§ 5.6 (d)(3)(iv) Fish and Aquatic Resources

(iv) Fish and aquatic resources. A description of the fish and other aquatic resources, including invasive species, in the project vicinity. This section must discuss the existing fish and macro-invertebrate communities, including the presence or absence of anadromous, catadromous, or migratory fish, and any known or potential upstream or downstream impacts of the project on the aquatic community. :

As previously described, Half-Moon Cove was once fed from both Cobscook Bay and Passamaquoddy Bay until causeways were built from Pleasant Point Reservation to Carlow Island and to Eastport (Moose Island). This modification greatly affected the productivity of Half-Moon Cove as a regional resource.

Information from the Quoddy Bay LNG application (outlined in a solid border) will be reproduced in this section to document an existing fish and aquatic resource.

Recent work being performed in Half Moon Cove indicates that it may not be as comparable to other areas of Cobscook or Passamaquoddy Bays as it was prior to the construction of the causeways for the Passamaquoddy Tidal Power Project. The causeways have altered water exchange and circulation characteristics within Half Moon Cove, which has resulted in some alteration of benthic conditions. Benthic sampling was performed on July 26 and 27, 2005 as part of Section 203 studies being performed by the New England District of the US Army Corps of Engineers (USACE, 2005). The Section 203 project is assessing restoration alternatives for Half Moon Cove, with a focus on removing or modifying the causeways between the Pleasant Point Indian Reservation and the city of Eastport. Eleven Van Veen grabs were taken in intertidal and subtidal areas for benthic community analysis. Five of the sample locations were along the western side of Split Rock and its adjoining causeways while two others were located immediately to the southeast of Split Rock. Other sample stations were located on the east and west side of the causeway between Carlow Island and Eastport. An additional 11 stations in Half Moon Cove and two southeast of Split Rock were sampled for shellfish.

The 11 benthic community samples yielded 104 putative species. There was an average of 25 species per 0.04 m^2 sample with a range of 12-38 (Table 3.1.1-3). Interestingly, 24 of the 90 species identified to the species level were not found in the checklist of Trott (2004a). This suggests that the benthic communities of the Quoddy region are not adequately studied. Perhaps the most remarkable feature of this small sampling program is the high density of individuals found. Densities ranged between 2,950 and 345,625 individuals per m^2 with a mean of 73,355. As with the cobble and gravel stations in Western Passage, oligochaetes were the first or second most dominant taxon at all but one station. Other abundant species included spionid polychaetes and amphipods. Abundance at this level is often suggestive of organic pollution. In this case, however, pollution indicator species, such as polychaete *Capitella capitata*, were not present. Furthermore, no major outfalls are known to empty into Half Moon Cove where the very high densities are found. Additional studies are needed to determine if this high density is at reflection of the high primary productivity of the region.

Shellfish sampling was also performed on July 26 and 27, 2005 as part of Section 203 studies being performed by the New England District of the US Army Corps of Engineers in Half Moon Cove and Western Passage. Softshell clam densities in Half Moon Cove averaged approximately 3.4 per square foot, of which nearly 2 were of harvestable size (>2 inches, USACE 2005).

Studies currently underway to assess the benefits and feasibility of removing or replacing with bridges, the causeways constructed as part of the Passamaquoddy Tidal Power Project over a half century ago reveal that the reduction of tidal exchange and near isolation of Half Moon Cove from the larger Passamaquoddy Bay estuary has had a detrimental affect on invertebrate and vertebrate biota (Tribal Partnership, 2005/2006). In addition, the causeways have forced water entering and exiting Half Moon Cove to be more isolated from the large volume exchange associated with tidal flows in Western Passage.

§ 5.6 (d)(3)(iv)(A) Fish & Aquatic Communities

(A) Identification of existing fish and aquatic communities;

3.1.1.2 Marine Fish and Habitats

There are about 500 species of fish found in coastal Maine and nearby Canada, not including 37 species of cartilaginous fish (sharks, skates, rays, and chimaeras). These fish can be roughly grouped into demersal or groundfish -- those occurring on or close to the bottom (cod, haddock, pollock, etc.), and pelagic -- those occurring in the water column usually away from the bottom (tuna, herring, mackerel, etc.). In addition, there are a number of pelagic and demersal fish species that can be considered important both commercially and recreationally.

diversity of benthic invertebrates and algae. With the construction of the causeways between Pleasant Point, Split Rock and Moose Island, Half Moon Cove has become a highly enclosed embayment experiencing a mean tidal range of approximately 5.7 meters (18.7 feet) as at Eastport (Larsen, 2004a). This condition results in an extensive intertidal zone, as reflected in an extreme change in water surface area between high and low tides. Within the Project footprint, the deepest portion of Half Moon Cove is approximately zero to 2 meters (6.5 feet) at mean low water (MLW). The Project area within Western Passage, that connects Head Harbor Passage with Passamaquoddy Bay, consists of a narrower intertidal zone as a result of steeper slopes that extend from zero meters downward to depths greater than 15 meters (49.2 feet).

While portions of Half Moon Cove have water currents that are relatively slow (less than 1 knot) and result in a sediment deposition environment with extensive mud flats, other portions experience higher currents (2 knots) (Crawford, 2006) and coarse gravel, rock and bedrock occur in the intertidal and subtidal zones. The currents in Western Passage can reach three knots (USEPA, 1978) and the Project area's preponderance of rocky substrates reflects a non-depositional, scour environment. These physical characteristics help to shape the biotic communities within these two differing marine portions of the Project.

3.1.1 Fisheries

There are no freshwater fishery resources associated with the LNG Terminal.

Half Moon Cove is a small embayment within the larger Cobscook Bay, which is in turn a boreal, macrotidal estuary in the northeastern Gulf of Maine. Western Passage is one of two principal channels through which massive amounts of tidal exchange occur between Passamaquoddy Bay and the Gulf of Maine. Both areas are on the northern side of the Bay of Fundy near its mouth.

The Gulf of Maine, including the Bay of Fundy is one of the world's most biologically-productive and rich marine ecosystems in the world (Pesch and Wells, 2004; Larsen and Gilfillan, 2004).

Cobscook Bay is a hydrographically and geologically complex estuary where very high levels of biodiversity and productivity co-exist (Brooks, 2004; Kelley and Kelley, 2004; Larsen, 2004a; Larsen, 2004b). The biodiversity of Cobscook Bay was recognized early and much of the Northwest Atlantic invertebrate fauna was described from here (Verrill, 1871 in Larsen, 2004b).

The Cobscook and Passamaquoddy Bays are dominated by energetic tides of high amplitude that result in thorough mixing of the water column. Extreme semi-diurnal tides, tidal upwelling, high incidence of summer fog shielding the intertidal zone from solar radiation, and unusually varied habitats, both intertidal and subtidal, all attribute to the extreme energy imparted by the tides (Campbell, 2004) have all been implicated as reasons for the diverse invertebrate fauna of the area (Trott and Larsen, 2003 in Trott, 2004a). The invertebrate biological productivity then supports a diverse vertebrate population of fish, birds, and marine mammals. In addition to existing data on the biota of Cobscook and Passamaquoddy Bays, the Project has undertaken site-specific studies to collect information on the biota within the Project footprint and areas of potential seafloor disturbance. Both sources of information are presented in the following sections.

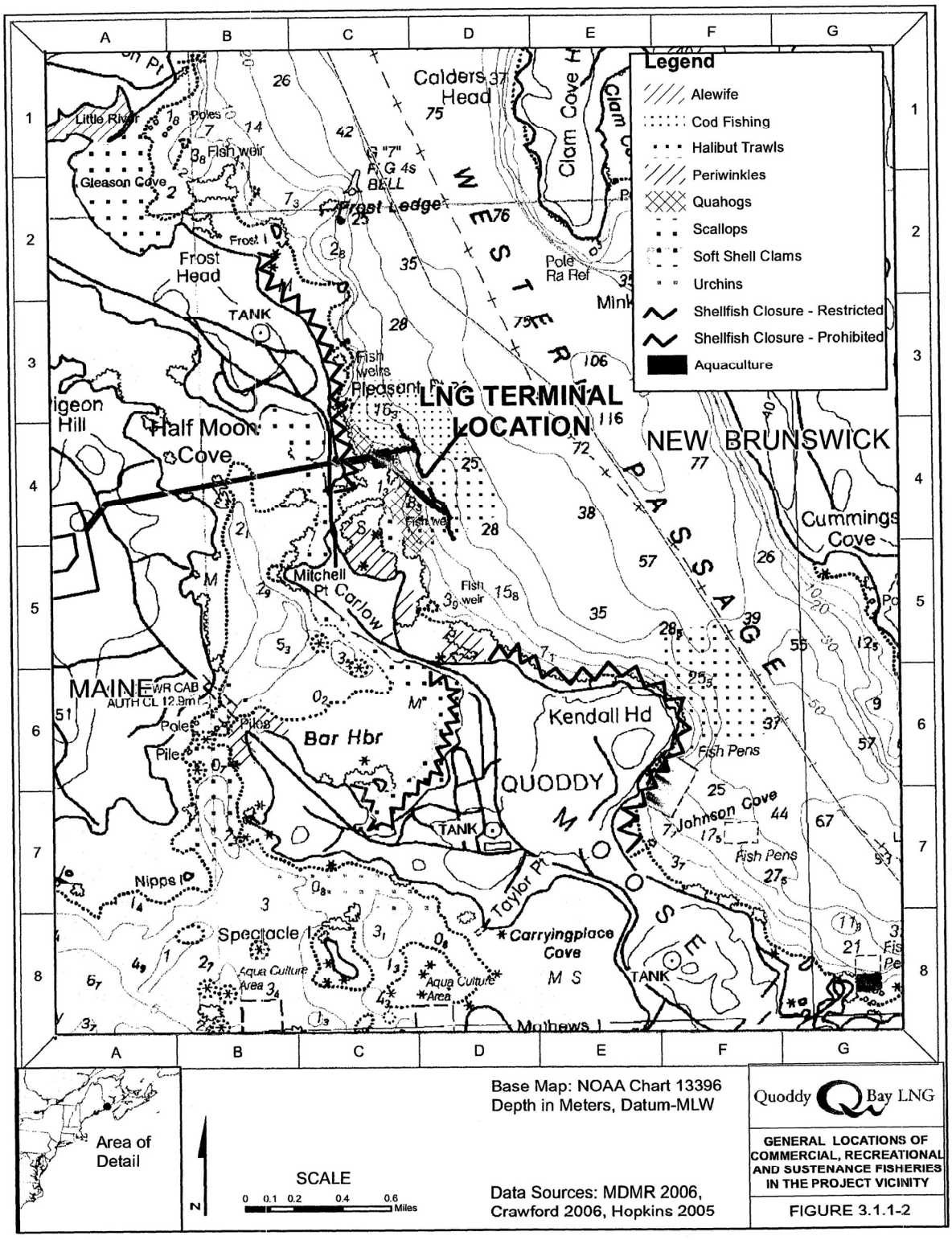

Figure HMC-21: Fisheries Distribution in Half-Moon Cove

TABLE 3.1.1-2

Summary of Annual Primary Productivity in Cobscook Bay (Modified from Campbell 2004)

Producer	Primary Production ($kgCy^{-1} \times 10^6$)
Phytoplankton	8.80×10^6
Benthic Diatoms	19.50×10^6
Eelgrass	0.24×10^6
Fucoid Algae	6.25×10^6
Green Algae	1.11×10^6
Kelp	0.46×10^6
Red Algae	0.78×10^6
Total Production	37.14×10^6

$kgCy^{-1}$ – Kilograms of Carbon per year

TABLE HMC-02: ANNUAL PRIMARY PRODUCTIVITY [QUODDY BAY LNG]

Summary of Species Numbers, Densities (m^2) and Diversity of Intertidal Samples in Half Moon Cove and Western Passage

Sample #	# Species	Density	Diversity
HMC 1	27	75,250	1.7406
HMC 2	28	345,625	1.2479
HMC 3	25	48,525	1.4800
HMC 4	12	2,950	1.5078
HMC 5	24	24,000	0.9168
HMC 6	19	34,200	1.6341
HMC 7	21	197,625	1.3043
HMC 8	31	5,275	2.5969
HMC 9	33	16,625	1.9289
HMC 10	19	48,950	0.7159
HMC 11	38	7,875	2.8724
Mean	25	73,355	1.6314
Min	12	2,950	0.7159
Max	38	345,625	2.8724

TABLE HMC-03: SPECIES DISTRIBUTION [QUODDY BAY LNG]

TABLE 3.1.1-6

Summary of Species and Lifestages with Designated EFH in the LNG Terminal Area (NEFMC 1998a)

Species	Lifestage				
	Eggs	Larvae	Juveniles	Adults	Spawning Adults
American Plaice (Hippoglossoides platessoides)	x	x	x	x	x
Atlantic Cod (Gadus morhua)	a/	x	x	x	
Atlantic Halibut (Hippoglossus hippoglossus)	x	x	x	x	x
Atlantic Mackerel (Scomber scombrus)			x	x	
Atlantic Salmon (Salmo salar)			x	x	
Atlantic Sea Herring (Clupea harengus)		x	x	x	
Atlantic Sea Scallop (Placopecten magellanicus)	x	x	x	x	x
Ocean Pout (Macrozoarces americanus)	x	x	x	x	x
Pollock (Pollachius virens)		x	x	x	
Red Hake (Urophysis chuss)			x	x	
White Hake (Urophysis tenuis)			x	x	
Whiting (Merluccius bilinearis)			x	x	
Windowpane Flounder (Scopthalmus aquosus)	x	x	x	x	x
Winter Flounder (Pleuronectes americanus)	x	x	x	x	x
Yellowtail Flounder (Pleuronectes ferruginea)	x	x			

a/ Empty spaces denote that EFH has not been designated within the square for the given species and lifestage.

TABLE HMC-04: FISH DISTRIBUTION [QUODDY BAY LNG]

Representative Fish Species in Project Area Waterbodies	
Common Name	**Scientific Name**
Warmwater	
Brown Bullhead	*Ictalurus nebulosus*
Chain Pickerel	*Esox niger*
Banded Killifish	*Fundulus diaphanus*
Threespine Stickleback	*Gasterosteus aculeatus*
Ninespine Stickleback	*Pungitius pungitius*
White Perch	*Morone americana*
Smallmouth Bass	*Micropterus dolomieui*
Yellow Perch	*Perca flavescens*
Redbreast Sunfish	*Lepomis auritus*
Pumpkinseed Sunfish	*Lepomis gibbosus*
Common Shiner	*Notropis cornutus*
Golden Shiner	*Notemigonus crysoleucas*
Fallfish	*Semotilus corporalis*
Creek Chub	*Semotilus atromaculatus*
Coldwater	
Blacknose Dace	*Rhinichthys atratulus*
Longnose Dace	*Rhinichthys cataractae*
Longnose Sucker	*Catostomus catostomus*
White Sucker	*Catostomus commersoni*
Landlocked Atlantic Salmon	*Salmo salar*
Brown Trout	*Salmo trutta*
Brook Trout	*Salvelinus fontinalis*
Burbot	*Lota lota*
Slimy Sculpin	*Cottus cognatus*
Diadromous	
Anadromous	
Rainbow Smelt	*Osmerus mordax*
Atlantic Salmon	*Salmo salar*
American Shad	*Alosa sapidissima*
Alewife	*Alosa pseudoharengus*
Blueback Herring	*Alosa aestivalis*
Striped Bass	*Morone saxatalis*
Catadromous	
American Eel	*Anguilla rostrata*

TABLE HMC-05: REPRESENTATIVE FISH SPECIES [QUODDY BAY LNG]

TABLE 3 1.1-10

Summary of Occurrence of Commercially and Recreationally Important Non –EFH Species and Lifestages in Passamaquoddy Bay (Jury et al., 1994)

Species	Lifestage	Month											
		Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Northern Quahog	Eggs						N/A						
	Larvae						N/A						
	Juveniles	X	X	X	X	X	X	X	X	X	X	X	X
	Adults	X	X	X	X	X	X	X	X	X	X	X	X
	Spawning Adults						N/A						
Softshell clam	Eggs					X	X	X	X	X			
	Larvae					X	X	X	X	X			
	Juveniles	X	X	X	X	X	X	X	X	X	X	X	X
	Adults	X	X	X	X	X	X	X	X	X	X	X	X
	Spawning Adults					X	X	X	X	X			
Northern shrimp	Eggs	X											
	Larvae	X	X	X									X
	Juveniles		X	X									
	Adults	X	X	X									X
	Spawning Adults	X	X	X									X
American Lobster	Eggs	X	X	X	X	X	X	X	X	X	X	X	X
	Larvae							X	X	X			
	Juveniles	X	X	X	X	X	X	X	X	X	X	X	X
	Adults	X	X	X	X	X	X	X	X	X	X	X	X
	Spawning adults						X	X	X	X			
Jonah crab	Eggs					N/A							
	Larvae					N/A							
	Juveniles					Rare							
	Adults					Rare							
Rock crab	Eggs	X	X	X	X	X	X				X	X	X
	Larvae						X	X	X	X	X	X	X
	Juveniles	X	X	X	X	X	X	X	X	X	X	X	X
	Adults	X	X	X	X	X	X	X	X	X	X	X	X
	Spawning adults									X	X	X	X
Green sea urchin	Eggs	X	X	X	X								
	Larvae		X	X	X	X							
	Juveniles	X	X	X	X	X	X	X	X	X	X	X	X
	Adults	X	X	X	X	X	X	X	X	X	X	X	X
	Spawning adults	X	X	X	X								
Blueback herring	Eggs					Rare							
	Larvae					Rare							
	Juveniles	X						X	X	X	X	X	X
	Adults	X			X	X	X	X	X	X	X	X	X
	Spawning Adults					Rare							
Alewife	Eggs					Rare							
	Larvae					Rare							
	Juveniles	X						X	X	X	X	X	X
	Adults	X			X	X	X	X	X	X		X	X
	Spawning Adults					Rare							

N/A = no data available
Rare = species/lifestage is present but not frequently encountered

TABLE HMC-06: COMMERCIAL AND RECREATIONAL IMPORTANT SPECIES [QUODDY BAY LNG]

TABLE 3.1.1-16

Results of Soft Substrate Recolonization Studies Including Location, Stressor, and Time to Recovery

Study	Location	Stressor	Time to Recovery
Germano *et al.* 1994	Coastal New England	Dredged material Disposal	6months–1 year
Rosenberg 1971	Sweden	Paper mill (sulfite)	3 years
Rosenberg 1976	Sweden	Enrichment	5 years
Murray and Saffert 1999	Western Long Island Sound	Dredged material disposal	1–4 months
Kropp et al. 1999	Massachusetts Bay	Storms	1 2 years
Rhoads *et al.* 1978	Long Island Sound	Dredged material Disposal	1–2 years
Rhoads *et al.* 1978	Long Island Sound	Azoic sediment	6–8 months

TABLE HMC-07: RESULTS OF RECOLONIZATION STUDIES [QUODDY BAY LNG]

TABLE 3.1.1-14

Rank and Mean Density of Ichthyoplankton Eggs from Region 5, Maine-New Hampshire Inshore Trawl Surveys

Taxon	Fall 2001		Spring 2002		Spring 2003	
	Rank	Density (no./100m^3)	Rank	Density (no./100m b/)	Rank	Density (no./100m^3)
H4B a/	1	1.02	1	130.52	1	117.23
Silver hake	2	0.32				
Fourbeard rockling	3	0.27	3	5.08	2	10.97
Urophycis sp.	4	0.11				
American Plaice	4	0.11	2	12.77	3	8.15
Cunner/Yellowtail			5	1.17		
Cusk			4	6.11	4	2.18
Cod	4	0.11			5	0.29

a/ Lumped category of *Urophycis* sp., fourbeard rockling, windowpane and butterfish

TABLE HMC-08: ICHTYOPLANKTON DENSITY [QUODDY BAY LNG]

TABLE 3.1.1-8

Commercially and Recreationally Important Species in Project Area

Group	Species	Fishery a/
Finfish Species	Cod *(Gadus morhua)*	C ,R,A
	Atlantic Mackerel (*Scomber scombrus)*	C,R
	Pollock *(Pollachius virens)*	CR,A,
	Halibut: Atlantic Halibut *(Hippoglossus hippoglossus* (Linnaeus)), Turbot or Greenland Halibut*(Reinhardtius hippoglossoides)*	C,R,A
	Alewife (*Alosa pseudoharengus)*	C,R,S
	Atlantic Salmon (*Salmo salar*)	C
	Atlantic Herring *(Clupea harengus harengus)*	R,S
	Atlantic Mackerel (*Scomber scombrus*)	C,R
	Flounder/sole: American Plaice (*Hippoglossoides platessoides*), Yellowtail Flounder (Yellowtail) *(Limanda ferruginea)*, Winter Flounder (Sole) *(Pseudopleuronectes americanus)*, Witch Flounder or Gray Sole *(Glytocephalus cynoglossus)*	C,R
	Striped Bass (not fished much)	R
Invertebrate Species	American Lobster *(Homarus americanus)*	C, R
	Soft-shelled Clams *(Mya arenaria)*	C,R,S
	Deep Sea Scallop (*Placopecten magellanicus)*	C
	Common Periwinkles *(Littorina littorea)*	C,R
	Green Sea Urchins *(Strongylocentrotus droebachiensis)*	C,S
	Worms (*Neanthes* spp)	C
	Sea Cucumber (Holothuroid)	C
	Jonah/Rock crab/*Cancer* spp	C
Plants	Algae	C,S

a/ Commercial (C), Recreational (R), Sustenance (S) or Aquaculture (A)

TABLE HMC-09: COMMERCIALLY AND RECREATINALLY IMPORTANT SPECIES [QUODDY BAY LNG]

TABLE 3.1.1-1

Benthic Habitat Overview

Project Feature	Location Description	Substrate Type	Range of Water Depths (MLW) (ft)	Benthic Community Types
LNG Pier	East Side of Split Rock	Ranges between silty sands to bedrock outcrops	+22 to 50	Rocky Intertidal, Coarse Sediment Intertidal, Rocky Subtidal, Coarse Sediment Subtidal
LNG Transfer Pipelines	East Side of Split Rock	Ranges between silty sands to bedrock outcrops	+22 to 0	Rocky Intertidal, Coarse Sediment Intertidal
	West side of Split Rock	Ranges between silty sands to bedrock outcrops	+22 to 0	Rocky Intertidal, Coarse Sediment Intertidal, Fine Sediment Intertidal
	Central Area of Half Moon Cove	Silty with high organics	0 to 27	Subtidal soft bottom, Eelgrass bed
	West Side of Half Moon Cove	Ranges between silty sands to bedrock outcrops	+22 to 0	Rocky Intertidal, Coarse Sediment Intertidal, Fine Sediment Intertidal

TABLE HMC-10: BENTHIC HABITAT OVERVIEW
[QUODDY BAY LNG]

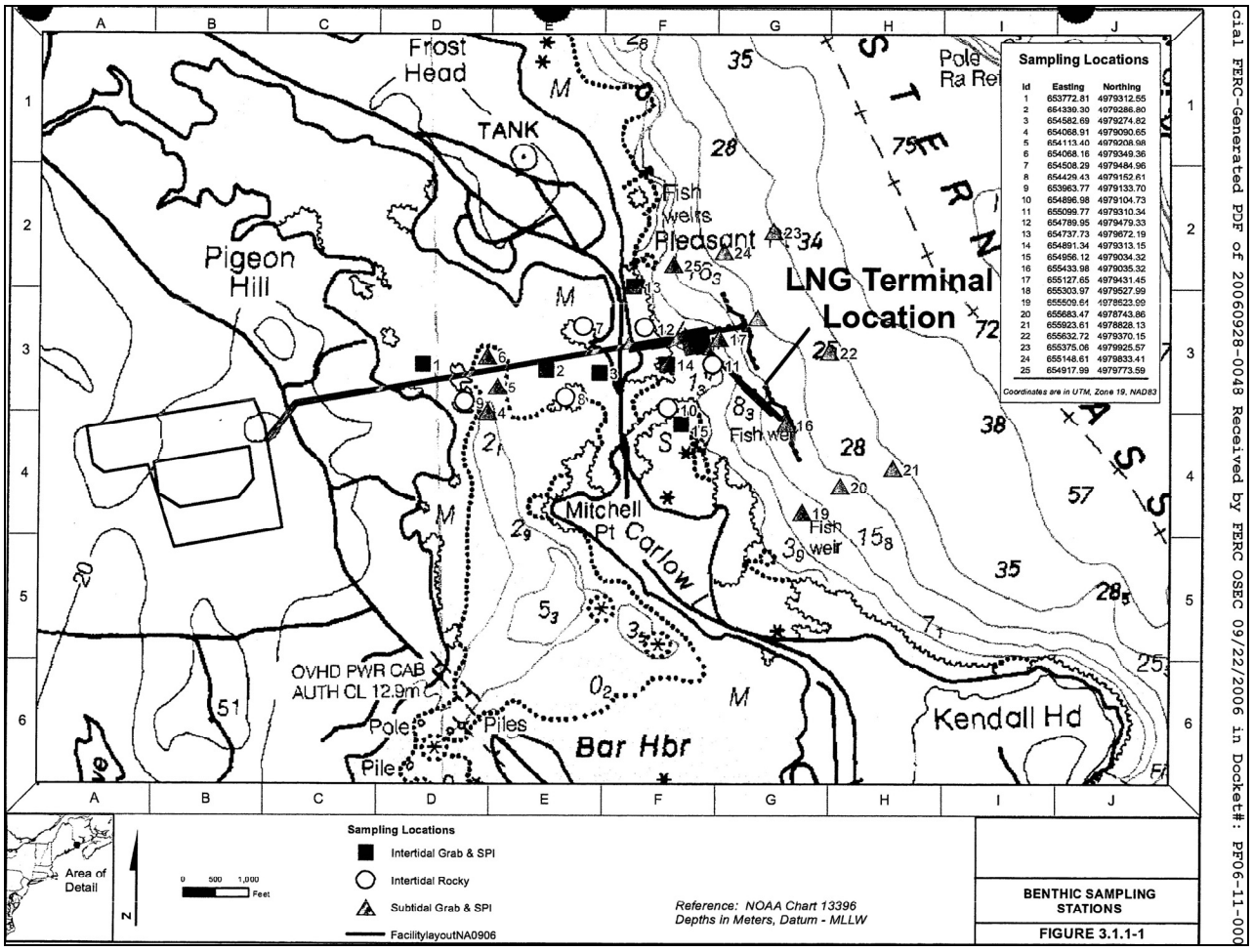

Figure HMC-22: Benthic Sampling Points from Quoddy Bay LNG License Application

TABLE 3.1-7

Summary of Seasonal Occurrence of Species and Lifestages with Designated EFH in Passamaquoddy Bay (Jury et al., 1994)

Species	Lifestage	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
American Plaice	Eggs			x	x	x							
	Larvae				x	x	x						
	Juveniles			x	x	x	x	x	x	x	x	x	
	Adults			x	x	x	x	x	x	x	x	x	
	Spawning Adults			x	x	x							
Atlantic Cod	Larvae				x	x	x						
	Juveniles				x	x	x	x	x	x	x		
	Adults				x	x	x	x	x	x	x		
Atlantic Halibut[1]	Eggs a/												
	Larvae a/												
	Juveniles a/												
	Adults a/												
	Spawning Adults a/												
Atlantic Mackerel	Juveniles						x	x	x	x			
	Adults						x	x	x	x			
Atlantic Salmon	Juveniles				x	x	x						
	Adults					x	x	x	x	x	x		
Atlantic Sea Herring	Larvae	x	x	x	x	x				x	x	x	x
	Juveniles	x	x	x	x	x	x	x	x	x	x	x	x
	Adults	x	x	x	x	x	x	x	x	x	x	x	x
Atlantic Sea Scallop	Eggs							x	x	x			
	Larvae							x	x	x	x		
	Juveniles	x	x	x	x	x	x	x	x	x	x	x	x
	Adults	x	x	x	x	x	x	x	x	x	x	x	x
	Spawning Adults							x	x	x			
Ocean Pout	Eggs	x								x	x	x	x
	Larvae	x	x	x	x							x	x
	Juveniles	x	x	x	x	x	x	x	x	x	x	x	x
	Adults	x	x	x	x	x	x	x	x	x	x	x	x
	Spawning Adults									x	x		

TABLE HMC-11: SEASONAL OCCURRENCE OF SPECIES AND LIFESTAGES [QUODDY BAY LNG]

TABLE 3.1.1-7

Summary of Seasonal Occurrence of Species and Lifestages with Designated EFH in Passamaquoddy Bay (Jury et al., 1994)

Species	Lifestage	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Pollock	Larvae			x	x								
	Juveniles	x	x	x	x	x	x	x	x	x	x	x	x
	Adults									x	x		
Red Hake	Juveniles						x	x	x	x			
	Adults						x	x	x	x			
White Hake	Juveniles						x	x	x	x	x	x	
	Adults						x	x	x	x	x	x	
Whiting (Silver Hake)	Juveniles						x	x	x	x	x		
	Adults						x	x	x	x	x		
Windowpane Flounder	Eggs						x	x	x				
	Larvae						x	x	x	x			
	Juveniles	x	x	x	x	x	x	x	x	x	x	x	x
	Adults	x	x	x	x	x	x	x	x	x	x	x	x
	Spawning Adults						x	x					
Winter Flounder	Eggs			x	x	x	x						
	Larvae				x	x	x						
	Juveniles	x	x	x	x	x	x	x	x	x	x	x	x
	Adults	x	x	x	x	x	x	x	x	x	x	x	x
	Spawning Adults			x	x	x							
Yellowtail Flounder	Eggs				x	x	x	x	x				
	Larvae				x	x	x	x	x				

a/ Information for this species specific to Passamaquoddy Bay is not provided in Jury et al., 1994.

TABLE HMC-12: SUMMARY OF SEASONAL OCCURRENCE [II]
[QUODDY BAY LNG]

TABLE 3.1.4-1

Federally and State Listed Wildlife and Plant Species that Potentially Occur within the Vicinity of the Quoddy Bay LNG Project

Species	Habitat Type in Proximity to Construction ROW	Federal Status	State Status
Golden Eagle *(Aquila chrysaetos)*	Potential migrant along Coast	None	Endangered
Peregrine Falcon *(Falco peregrinus)*	Terrestrial	None	Endangered (breeding population only)
Piping Plover *(Charadrius melodus)*	Shorebird	Threatened	Endangered
American Pipit *(Anthus rubescens)*	Rare migrant along Coast	None	Endangered (breeding population only)
Plants			
Showy Lady's-Slipper *(Cypripedium reginae)*	Near Sawtelle Heath	None	Special Concern Species
Swamp Fly-Honeysuckle *(Lonicera oblongifolia)*	Near Sawtelle Heath	None	Special Concern Species
Swamp Birch *(Betula pumila)*	(To be completed with field data Summer 2006)	None	Special Concern Species
Sparse-flowered sedge *(Carex tenuiflora)*	(To be completed with field data Summer 2006)	None	Special Concern Species
Bog Bedstraw *(Galium labradoricum)*	(To be completed with field data Summer 2006)	None	Special Concern Species
Vasey Rush *(Juncus vaseyi)*	(To be completed with field data Summer 2006)	None	Endangered

TABLE HMC-13: FEDERALLY AND STATE LISTED WILDLIFE AND PLANT SPECIES [QUODDY BAY LNG]

The proposed modification to the tidal regime of Half-Moon Cove will result in the presence of more water in the impoundment at its minimum elevation, an unavoidable consequence of development which has both benefits and costs to the region.

i. description of existing fish,wildlife, and plant communities of the proposed project area and vicinity

outline:
- introduction
- terrestial resources
- birds
- mammals
- reptiles and amphibians
- existing environment
  - physical, algae and tracheophytes, phytoplankton and zooplankton, ichthyoplankton, finfisn, and marine mammals

A-4 MAMMALS

The mammals possibly occurring in the terrestrial vegetation communities and/or saltmarshes of the Half Moon Cove area would include 42 species (Table A-2).

A-5 REPTILES AND AMPHIBIANS

The reptiles and amphibians which possibly inhabitat the Half Moon Cove area are listed in Table A-3.

A-6 EXISTING ENVIRONMENT

A-6.1 Physical Environment

The mean tidal amplitude fluctuates in excess of 18 feet and varies from 11.3 feet to 25.3 feet. Under these extreme conditions, the surface area at high tide and low tide are 795 acres and 290 acres, respectively. The strong tidal flows and high velocity currents result in vertical mixing of the water column and prevent stratification as indicated by the uniformity of temperature, salinity and dissolved oxygen concentration at all depths. Although not an estuary, there are

areas of minor freshwater influx existing within the Half Moon Cove. However, the influx does not alter the marine characteristics of the water column.

In Half-Moon Cove, salinity values remained constant throughout the water column with values ranging from 26.5 ppt. to 31.7 ppt. Summer dissolved oxygen concentrations are unstratified and range from 8.9 to 10.5 ppm. Water temperatures increased from 10.5° C to 15.2° C through the month of July (Merrill and Oullette, 1979). These physical and chemical parameters coincide with the season range of values reported for the Cobscook Bay area (Stone and Webster 1977). Biological oxygen demand in the Cove is low as indicated by values ranging from 0.06 to 0.48 ppm/day. Secchi disk turbidity measurements ranged from 500 cm to 650 cm. The bottom (400-550 cm) was visible at several locations throughout the Cove.

A-6.2 Algae and Tracheaphytes

The marine ecosystem of Half Moon Cove can be divided into several major habitat types as described by Merrill and Ouellette (1979) in their preliminary study. The magnitude of the tides and the gradually sloping bottom of the cove produces an extensive littoral zone of glacial till, marine silt, clay, sand and other gravel. The mud flats are covered by Enteromorpha and other ephemeral green algae from the low mark to approximately 10 feet above the mark. Ascophyllum nodosum and Fucus spp. are associated with rocky substrate and found throughout the intertidal zone. Salt marshes found in the high intertidal area are dominated by Spartina spp. although Ascophyllum and Fucus are present. The shallow sub-tidal zone is dominated by Zosteria marina while Agarum cribosum and Laminaria spp. is found in most of the deeper subtidal areas of the Cove.

Phycodrys rubens and Desmarestia virdis are abundant around the proposed dam site. Table A-4 lists the algae and tracheophyte found in the preliminary survey of Half Moon Cove.

A-6.3 Phytoplankton and Zooplankton

No plankton studies have been conducted in Half Moon Cove but information is available for Cobscook Bay. Diatoms, dominated by Biddulphi ssp., Thalassosira ssp., and Chaltoceros ssp. are the most abundant phytoplankter. Dinoflagellates were never abundant. Species composition varies throughout the year with blooms occurring in early June. (National Marine Fisheries Service, 1980; Stone and Webster 1977.)

In the Cobscook Region, copepods were the dominant zooplankter. Fifty (50) taxa of zooplankters have been identified although six copepod species account for the majority of the taxa collected. Calanus finmarchicus, Pseudocalanus minutus and Centropages typicus, common in the Gulf of Maine, were the most abundant species. Tortanus discaudatus, Acartia clausi and Eurytemora herdmani are considered endemic to the Quoddy Region (Legare and McClellan, 1960). The relative abundance of zooplankter varied seasonally with the greatest densities occurring in summer and decreasing from fall and winter through spring. Also eggs, larvae and juveniles of neritic and benthic species were collected as zooplankton including fish, crabs, euphausiids, mussels, barnacles, chaetognaths and annelids (NMNS,1980).

A-6.4 Marine Benthic Organisms

Preliminary studies conducted at Half Moon Cove yielded over 60 taxa representing 10 phyla of invertebrates. Approximately 30 of the taxa occurred frequently. Table A-5 lists the invertebrates

found in the intertidal and subtidal areas of Half Moon Cove (Merrill and Ouellette, 1979). In shallow subtidal areas, Echinarochnius parma was common. Dominant organisms in deeper subtidal areas include Placopecten magellanicus, Buccinum undatum, Solaster endeca and Crossaster papposus. In the intertidal area, Mya arenaria, Macoma balthica and Saccoglossus kowalewskii were the most common organisms. Mytilus edulis and Asterias vulgaris were the dominant species at the dam site.

The soft shell clam is the most important commercial invertebrate in Half Moon Cove. Results of a preliminary survey showed that clam densities were greatest near Carlow Island on the east and west shore of the cove. The clam population is mainly distributed in the mid-and high sections. Both young and older clams were found in these areas indicating the successful setting of spats in the area. Presently, clam flats near Quoddy Village are closed to clam diggers due to the raw sewage discharge into the Cove. (Merrill and Ouellette, 1979). This has severely limited any serious consideration of extensive commercial clamming activities.

In Cobscook Bay and adjacent water, the shellfish harvest is limited. Biological constraints such as extreme tidal ranges, tidal velocity, extensive scouring and cold water temperatures reduce growth rates and increase mortality rates. Even though it is estimated that the landings could be increased, economic factors such as public acceptance of minimum size clams and distribution constraints influence the intensity of the fishery.

The marine worm population has not been inventoried in the Cove but the Maine State Planning Office has designated the eastern shore near Quoddy Village as a commercial marine worm bed.

A-7

No full-time diggers are presently operating in the area. Edible snails (Littorina littorea) are abundant in Half Moon Cove and Cobscook Bay. Detailed surveys of the periwinkle populations have not been made and detailed landing records are not available but the fishery is expanding (Stone and Webster, 1977).

A-6.5 Ichthyoplankton

No ichthyoplankton surveys have been conducted in Half-Moon Cove. Surveys in the Quoddy Region indicated twenty-two taxa of ichthyoplankton were present (Table A-6). Larvae of Anguilla rostrata (American eel), Hippoglossoides platessoides (American plaice) Cyclopterus lumpus (lumpfish), Crypotocanthodes maculatus (wrymouth) and Liparis spp. (sea snails) were frequently collected. Few individuals of the remaining taxa were reported. Larvae of important commercial fishes were scarce indicating Cobscook Bay is not a major spawning area for most pelagic and demersal fishes.

A-6.6 Finfish

Sixty-six species of finfish are known to occur in Cobscook Bay (Table A-7). Three of these species were collected by otto trawl in a preliminary survey in Half-Moon Cove: Pseudopleuronectes americanus (winter flounder), Cyclopterus lumpus (lumpfish) and Pholis gunnelus (rock gunnel). Visual sightings of Hemitripterus americanus (sea raven) and Gasterosteus aculatus (threespine stickleback) were reported at several locations within the cove (Merrill and Ouellette, 1979). Although few species of fish were collected, it is possible the Cove is used as a feeding area. As an example, pelagic fish (herring and mackeral) and demersal fish (flatfish and codfish) present in Cobscook Bay may move in and out of Half-Moon Cove in limited forage wanderings.

Half-Moon Cove is a potential spawning area for the winter flounder. The preferred spawning substrate of soft mud or sand and mud mixture

is found throughout the Cove. The potential spawning period is April and May based on data from the Passamaquoddy Bay Region (EPA,1978). It is unlikely that anadromous or catadromous species used the Cove during spawning runs since the freshwater flux into the Cove is very limited.

Few fish species of commercial value are found in Half-Moon Cove. Restrictions on the use of draggers have prevented the development of a winter flounder fisheries. Exploitation of marine resources is further limited by the general lack of productivity in the Cove caused by the construction of two dams in the 1930's that restricted the flow of the Passamaquoddy Bay into the cove.

A-6.7 Marine Mammals

The harbor seal (Phoca vitulina) was the only marine mammal sighted in Half-Moon Cove (Merrill and Ouellette 1979). A breeding population of harbor seals exist in Cobscook Bay. Other marine mammals regularly sighted in Cobscook Bay include the finback whale (Balanoptera physalus), minke whale (B.acutorostra) and right whale (Eupalaena glacialis). The harbor porpoise (Phocaena phocoena) is the most common cetacean found in the region (EPA,1978). No endangered marine mammals have been reported in Half-Moon Cove.

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TABLE A-1

POTENTIAL FLORA FOUND NEAR HALF MOON COVE (1)

Ferns and Mosses:

Polytrichum commune (sphagnum moss)
Lycopodium complanatum (creeping Jenny - running pine)
Lycopodium obscurum (princess pine)
Osmunda claytoniana (interrupted fern)
Dennstaedtia punctilobula (hay-scented fern)
Dryopteris cristata (crested shield fern)
Polypodium vulgare (common polypody fern)
Pteridium aquilinum (bracken fern)

Herbaccous plants:

Carex sp. (sedge)
Juncus sp. (rush)
Maianthemum canadense (false lily of the valley)
Trillium erectum (waterobin)
Goodyera teselata (rattlesnake plantain)
Comptonia pergrina (sweet fern)
Rumex acetosella (common sorrel)
Spirea alba (meadowsweet)
Potentilla simplex (common cinquefoil)
Rubus hispidus (raspberry)
Fragaria sp. (strawberry)
Viburum lentago (nannyberry)
Kalmia angustifolia (lamb kill)
Gaultheria Trocumbens (wintergreen)
Vaccinum corymbosum (high bush blueberry)
Vaccinum augustifolium (low sweet blueberry)
Michella repens (partridge berry)
Verbascum thapsus (common mullein)
Linaria canadensis (toadflax)

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Table A-1 (Continued)

Solidago sp. (goldenrod)
Aster sp. (aster)
Achillea millefolium (yarrow)

Deciduous and Evergreen Trees:

Abies balsamea (balsam fir)
Tsuga canadensis (hemlock)
Thuja occidentalis (n. white cedar)
Picea rubens (red spruce)
Larix laricinia (tamarack)
Salix sp. (willow)
Populus tremuloides (trembling aspen)
Populus deltoides (cottonwood)
Faqus grandifolia (American beech)
Betula lutea (yellow birch)
Betula populifolia (gray birch)
Betula papyrifera (paper birch)
Alnus glutinosus (european alder)
malus malus (apple)
Ostraya virginiana (eastern hornbeam)
Pyrus americana (mountain ash)
Prunus pensylvanica (pin cherry)
Prunus virginiana (choke cherry)
Prunus avium (sweet cherry)
Acer rubrum (red maple)
Acer spicatum (mountain maple)
Acer pensylvanicum (striped maple)
Cornus florida (flowering dogwood)
Amelanchier sp. (shadbush - service berry)

Source: U.S. Environmental Portection Agency, 1976. Final Environmental Impact Statement. Proposed Issuance of Federal Permits to the Pittsson Co. of New York for Construction of a 250,000 Barrel/Day Oil Re - finery and Marine Terminal - Eastport, Maine, Region I, Boston.

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MAMMALS POSSIBLY OCCURRING IN THE HALF MOON COVE AREA

Hairytail Mole (Parascalops breweri)
Starnose Mole (Condylura cristata)
Masked Shrew (Sorex cinereus)
Smokey Shrew (Sorex fumeus)
Northern Water Shrew (Sorex palustris)

Pigmy Shrew (Microsorex hoyi)
Shorttail Shrew (Blarina brevicanda)
Little Brown Myotis (Myotis lucifugus)
Keen Myotis (Myotis keeni)
Silver-Haired Bat (Lasionycteris noctigagans)

Hoary Bat (Lasiurus cinereus)
Red Bat (Lasiurus borealis)
Big Brown Bat (Eptesicus fuscus)
Black Bear (Ursus americanus)
Raccoon (Procyon lotor)

Marten (Martes americana)
Fisher (Martes pennanti)
Shorttail Weasel (Mustela erminea)
Longtail Weasel (Mustela frenata)
Mink (Mustela vison)

Striped Skunk (Mephitis mephitis)
River Otter (Lutra canadensis)
Red Fox (Vulpes fulva)
Bobcat (Lynx rufus)
Woodchuck (Marmota monax)

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TABLE A-2 (Continued)

Eastern Chipmunk (*Tamias striatus*)
Red Squirrel (*Tamiasciurus hudsonicus*)
Eastern Gray Squirrel (*Sciurus cardinensis*)
Northern Flying Squirrel (*Glaucomys sabrinus*)
Deer Mouse (*Peromyscus maniculatus*)

Beaver (*Castor canadensis*)
Southern Bog Lemming (*Synaptomys cooperi*)
Meadow Vole (*Microtus pennsylvanicus*)
Boreal Redback Vole (*Clethrionononomys gapperi*)
Muskrat (*Ondatra zibethica*)

Norway Rat (*Rattus norvegicus*)
House Mouse (*Mus musculus*)
Meadow Jumping Mouse (*Zapus hudsonius*)
Woodland Jumping Mouse (*Napaeozapus insignis*)
Porcupine (*Erethizon dorsatum*)

Snowshoe Hare (*Lepus americanus*)
Whitetail Deer (*Odocoileus virginianus*)

Source: U.S. Environmental Protection Agency. 1976. Final Environmental Impact Statement. Proposed Issuance of Federal Permits to the Pittsson Co. of New York for Construction of a 250,000 Barrel/Day Oil Refinery and Marine Terminal - Eastport, Maine. Region I, Boston.

TABLE A-3

REPTILES AND AMPHIBIANS POSSIBLY OCCURRING IN THE HALF MOON COVE AREA

Common Snapping Turtle (Chelydra serpentina)
Stinkpot (Sternothaerus odoratus)
Wood Turtle (Clemmys insculpta)

Northern Red-bellied Snake (Storeria occipitomaculata)
Eastern Garter Snake (Thamnophis sirtalis)
Eastern Ribbon Sanke (Thamnophis sauritus)
Northern Ringneck Snake (Diadophis punctatus)
Northern Black Racer (Coluber constrictor)
Eastern Smooth Green Snake (Opheadrys vernalis)

Jefferson Salamander (Ambystoma jeffersonianum)
Blue-spotted Salamander (Ambystoma laterale)
Spotted Salamander (Ambystoma maculatum)
Red-spotted Newt (Diemictylus viridescens)
Northern Dusky Salamander (Desmognathus fuscus)
Northern Two-lined Salamander (Eurycea bislineata)
Red-Backed Salamander (Plethodon cinereus)

American Toad (Bufo americanus)
Northern Spring Peeper (Hyla crucifer)
Bullfrog (Rana catesbeiana)
Green Frog (Rana clamitans)
Northern Leopard Frog (Rana pipiens)

Pickerel Frog (Rana palustris)
Wood Frog (Rana sylvatica)

Source: U. S. Environmental Protection Agency. 1976. Final Environmental Impact Statement. Proposed Issuance of Federal Permits to the Pittsson Co., of New York for Construction of a 250,000 Barrel/Day Oil Refinery and Marine Terminal - Eastport, Maine. Region I, Boston.

TABLE A-4

ALGAE AND TRACHEOPHYTES (1)

Division Chlorophyta
- Class Ulotrichales
  - *Ulva lactuca*
  - *Enteromorpha* spp.
- Class Cladophorales
  - *Chaetomorpha* sp.
  - *Rhizoclonium* sp.
  - *Spongamorpha arcta*

Division Phaeophyta
- Class Desmarestiales
  - *Desmarestia aculeata*
  - *Desmarestia viridis*
- Class Laminariales
  - *Agarum cribosum*
  - *Laminaria longicrusis*
  - *Laminaria digitata*
  - *Laminaria saccharina*
  - *Ascophyllum nodosum*
  - *Fucus vesiculosis*
  - *Fucus edentatus*

Division Rhodophyta
- Class Gigartinales
  - *Chondrus crispus*
  - *Cystoclonium purpureum*
- Class Ceramiales
  - *Ceramium rubrum*
  - *Ptilota serrata*
  - *Polysiphonia lanosa*
  - *Membranoptera alata*

TABLE A-4 (Continued

Class Bangiaceae

Porphyra sp.

Class Rhodymeniales

Phodymenia palmata

Class Corallenaceae

encrusting red algae

Division Tracheophyta

Zostera marina

Spartina alterniflora

Spartina patens

Salicornia sp.

Source: Merrill, C.L. and D.E. Ouellette, 1979. A Preliminary Ecological Survey of Half Moon Cove, Maine. Prepared by R.S. Friedman Cobscook Bay Laboratory.

TABLE A-5

INVERTEBRATES (1)

Phylum Porifera	
Class Desmospongeae	
Haliclona oculata	R
Halichondria panicea	M
Isodictya deichmannae	F
Phylum Cnidaria	
Class Hydrozoa	
Corymorpha pendula	M
Class Scyphozoa	
Lucernaria quadricornis	R
Cyanea capillata	M
Class Anthozoa	
Metridium senile	R
Tealia felina	F
Phylum Ctenophora	
unidentified	M
Phylum Mollusca	
Class Polyplacophora	
Ischnochiton ruber	R
Class Gastropoda	
Acmeae testudinalis	R
Margarites groenlandica	M
Lacuna vincta	M
Littorina littorea	M
Littorina obtusata	F
Littorina saxatilus	F
Lunatia heros	M
Neptunea decemostata	F
Buccinum undatum	M
Coryphella rufibranchialis	R

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E.3-20

TABLE A-5 (Continued)

Class Bivalvia	
Venericardia borealis	R
Astarte sp.	R
Mytilus edulis	M
Modiolus modiolus	M
Placopecten magellanicus	M
Macoma balthica	M
Mya arenaria	M
Class Cephalopoda	
Illex illecebrosus	M
Phylum Annelida	
Class Polychaeta	
Spirorbis spirillum	M
Phyllodoce groenlandica	R
Nereis sp.	R
Clymenella zonalis	R
Amphitrite johnstoni	R
Lepidonotus squamatus	F
Myxicola infundibulum	M
Class Oligochaeta	
Clitellio arenarius	M
Phylum Priapulida	
Priapulus caudatus	R
Phylum Arthropoda	
Class Crustacea	
Corophium volutator	M
Idotea balthica	F
Idotea phosphorea	F
Marinogammarus finmarchicus	R
Gammarus sp.	F
Amphithoe rubricata	R

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E.3-21

TABLE A-5 (Continued)

Labbeus polaris	F
Crangon septemspinosa	F
Balanus sp.	F
Cancer irroratus	M
Libinia sp.	R
Pagurus acadianus	M
Phylum Echinodermata	
Class Holothuroidea	
Chirodota laevis	M
Cucumaria frondosa	F
Class Echinoidea	
Echinarachnius parma	M
Strongylocentrotus droenbachiensis	M
Class Stelleroidea	
Axiognathis squamata	F
Asterias vulgaris	M
Leptasterias spp.	M
Crossaster papposus	M
Solaster endeca	M
Phylum Hemichordata	
Class Enteropneusta	
Saccoglossus kowalewskii	M
Phylum Chordata	
Class Ascidiacea	
Molgula sp.	F
Boltenia ovifera	M
Halocynthia pyriformis	M

R-Representative (only 1 or 2 found)
F-Few (3 to several found)
M-Many (In abundance)

(1) Source: Merrill, C. L. and D. E. Ouellette. 1979. A Preliminary Ecological Survey of Half-Moon Cove, Maine. Prepared by R. S. Friedman Cobscook Bay Laboratory

A-20

Table A-6

ICHTHYOPLANKTON OF THE QUODDY REGION (1)

Ammodytes americanus	Sand lance
Anarhichas lupus	Wolfish
Anguilla rostrata	American eel
Apeltes quadracus	Four-Spine stickleback
Aspidophoroides monopteryqius	Alligatorfish
Clupea harenqus	Herring
Cryptocanthodes maculatus	Wrymouth
Cyclopterus lumpus	Lumpfish
Enchelyopus cimbrius	Four-beard rockling
Gadus morhua	Atlantic Cod
Glyptocephalus cynoglossus	Witch flounder
Hippoglossoides platessoides	Sand dab (American plaice)
Melanogrammus aeqlefinus	Haddock
Merluccius bilinearis	Silver Hake
Myxocephalus scorpius	Shorthorn Sculpin
Nectoliparis atlanticus	Snail fish
Osmerus mordax	Smelt
Pholis gunnellus	Rock gunnel
Pollachius virens	Pollock
Peprilus triacanthus	Butterfish
Pseudopleuronectes americanus	Winter flounder
Urophycis tenuis	White Hake

(1) Source: Legare and MaClellan 1960. A Qualitative and Quantitative Study of the Plankton of the Quoddy Region in 1957 and 1958 With Special Reference to the Food of the Herring. J. Fish. Res. Bd. Can. 17(3): 409-448.

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TABLE A-7

FINFISH SPECIES IN THE
QUODDY AND NEW BRUNSWICK REGIONS (1)

COMMON NAME	SCIENTIFIC NAME
Atlantic hagfish	Myxine Glutinosa
Sea lamprey	Petromyzon marinus
Sand shark	Carcharius taurus
Basking shark	Cetorhinus maximus
White shark	Carcharodon carcharias
Porbeagle	Lamna nasus
Little skate	Raja erinacea
Barndoor skate	R. laevis
Winter skate	R. ocellata
Thorny skate	R. radiata
Blueback herring	Alosa aestivalis
Alewife	A. pseudoharengus
American's shad	A. sapidissima
Atlantic herring	Clupea harengus
Atlantic salmon	Salmo salar
Brown trout	Salmo trutta
Brook trout	Salvelinus fontinalis
Freshwater eel	Anguilla rostrata
Mummichog	Fundulus heteroclitus
Fourspine stickleback	Apeltes quadracus
Threespine stickleback	Gasterosteus aculeatus
Blackspotted stickleback	G. wheatlandi
Nine spined stickleback	Pungitius pungitius
Cusk	Brosme brosme
Fourbeard rockling	Enchelyopus cimbrius
Atlantic cod	Gadus morhua
Haddock	Melanogrammus aeglefinus

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TABLE A-7 (Continued)

Silver hake	Merluccius bilinearis
Atlantic tomcod	Microgadus tomcod
Pollock	Pollachius virens
White hake	Urophycis tenuis
Striped bass	Morone saxatilis
Tautog	Tautoga onitis
Cunner	Tautogolaburs adspersus
Sand lance	Ammodytes hexapterus
Atlantic mackeral	Scomber scombrus
Atlantic wolffish	Anarchieus lupus
Rock gunnel	Pholis gunnellus
Wrymouth	Cryptocanthodes maculatus
Snake blenny	Lumpenus lumprataeformis
Radiated shanny	Ulvaria subbifurcata
Wolf eelpout	Lysenchlys verrilli
Ocean pout	Macrosoarces americanus
Butterfish	Peprilus triacanthus
Atlantic silverside	Menidia menidia
Ocean perch	Sebastes marinus
Northern searobin	Prionotus carolinus
Atlantic sea raven	Hemitripterus americanus
Grubby	Myoxocephalus aeneus
Longhorn sculpin	M. octodecemspinosus
Shorthorn sculpin	M. scorpius
Mailed sculpin	Triglops murrayi
Alligator fish	Aspidophoroides monopterygius
Lumpfish	Cyclopterus lumpus
Atlantic seasnail	Liparis atlanticus
Striped seasnail	L. liparis
Fourspot flounder	Paralichthys oblongus

A-23

E.3-25

TABLE A-7 (Continued)

Window pane	Scophthelmus aquosus
Witch flounder	Glyptocephalus cygnoglossus
American plaice	Hippoglossoides platessoides
Atlantic halibut	Hippoglossus hippoglussus
Yellowtail Flounder	Limanda ferruginea
Smooth flounder	Liopsetta putnami
Winter flounder	Pseudopleuronectis americanus
Monkfish	Lophius americanus
Atlantic torpedo	Torpedo nobiliana

3.1.1.1.3 Marine Invasive Species

Several species of marine invertebrates can be considered invasive, having been introduced over the past several centuries in association with vessel transits across the Atlantic ocean. The green crab, *Carcinus maenas*, was originally a European species that probably clung to the hull of wooden sailing vessels or whose larvae were introduced in ballast water. *Didemnum albidum* is an invasive tunicate first identified in Cobscook Bay over a hundred years ago. More recently, an unknown tunicate, possibly thought to be *Didemnum vexillim*, has been discovered in the Cobscook Bay area (Larry Harris, pers comm.). Invasive species can have varying degrees of affect on the local ecology, depending upon factors such as there competitiveness with native species, mode of reproduction, use of the habitat, hardiness, and other opportunistic characteristics.

It appears that there has been no systematic effort to evaluate the distribution of invasive tunicates in the Quoddy region. It is possible that the development of the more recent *Didemnum* in well-mixed areas like Cobscook Bay is limited by cold water temperatures. It may be that the temperatures do not allow sexual reproduction. In general species of *Didemnum* may recruit by budding or fragmentation of colonies.

§ 5.6 (d)(3)(iv)(B) Essential Fish Habitat

(B) Identification of any essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act and established by the National Marine Fisheries Service

3.1.1.3 Essential Fish Habitat

In 1976, the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) established a management system for marine fishery resources of the United States. This included the establishment of regional fishery management councils (FMCs) that develop fishery management plans to properly manage fishery resources within their jurisdictional waters. The 1986 and 1996 amendments to the Magnuson-Stevens Act, renamed the Sustainable Fisheries Act, recognized that many fisheries are dependent on nearshore and estuarine habitats for at least part of their lifecycles and included evaluation of habitat loss and protection of critical habitat. Specifically, Congress charged NOAA Fisheries and the fishery management councils, along with other federal and state agencies and the fishing community, to identify habitats essential to managed species, which include marine, estuarine, and anadromous finfish, mollusks and crustaceans. The habitat is identified as Essential Fish Habitat (EFH) and is defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". The Magnuson-Stevens Act further mandates that NOAA Fisheries coordinate with other federal agencies to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH that could result from activities or proposed activities.

To delineate EFH, coastal waters were mapped by regional FMCs and superimposed with 10-minute by 10-minute square coordinate grids or quadrats. The proposed Project's LNG Terminal area crosses one of the 10-minute by 10-minute quadrats that have been designated EFH for 14 species of finfish and one species of shellfish (Table 3.1.1-6). A summary of seasonal occurrence of species and lifestages with designated EFH is presented in Table 3.1.1-7. Correspondence with the Northeast Region of NOAA National Marine Fisheries Service (NOAA Fisheries) (Colosi, 2006), State of Maine Atlantic Salmon Commission (Dubé, 2006) and USFWS (Russell, 2006a) have indicated the proposed Project's LNG Terminal area includes and is adjacent to areas identified as EFH for various lifestages of species that are included in Table 3.1.1-7.

A detailed description of the life history characteristics and habitat preferences of these species is provided in Appendix 3-D, as is a discussion of the potential for these species to occur within the proposed Project's LNG Terminal area of potential effect. The EFH Assessment evaluates the Project's potential construction and operation impacts on EFH and EFH species, including all lifestages that occur in the Project area.

3.1.1.4 Commercially and Recreationally Important Species

There are a number of commercially and recreationally important fish, shellfish and other invertebrate species in the Quoddy Bay LNG Project area (Table 3.1.1-8). Although not comprehensive, Figure 3.1.1-2 shows general locations of some of the commercial, recreational and sustenance fisheries in the vicinity of the LNG Terminal compiled by several resources. The statewide landings and landed value (Table 3.1.1-9) for 2004 give an indication of the importance of the fisheries throughout the State. Importance within the study area was gauged by the number of licenses as well as anecdotal information about harvesting effort. Information on seasonal occurrences of the various lifestages occurring in Passamaquoddy Bay has been summarized by Jury et al., (1994) and presented in Table 3.1.1-10. Trawl data collected by the Maine Department of Marine Resources (MDMR) for stations closest to Quoddy Bay are shown in Table 3.1.1-11. The economic benefit from commercial and recreational fishing and harvesting is presented below and in Resource Report 8, while this section focuses on the targeted resources. While not an animal, there is harvest and culture of several algae species in the region, and for continuity purposes, this resource is discussed here rather than in Section 3.1.2.

Table 3.1.1-9 covers those species not covered in another section. The Atlantic salmon is covered under Threatened and Endangered Species (Section 3.1.4) and EFH, and those commercial fish species that are also identified as EFH species are covered under the EFH Assessment (Section 3.1.1.3) and Appendix 3-D). It should be noted that the current status of the fishery resource of Half Moon Cove is not well known; however, members of the Passamaquoddy Tribe have stated that migratory species (*i.e.,* herring) were traditionally caught in the Cove but do not currently exist. The Tribe has also noted that there was a historically sustaining small recreational fishery for haddock and Winter Flounder in the Cove, which is now non-existent (USACE, 2006). Lastly, some algae culture does occur in Half Moon Cove by members of the Passamaquoddy Tribe.

In Half Moon Cove, clams are most abundant in areas of silt and sand, generally near to the causeway and exposed rocky ledges, and in the southern portion of the Cove. The northernmost portion of the Cove as well as the lower intertidal throughout the Cove have few clams in the predominately soft, silt and mud sediment (Nault, 2006). The Tribal Partnership Program Section 203 Studies at Half Moon Cove indicates that historically this area was productive prior to construction of the causeway connecting Pleasant Point and Carlow Island, which resulted in increased silt deposition. According to Steve Crawford, Environmental Planner for the Passamaquoddy Tribe (Crawford, 2006a), this area has not been productive in recent memory, as sediments are too soft and silty to support a clam population. A shellfish survey was conducted in July 2005 by the U.S. Army Corps of Engineers (2006), and results are reported in USACE, 2005. Sample plots were generally concentrated along the western side of the causeway north and south of Split Rock. Additional stations were located in the lower intertidal near the middle of the Cove, and two on the east side of the causeway. Plots varied in size, from 1 ft^2 to 10 ft^2. Eight of the thirteen stations yielded clams ranging in size from 0.50 inches (1.27 cm) to 3.38 inches (8.52 cm); average size was 1.20 inches (3.05 cm); average number of clams per square foot over all plots was 1.6, ranging from 0 to 22. The Cove has had successful sets for the past several years but few grow to the 2-inch legal size; high numbers of sub-legal sized clams are present (Crawford, 2006a; Nault, 2006). Softshell clam are also harvested on the eastern side of the causeway in the non-ledge areas. To the north, Gleason Cove has also been an area of regular harvesting. However, no estimates on landings from this cove were available.

Quoddy Bay collected shellfish data were collected at 145 stations in the vicinity of the proposed pipeline route through Half Moon Cove between August 21-23, 2006. Three intertidal transects were established on the east and west sides of Half Moon Cove (Appendix 3-E). Softshell clams (*Mya arenaria*) are the dominant shellfish species within the project area in Half Moon Cove. The majority of clams collected were less than 30 mm and the largest individual measured 82 mm. Of the total collected, 179 clams were classified as juveniles (≥24mm), 116 were sub-legal adults (25-50 mm), and 69 were legally harvestable adults (≥51mm). Densities ranged from 0 to 22 clams per square foot sample with a mean of 2.5. By comparison, the largest individual collected during the USACE survey was 85 mm and densities also ranged from 0 to 22 clams per square foot sample, with a slightly lower mean of 1.6 (USACE 2005a). The distribution of *M. arenaria* throughout the intertidal reflected the availability of suitable habitat. Densities were typically highest between 150 and 550 feet into the intertidal, following patterns of variation in sediment composition. Sand content in the sediments was highest in the upper intertidal, with increasing amounts of soft silt and mud towards the lower intertidal.

The number of shellfishing licenses is one indication of harvest pressure. Two types of licenses are available in the Project area, -- one from municipalities and the other from the Passamaquoddy Tribe. Municipalities grant shellfish licenses for harvesting activities in their town. The licenses are used for softshell clams, quahogs, and oysters, although most are used for softshell clams. Both commercial and recreational licenses are available for residents and non-residents. The Passamaquoddy Tribe also grants licenses to their residents for commercial harvesting and for sustenance harvesting that allows for personal use only. The Passamaquoddy Tribal Center reported the sale of 16 commercial and two sustenance shellfish/clam licenses (Lola, 2006), while the Towns of Perry and Eastport sold 11 and six commercial licenses, respectively. Information on the sale of recreational licenses was not available from tribe and towns.

Landings are another indication of the importance of the resource. The Towns of Perry reported 166,490 pounds landed in 2005 and Eastport reported 3,800 lbs in 2005. All information specific to the Project area is anecdotal for Half Moon Cove and the east side of Route 190. Area dealers were contacted by Quoddy Bay (Chipman, 2006; Matthews, 2006); Mr. Matthews estimated that 5 to 8 bushels per day, or 250 pounds, may be harvested from the Cove when digging is most intense. There is little softshell harvesting on the east side of Route 190 in the Project area due to MDMR closures and unsuitable habitat. Crawford (2006a) believes Half Moon Cove supports 1 to 2 harvesters per month.

Scallops are harvested by boats equipped with 5 ½ foot drags, and by scuba divers. The scallop season is from December 1 to April 15. Scallops are harvested in the Western Passage, in Cobscook Bay, and just inside Half Moon Cove in the Bar Harbor area of the old toll bridge (Mitchell, 2006). Draggers also fish around Nipps, Spectacle and Goose Islands, which are adjacent to and south of Half Moon Cove (Matthews, 2006). The MDMR scallop stock assessment study conducted in 2001–2004 collected scallops in five areas within Cobscook Bay. The density of harvestable-size scallops was lowest (0.019 per meter^2) in the area sampled closest to Half Moon Cove, labeled as "Other" (west of Nipps Island southward to Goose Island), compared with the highest density (0.077 per m^2) found in South Bay. South Bay lies in the southern half of Central Bay, which is the largest portion of Cobscook Bay. Tidal circulation and exchange studies conducted by Brooks (2004) revealed the presence of paired back-eddies in the Inner Bay, which result in lower flushing times of up to a week or longer compared with flushing rates in the Outer Bay of one to two days. This could contribute to higher recruitment and retention of larval scallops in this area.

The MDMR assessment data reports a total of 28,246 kg (62,272 lbs) of harvestable biomass in all six of the areas surveyed in Cobscook Bay; the area closest to the Half Moon Cove yielded 1,340 kg (2,954 lbs); South Bay had the highest yield (40,821 lbs,18,516 kg) (Schick and Feindel, 2005).

Scallop densities in Half Moon Cove are thought to be confined to the old toll road crossing in areas not exposed during the low tides. Eelgrass beds are mapped on either side of this channel and may serve as a nursery for scallops in the area. According to Russell Wright (2006), there may be 2 to 3 draggers in the area, in the Western Passage and around the Half Moon Cove area on most days during the season. Harbor Pilot Captain Bob Peacock (2006) also has observed draggers in the Western Passage zone, and one to two occasionally in Half Moon Cove. Many fisherpersons hold multiple licenses, fishing various species with the changing seasons and markets. In the towns surrounding Cobscook Bay, 99 scalloping licenses were issued in 2005 by the MDMR, including 82 dragger, 6 diver, and 11 non-commercial licenses. The Town of Perry issued 23, Eastport issued 11, and the Passamaquoddy Tribal Center issued 10 licenses. The Tribal Center licenses were under a combination category that allows for the harvesting of several species, including scallops. Scallop licenses are issued under state jurisdiction and allow for harvesting anywhere within state waters; boats fishing the Cobscook Bay or Western Passage are not necessarily local. A report prepared for the Cobscook Bay Resource Center estimates 22 to 40 boats from the Cobscook Bay area towns actively fish for scallops in Cobscook Bay (Athearn, 2005).

According to MDMR state-wide landings data, 178,400 lbs of scallops were harvested in 2004 (see Table 3.1.1-9). Fishery market studies by Athearn (2005) estimates of 155,000 lbs of scallops were landed from Cobscook Bay alone at a gross ex-vessel value of $1 million.

Half Moon Cove has no major tributaries that would provide habitat for the freshwater lifestage of migratory fish species, and is therefore unlikely to be attractive to many individuals of any species, other than perhaps some minimal foraging activity. In light of this, Half Moon Cove is not likely to support or be valuable habitat for many migratory fish. In contrast, Western Passage represents a major passageway between Passamaquoddy Bay and the northern Gulf of Maine, with many of the migratory species listed above likely to migrate past the pier facility during their in- and out-migrations. Depending upon the species and the lifestage, migratory fish tend to travel at different positions within the water column, move at different times of the day, and may or may not overlap with other migratory species. The typical pattern is for a springtime adult in-migration and a fall out-migration of juveniles. However, as described in more detail in section 3.1.4 Atlantic salmon eggs are spawned in rivers in the fall, overwinter, and then mature in the spring, with smolts out-migrating before mid-summer.

Invasive Species

The primary invasive species of concern for the project area are members of the genus *Didemnum*. These tunicates, upon invading new shorelines, alter marine habitats and threaten to interfere with fishing and aquaculture, as well as altering benthic ecology of hard substrates. They overgrow organisms such as sponges, hydroids, anemones, bryozoans, macroalgae, scallops, mussels, and barnacles. Where these colonies become extensive in areas of gravelly sediments, they likely cover the siphons of infauna bivalves. It is thought that fragmentation of the colonies results in increasing the spread of the species, and therefore activities such as dredging have the potential to exacerbate the invasion. However, because Quoddy intends to use land stockpiling of dredge material, where any tunicates will become desiccated and die, it is unlikely that project construction will substantially aid in the spread of these species. Project operations do not involve disturbance of the benthos and is therefore unlikely to result in the spread of invasives.

3.1.1.7.3 Essential Fish Habitat

A detailed assessment of impacts to Essential Fish Habitat and species is presented in Appendix 3-D. In general, many of the impacts to benthos described in Section 3.1.1.7.1 are also relevant in many instances as a component of impacts to EFH. Seafloor dredging and disturbances will have both temporary and permanent impacts on demersal species such as loss of eggs, temporary reduction in benthic prey items, or loss of rock habitat in areas of blasting or creation of structure around the pilings associated with the pier. Entrainment of eggs and larvae will occur with water withdrawals for LNG carrier ballast and hoteling needs as well as the one-time hydrostatic test water withdrawals associated with the testing of the LNG storage tanks. These impacts are more fully characterized in Appendix 3-D.

However, impacts to EFH from pipeline construction across Half Moon Cove will primarily be temporary, and the acreage affected for construction of the pier is small. The pier is relatively narrow and will be of sufficient height above the water as to have minimal shading affects. The pilings will create structures that could benefit some species and may interfere with other species' use of the area. Operation of the LNG facility will result in increased levels of noise and nighttime lighting of the pier, which could alter conditions and affect species residing in or moving through the area.

3.1.1.7.5 Migratory Finfish

Half Moon Cove is unlikely to support a large number of anadromous species or individuals, and no anadromous fish run occurs because of the lack of suitable streams. In contrast, Western Passage is a major route for anadromous fish moving in and out of the rivers and streams entering Passamaquoddy Bay. Construction of the pier in Western Passage is not anticipated to produce much of a suspended sediment plume, since rock socket pile drilling is unlikely to produce substantial amounts of suspended sediments. In general construction activities will generate elevated sound levels at various intensities, durations, and time of day. If construction occurs during daylight hours, many migratory species tend to move during the night, which would lessen construction effects on these species. In any event, migrating fish will have plenty of water column to get by the facility by staying east of the pier location during construction. Rock socket drilling activities will occur over several months, which will overlap with fall and spring migratory periods of species such as herring, alewife, and Atlantic salmon. Other impacts to migratory finfish are similar to those likely to be experienced by commercially and recreationally fish, as described in Section 3.1.1.7.4.

shipping to Far East markets. Canadians in Labrador and Newfoundland are beginning to consider harvesting this species with divers or by dragging (Hamel and Mercier, 1999).

In Maine, fishermen are now required to have a sea cucumber drag license, granted only to those who have harvested at least 100,000 lbs. of sea cucumbers in 2002, 2003, or 2004. In addition, they must use a drag no larger than 5-foot 6-inches, and fish only during the daylight hours. The season is closed from July 1-September 30These new regulations were designed to reduce fishing pressure while evaluating management options. Divers could in the future be used to harvest sea cucumbers, as is done in other states.

In Passamaquoddy Bay, there are no licenses for sea cucumber dragging. There is anecdotal information about harvest activities. There are two or three scallop draggers in the area that may harvest cucumbers in the off-season (Wright 2006). The Passamaquoddy Tribe Environmental Department reports that the sea cucumber is currently not commercially-collected in Half Moon Cove (Crawford, 2006a), but are harvested from the Western Passage area.

3.1.1.4.19 Algae

Algae harvesting in Maine includes a variety of species including bladderwrack (*Fucus* spp.) rockweed (*Ascophyllum nodosum*), nori or laver (*Porphyra),* kelps *Laminaria* spp., dulse (*Palmaria palmaria),* Alaria (*Alaria esculenta)* and Irish moss (*Chondrus crispus)*, used to make carrageenan. Harvest is mainly by hand; there is some experimentation with mariculture of nori. Mechanical harvesting occurs in Canada, with one mechanical harvester in operation in the State of Maine.

Rockweed is the most commonly harvested species. Harvest is by hand, either on foot or in a boat, using a rake. Maine harvest regulations specify that the lowest lateral branches must remain attached, with at least 16 inches of holdfast. Rockweed is an important species in the intertidal zone, providing habitat, food, and cover for a variety of intertidal organisms. It can grow up to 8 feet long and live 12-15 years. It is harvested for use as a mulch and fertilizer as well as cattle feed. A more detailed description of macroalgal species is provided in Section 3.1.2.1.

The sum total of seaweed harvest in 2004 was 3.5 million pounds, worth approximately $202, 482. Harvest over time has been highly variable, relatively low through the 1990s and experiencing a resurgence in 2001-2002, before dropping slightly in 2003-2004.

The state issued 73 licenses in 2005, of which six are in Cobscook Bay. Of these, one was issued in Eastport. There appears to be little seaweed harvesting currently. Nori was formerly harvested by one person, but it was not profitable (Mitchell, 2006).

3.1.1.4.20 Commercially Important Species Observed During Benthic and Sediment Profile Image Surveys

Quoddy Bay conducted macroinvertebrate benthic surveys during July 2006 (Appendix 3-B). Several taxa of economic importance to commercial or recreational fisheries were collected during the July 2006 benthic survey. Rockweeds, including *Ascophyllum nodosum* and *Fucus vesiculosus*, were the dominant algal taxa in the rocky intertidal, and Irish moss (*Chondrus crispus*) was found at one site in Western Passage. Blue mussels (*Mytilus edulis*), common periwinkles (*Littorina littorea*), softshell clams (*Mya arenaria*) (Appendix 3-E) and sand worms (*Neanthes virens*), were all collected during the survey. Among the economically important invertebrate taxa, only blue mussels were found in abundance.

§ 5.6 (d)(3)(iv)(C): Temporal and Spatial Distribution

(C) Temporal and spacial distribution of fish and aquatic communities and any associated trends with respect to:

(1) Species and life stage composition;
(2) Standing crop;
(3) Age and growth data;
(4) Spawning run timing; and
(5) The extent and location of spawning, rearing, feeding, and wintering habitat.

Except for information contained in the Quoddy Bay LNG application, a great deal of data does not exist on the distribution of fish and aquatic communities in Half-Moon Cove. The ecology of Half-Moon Cove is stable and is relatively productive. The important feature of the proposed project is that the intertidal area which will be impacted by the project is considered unproductive and is located in a region which periodically shifts from intertidal to submerged depending on the tidal range. The area under the proposed dam or tidal wall will be impacted by the project and this topic will be recommended for further studies in a later section of this PAD.

In addition, benthic habitats were characterized by a Sediment Profile Imaging (SPI) survey, also conducted in July 2006 (Appendix 3-C). A number of commercially important species were observed in SPI and surface video. These include *Cancer* crabs, sea scallops, blue mussels, sea cucumbers, green urchins, and sculpin. The blue mussel was the only commercial species to be found in both Half Moon Cove and Western Passage images. Burrow openings at the sediment surface were observed at stations in both project areas. These openings may have been siphon holes of bivalves or worm tubes, but the photography did not allow for identifying the organism(s) that made the openings. At Western Passage stations, green urchins were overall the most abundant and widely distributed of the commercial species with high densities at most stations. The other commercial species, Cancer crabs and sea scallops, were abundant at one or two stations in Western Passage. Sea cucumbers were widely distributed but occurred in lower densities.

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