M	M	L
	Ingestion	L	M	L	M	M	M
	Contaminant releases	L	M	L	L	M	M
	Introduction of invasive species	M	M	L	M	M	M
	Introduction of pathogens	L	M	L	L	M	M
	Conversion of habitat	L	M	L	L	M	L

Table 2. Habitat impact categories in energy-related activities workshop session (N=13)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Petroleum Exploration, Production, and Transportation	Underwater noise	M	M	M	M	M	M
	Habitat conversion	H	H	H	H	H	M
	Loss of benthic habitat	M	H	M	M	M	M
	Contaminant discharge	M	H	M	M	H	M
	Discharge of debris	M	M	M	M	M	L
	Oil spills	H	H	H	H	H	H
	Siltation/sedimentation/turbidity	M	M	M	M	M	M
	Resuspension of contaminants	M	H	M	M	M	L
	Impacts from clean-up activities	H	H	M	M	H	M
Liquified Natural Gas	Habitat conversion	H	H	M	M	M	M
	Loss of benthic habitat	H	H	M	M	M	L
	Discharge of contaminants	H	H	H	H	H	H
	Discharge of debris	M	M	M	M	M	L
	Siltation/sedimentation/turbidity	M	H	M	M	M	M
	Resuspension of contaminants	M	H	M	M	H	L
	Entrainment/impingement	M	M	M	M	H	M
	Alteration of temperature regimes	M	M	L	M	M	L
	Alteration of hydrological regimes	M	M	L	M	M	L
	Underwater noise	M	M	M	H	H	M
	Release of contaminants	H	H	M	H	H	M
	Exclusion zone impacts	M	M	L	M	M	L
	Physical barriers to habitat	M	M	M	M	M	L
	Introduction of invasive species	H	H	M	H	M	M
	Vessel impacts	H	H	L	M	M	L
Benthic impacts from pipelines	H	H	M	M	M	M	
Offshore Wind Energy Facilities	Loss of benthic habitat	M	H	H	L	M	M
	Habitat conversion	M	H	H	L	M	M
	Siltation/sedimentation/turbidity	L	M	M	L	M	M
	Resuspension of contaminants	L	M	L	L	M	L
	Alteration of hydrological regimes	L	M	M	L	M	M
	Altered current patterns	L	M	M	L	M	M
	Alteration of electromagnetic fields	L	L	L	L	L	L
	Underwater noise	L	L	M	L	M	H
	Alteration of community structure	M	H	M	L	H	M
	Erosion around structure	L	M	M	L	L	L
Spills associated w/ service structure	M	H	M	L	M	M	

Table 2 (continued). Habitat impact categories in energy-related activities workshop session (N=13)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Wave/Tidal Energy Facilities	Habitat conversion	H	H	M	M	M	M
	Loss of benthic habitat	H	H	M	M	M	L
	Siltation/sedimentation/turbidity	M	H	M	M	M	L
	Resuspension of contaminants	M	M	L	M	M	L
	Alteration of hydrological regimes	M	M	M	M	H	L
	Altered current patterns	M	M	M	M	H	M
	Entrainment/impingement	M	M	L	H	H	M
	Impacts to migration	M	M	L	H	M	L
	Electromagnetic fields	L	L	L	L	L	L
Cables and Pipelines	Loss of benthic habitat	H	H	M	L	M	L
	Habitat conversion	H	H	M	M	M	M
	Siltation/sedimentation/turbidity	M	H	M	M	M	M
	Resuspension of contaminants	H	H	M	M	M	M
	Altered current patterns	M	M	M	L	M	L
	Alteration of electromagnetic fields	L	L	L	L	L	L
	Underwater noise	L	L	L	L	M	M
	Alteration of community structure	M	M	M	M	M	M
	Erosion around structure	L	M	M	L	M	M
	Biocides from hydrostatic testing	M	M	M	M	M	M
	Spills associated w/ service structure	H	H	M	M	M	M
	Physical barriers to habitat	H	H	H	L	L	L
	Impacts to submerged aquatic vegetation	M	H	M	M	M	L
	Water withdrawal	M	M	L	H	H	L
	Impacts from construction activities	M	H	H	M	M	M
	Impact from maintenance activities	M	M	M	L	M	M
	Thermal impacts associated with cables	L	L	L	L	L	L
Impacts associated with armoring of pipe	M	M	M	L	L	L	
Impacts to migration	H	H	H	L	L	L	

Table 3. Habitat impact categories in alteration of freshwater systems workshop session (N=13)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Dam Construction /Operation	Impaired fish passage	H	H	L	H	H	L
	Altered hydrological regimes	H	H	L	H	M	L
	Altered temperature regimes	H	H	L	H	M	L
	Altered sediment/ large woody debris transport	H	M	L	H	M	L
	Altered stream morphology	H	M	L	H	M	L
	Altered stream bed characteristics	H	M	L	H	M	L
	Reduced dissolved oxygen	H	M	L	H	M	L
	Alteration of extent of tide	H	H	L	H	H	L
	Alteration of wetlands	H	H	L	H	H	L
	Change in species communities	H	M	L	H	M	L
	Bank erosion because of drawdown	M	L	L	M	L	L
	Riparian zone development	H	M	L	H	M	L
Acute temperature shock	H	M	L	H	M	L	
Dam Removal	Release of contaminated sediments	H	H	L	H	M	L
	Alteration of wetlands	H	M	L	H	M	L
Stream Crossings	Impacts to fish passage	H	M	L	H	M	L
	Alteration of hydrological regimes	H	M	L	H	M	L
	Bank erosion	H	L	L	M	L	L
	Habitat conversion	H	M	L	H	M	L
Water Withdrawal/ Diversion	Entrainment and impingement	M	M	L	H	M	L
	Impaired fish passage	H	H	L	H	H	L
	Altered hydrological regimes	H	M	L	H	M	L
	Reduced dissolved oxygen	H	M	L	H	M	L
	Altered temperature regimes	H	H	L	H	M	L
	Release of nutrients/eutrophication	H	M	L	H	M	L
	Release of contaminants	H	M	L	H	M	L
	Altered stream morphology	H	L	L	H	M	L
	Altered stream bed characteristics	H	M	L	H	M	L
	Siltation/sedimentation/turbidity	H	M	L	H	M	L
	Change in species communities	H	M	L	H	H	L
	Alteration in groundwater levels	H	L	L	H	L	L
	Loss of forested/palustrine wetlands	H	L	L	H	L	L
	Impacts to water quality	H	M	L	H	M	L
Loss of flood storage	M	L	L	M	L	L	

Table 3 (continued). Habitat impact categories in alteration of freshwater systems workshop session (N=13)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Dredging and Filling, Mining	Reduced flood water retention	H	M	L	H	M	L
	Reduced nutrient uptake and release	M	M	L	M	M	L
	Reduced detrital food source	H	M	L	M	M	L
	Altered hydrological regimes	H	M	L	H	M	L
	Increased storm water runoff	H	M	L	H	M	L
	Loss of riparian and riverine habitat	H	M	L	H	M	L
	Altered stream morphology	H	M	L	H	L	L
	Altered stream bed characteristics	H	M	L	H	M	L
	Siltation/sedimentation/turbidity	H	M	L	H	M	L
	Reduced dissolved oxygen	H	M	L	H	M	L
	Altered temperature regimes	H	M	L	H	M	L
	Release of nutrients/eutrophication	H	M	L	H	H	L
	Release of contaminants	H	M	L	H	M	L
	Loss of submerged aquatic vegetation	H	H	L	H	H	L
Change in species communities	H	H	L	H	M	L	

Table 4. Habitat impact categories in marine transportation workshop session (N=18)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Construction and Expansion of Ports and Marinas	Loss of benthic habitat	H	H	H	M	M	M
	Siltation/sedimentation/turbidity	H	H	M	M	M	M
	Contaminant releases	H	H	M	M	H	M
	Altered hydrological regimes	H	H	L	H	H	L
	Altered tidal prism	M	H	L	M	H	L
	Altered current patterns	M	M	L	M	M	L
	Altered temperature regimes	H	M	L	H	M	L
	Loss of wetlands	H	H	L	H	H	L
	Underwater blasting/noise	M	M	L	M	M	M
	Loss of submerged aquatic vegetation	H	H	M	H	H	M
	Conversion of substrate/habitat	H	H	M	M	M	M
	Loss of intertidal flats	H	H	L	L	M	L
	Loss of water column	M	M	L	H	H	L
	Altered light regime	M	M	L	M	M	L
Derelict structures	M	M	L	M	M	L	
Operations and Maintenance of Ports and Marinas	Contaminant releases	H	H	M	M	M	M
	Storm water runoff	H	H	M	M	M	L
	Underwater noise	M	M	L	M	M	L
	Alteration of light regimes	M	M	L	M	M	L
	Derelict structures	M	M	L	L	L	L
	Mooring impacts	M	M	L	L	L	L
	Release of debris	M	M	L	M	L	L
Operation and Maintenance of Vessels	Impacts to benthic habitat	H	H	L	M	M	L
	Resuspension of bottom sediments	M	M	L	M	M	L
	Erosion of shorelines	M	M	L	M	M	L
	Contaminant spills and discharges	M	H	M	M	H	M
	Underwater noise	M	M	M	M	M	M
	Derelict structures	M	M	L	L	L	L
	Increased air emissions	L	L	L	L	L	L
	Release of debris	M	M	L	L	L	L
Navigation Dredging	Conversion of substrate/habitat	H	H	M	M	M	L
	Loss of submerged aquatic vegetation	H	H	M	H	H	L
	Siltation/sedimentation/turbidity	H	H	M	H	M	L
	Contaminant releases	H	H	M	M	M	M
	Release of nutrients/eutrophication	M	M	M	M	M	L
	Entrainment and impingement	M	M	M	M	M	L
	Underwater blasting/noise	M	M	L	M	M	L
	Altered hydrological regimes	H	H	L	H	M	L
	Altered tidal prism	M	M	L	M	M	L
	Altered current patterns	M	M	L	M	M	L
	Altered temperature regimes	H	H	L	M	M	L
	Loss of intertidal flats	H	H	L	H	H	L
	Loss of wetlands	H	H	L	H	H	L
Contaminant source exposure	M	M	M	M	M	L	

Table 5. Habitat impact categories in offshore dredging and disposal workshop session (N=22)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Offshore Mineral Mining	Loss of benthic habitat types	L	L	H	L	L	M
	Conversion of substrate/habitat	L	L	H	L	L	L
	Siltation/sedimentation/turbidity	L	L	M	L	L	M
	Changes in bottom topography	L	L	M	L	L	L
	Changes in sediment composition	L	L	H	L	L	L
	Sediment transport from site (erosion)	L	L	M	L	L	L
	Impacts to water quality	L	L	M	L	L	M
	Release of contaminants	L	L	M	L	L	M
	Change in community structure	L	L	H	L	L	M
	Changes in water flow	L	L	M	L	L	M
Noise impacts	L	L	L	L	L	M	
Petroleum Extraction	Contaminant releases	L	L	H	L	L	H
	Drilling mud impacts	L	L	H	L	L	H
	Siltation/sedimentation/turbidity	L	L	M	L	L	M
	Release of debris	L	L	M	L	L	L
	Noise impacts	L	L	M	L	L	M
	Changes in light regimes	L	L	M	L	L	M
	Habitat conversion	L	L	M	L	L	M
	Pipeline installation	L	L	M	L	L	L
Offshore Dredge Material Disposal	Burial/disturbance of benthic habitat	L	M	H	L	L	M
	Conversion of substrate/habitat	L	L	H	L	L	M
	Siltation/sedimentation/turbidity	L	L	M	L	L	M
	Release of contaminants	L	L	M	L	L	M
	Release of nutrients/eutrophication	L	L	M	L	L	M
	Altered hydrological regimes	L	L	M	L	L	M
	Altered current patterns	L	L	M	L	L	M
	Changes in bottom topography	L	L	M	L	L	L
	Changes in sediment composition	L	L	H	L	L	L
Changes in water bathymetry	L	L	M	L	L	L	
Fish Waste Disposal	Introduction of pathogens	L	L	H	L	L	H
	Release of nutrients/eutrophication	L	L	H	L	L	H
	Release of biosolids	L	L	H	L	L	M
	Loss of benthic habitat types	L	L	H	L	L	L
	Behavioral affects	L	L	M	L	L	M
Vessel Disposal	Release of contaminants	L	L	M	L	L	M
	Conversion of substrate/habitat	L	L	H	L	L	M
	Changes in bathymetry	L	L	M	L	L	L
	Changes in hydrodynamics	L	L	M	L	L	M
	Changes in community structure	L	L	H	L	L	M
	Impacts during deployment	L	L	M	L	L	M
	Release of debris	L	L	M	L	L	L

Table 6. Habitat impact categories in chemical effects: water discharge facilities workshop session (N=19)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Sewage Discharge Facilities	Release of nutrients/eutrophication	H	H	H	H	H	H
	Release of contaminants	H	H	H	H	H	H
	Impacts to submerged aquatic vegetation	H	H	M	H	H	M
	Reduced dissolved oxygen	H	H	M	H	H	M
	Siltation/sedimentation/turbidity	H	H	M	H	H	M
	Impacts to benthic habitat	H	H	M	M	M	M
	Changes in species composition	H	H	M	H	H	M
	Trophic level alterations	H	H	M	H	H	M
	Introduction of pathogens	H	H	M	M	H	M
	Introduction of harmful algal blooms	H	H	H	H	H	M
	Bioaccumulation/biomagnification	H	H	H	H	H	M
	Behavioral avoidance	M	H	M	M	H	M
Release of pharmaceuticals	M	M	M	M	M	M	
Industrial Discharge Facilities	Alteration of water alkalinity	H	M	M	M	M	L
	Release of metals	H	H	M	M	M	M
	Release of chlorine compounds	H	H	M	H	H	M
	Release of pesticides	H	H	M	H	H	M
	Release of organic compounds	H	H	H	M	H	M
	Release of petroleum products	H	H	M	M	H	M
	Release of inorganic compounds	H	H	M	H	H	M
	Release of organic wastes	M	M	M	M	M	M
Introduction of pathogens	M	M	M	M	M	M	
Combined Sewer Overflows	Potential for all of the above effects	H	H	H	H	H	H

Table 7. Habitat impact categories in physical effects: water intake and discharge facilities workshop session

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Discharge Facilities	Scouring of substrate	M	M	L	L	L	L
	Turbidity/sedimentation	H	H	M	M	M	L
	Alteration of sediment composition	H	H	M	L	L	L
	Reduced dissolved oxygen	H	H	M	H	H	L
	Alteration of salinity regimes	H	H	L	H	H	M
	Alteration of temperature regimes	H	H	M	H	H	M
	Conversion/loss of habitat	M	M	M	M	M	M
	Habitat exclusion/avoidance	H	H	L	H	H	L
	Restrictions to migration	H	H	L	H	H	L
	Acute toxicity	M	H	M	H	H	M
	Behavioral changes	M	M	L	M	M	L
	Cold shock	M	M	M	H	M	L
	Stunting of growth in fishes	M	M	L	M	M	L
	Attraction to flow	H	H	M	H	H	M
	Alteration of community structure	H	H	M	H	H	M
	Changes in local current patterns	M	M	L	M	M	L
	Physical/chemical synergies	M	H	M	M	M	M
	Increased need for dredging	H	H	L	H	H	L
	Ballast water discharge	H	H	M	M	M	M
	Gas-bubble disease/mortality	M	M	L	M	H	L
Release of radioactive wastes	H	H	M	H	H	M	
Intake Facilities	Entrainment/impingement	H	H	H	H	H	H
	Alteration of hydrological regimes	H	H	M	H	H	L
	Flow restrictions	H	H	L	H	H	L
	Construction related impacts	H	M	M	M	M	M
	Conversion/loss of habitat	H	H	M	H	H	M
	Seasonal loss of habitat	M	M	L	M	M	M
	Backwash (cleaning of system)	M	M	L	M	M	L
	Alteration of community structure	H	H	L	H	H	L
	Increased need for dredging	H	H	M	H	H	L
	Ballast water intake	H	H	M	H	H	M

Table 8. Habitat impact categories in agriculture and silviculture workshop session (N=11)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Cropland, Rangelands, Livestock, and Nursery Operations	Release of nutrients/eutrophication	H	H	L	H	H	L
	Bank/soil erosion	H	H	L	M	M	L
	Altered temperature regimes	M	M	L	M	M	L
	Siltation/sedimentation/turbidity	H	H	L	H	H	L
	Altered hydrological regimes	M	M	L	M	M	L
	Entrainment and impingement	M	L	L	H	L	L
	Impaired fish passage	M	L	L	H	M	L
	Reduced soil infiltration	M	L	L	M	L	L
	Release of pesticides	H	H	L	H	M	L
	Reduced dissolved oxygen	H	M	L	H	M	L
	Soil compaction	M	M	L	M	L	L
	Loss/alteration of wetlands	H	H	L	M	M	L
	Land-use change (post agriculture)	H	M	L	H	M	L
	Introduction of invasive species	M	M	L	M	L	L
	Introduction of pathogens	H	M	L	M	M	L
	Endocrine disruptors	H	H	L	H	H	L
Change of community structure	M	M	L	M	M	L	
Change in species composition	H	M	L	M	M	L	
Silviculture and Timber Harvest Activities	Reduced soil infiltration	M	M	L	M	L	L
	Siltation/sedimentation/turbidity	H	M	L	H	M	L
	Altered hydrological regimes	M	M	L	M	M	L
	Impaired fish passage	M	L	L	H	M	L
	Bank/soil erosion	H	M	L	H	M	L
	Altered temperature regimes	H	M	L	H	M	L
	Release of pesticides	H	H	L	H	H	L
	Release of nutrients/eutrophication	H	H	L	H	H	L
	Reduced dissolved oxygen	H	M	L	H	M	L
	Loss/alteration of wetlands	H	M	L	H	M	L
Soil compaction	M	L	L	M	L	L	
Timber and Paper Mill Processing Activities	Chemical contaminant releases	H	H	L	H	H	L
	Entrainment and impingement	M	L	L	H	M	L
	Thermal discharge	H	L	L	M	L	L
	Reduced dissolved oxygen	H	M	L	H	M	L
	Conversion of benthic substrate	H	M	L	M	L	L
	Loss/alteration of wetlands	M	M	L	M	M	L
	Alteration of light regimes	M	L	L	M	L	L

Table 9. Habitat impact categories in introduced/nuisance species and aquaculture workshop session (N=14)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Introduced/ Nuisance Species	Habitat alterations	H	H	M	M	M	M
	Trophic alterations	M	H	M	M	M	M
	Gene pool alterations	H	H	M	H	H	M
	Alterations of communities	H	H	M	M	H	M
	Introduced diseases	M	H	M	M	H	M
	Changes in species diversity	H	H	H	H	H	M
	Alteration in health of native species	M	M	M	M	M	M
	Impacts to water quality	M	M	M	M	M	M
Aquaculture	Discharge of organic waste	M	H	M	M	M	M
	Seafloor impacts	M	H	M	M	M	M
	Introduction of exotic invasive species	H	H	M	M	H	M
	Food web impacts	H	H	M	H	H	M
	Gene pool alterations	H	H	M	H	M	M
	Impacts to water column	M	M	M	M	H	M
	Impacts to water quality	M	H	L	M	H	M
	Changes in species diversity	M	H	M	M	H	M
	Sediment deposition	H	H	M	L	L	L
	Introduction of diseases	M	H	M	M	M	M
	Habitat replacement/exclusion	H	H	M	M	M	L
	Habitat conversion	H	H	M	M	H	M

Table 10. Habitat impact categories in global effects and other impacts workshop session (N=17)

Activity Type	Potential Effects	Habitat Impact Categories					
		Life History/Ecosystem Type					
		Benthic/Demersal Stages			Pelagic Stages		
		Riverine	Estuarine/ Nearshore	Marine/ Offshore	Riverine	Estuarine/ Nearshore	Marine/ Offshore
Climate Change	Alteration of hydrological regimes	H	H	M	H	H	H
	Alteration of temperature regimes	H	H	H	H	H	H
	Changes in dissolved oxygen	H	H	M	H	H	M
	Nutrient loading/eutrophication	M	H	M	M	M	M
	Release of contaminants	H	H	M	M	M	M
	Bank/soil erosion	H	M	L	M	M	L
	Alteration in salinity	M	H	M	M	H	M
	Alteration of weather patterns	H	H	M	H	H	H
	Alteration of alkalinity	M	M	M	M	M	M
	Changes in community structure	H	H	H	H	H	H
	Changes in ocean/coastal use	M	M	M	M	M	M
	Changes in ecosystem structure	M	H	L	M	H	L
Loss of wetlands	H	H	L	H	H	L	
Ocean Noise	Mechanical injury to organisms	M	M	H	M	M	H
	Impacts to feeding behavior	M	M	M	M	M	M
	Impacts to spawning behavior	M	M	M	M	M	M
	Impacts to migration	M	M	M	M	M	M
	Exclusion of organisms to habitat	M	M	M	M	M	M
	Changes in community structure	M	M	M	M	M	M
Atmospheric Deposition	Nutrient loading/eutrophication	H	H	M	H	H	M
	Mercury loading/bioaccumulation	H	H	M	H	H	H
	Polychlorinated biphenyls and other contaminants	H	H	M	H	H	M
	Alteration of ocean alkalinity	M	M	M	M	M	M
	Alteration of climatic cycle	M	M	M	M	M	M
Military/ Security Activities	Exclusion of organisms to habitat	L	L	M	L	M	M
	Noise impacts	M	M	M	M	M	H
	Chemical releases	M	H	M	M	M	M
	Impacts to tidal/intertidal habitats	M	M	L	L	M	L
	Blasting injuries from ordinances	M	M	M	M	M	M
Natural Disasters and Events	Loss/alteration of habitat	H	H	M	H	H	M
	Impacts to habitat from debris	M	M	M	M	M	L
	Impacts to water quality	M	H	M	H	H	M
	Impacts from emergency response	M	M	L	M	M	L
	Alteration of hydrological regimes	M	M	M	M	M	L
	Changes in community composition	M	H	M	M	M	M
	Underwater landslides	L	L	M	L	L	M
Electromagnetic Fields	Changes to migration of organisms	M	M	M	M	M	M
	Behavioral changes	M	M	M	M	M	M
	Changes in predator/prey relationships	L	M	M	M	M	M