Appendix 1: Quantitative and detailed baseline phenology data from the Gulf of Maine ecosystem. Information is organized by functional groups, species, sub-region and season.

Functional Group	Species	Gulf of Maine Region	Winter	Spring	Summer	Fall	References
Phytoplankton		Central and eastern Gulf, Scotian Shelf, Massachusetts and Cape Cod Bays		Pronounced spring bloom in offshore surface waters. Average bloom initiation timing varies between day 67-90 across the Scotian Shelf and Slope waters		Relatively small bloom (compared to spring) in offshore waters	O'Reilly & Zetlin, 1998; Keller et al., 2001; Platt et al., 2010; Zhai et al., 2011
Phytoplankton		Scotian Shelf		Spring bloom on the eastern and western Scotian Shelf are short in duration but high in amplitude on average, while blooms in the slope and Gulf Stream waters are longer in duration but smaller in amplitude			DFO, 2015
Phytoplankton		Prince-5 time series station in the outer Bay of Fundy			Spring bloom initiation is later and duration is longer than on the Scotian Shelf; peaks occur in June and August-September		Johnson et al., 2016
Zooplankton	Mesozooplankton	Central Scotian Shelf, Halifax-2 time series station	Minimum biomass and abundance January-February	Maximum biomass and abundance in April			Johnson et al., 2016
Zooplankton	Mesozooplankton		Low species diversity			High species diversity	Record et al., 2010
Zooplankton	Mesozooplankton	Outer Bay of Fundy, Prince-5 time series station	Minimum biomass/abundance in January-May. Coastal influence is evident at Prince-5 with strong pulses of barnacle larvae in late winter-early spring		Maximum biomass/abundance in July-September		Johnson et al., 2010; Johnson et al., 2016
Zooplankton	*Calanus finmarchicus*	Central Gulf, Central Scotian Shelf, Halifax-2 time series station	Develop from diapausing fifth copepodite stages to adults in early January	Emergence from depth; first generation in the spring.	Peak abundance in late spring/early summer; smaller second generation in late summer	Late stage individuals enter diapause; annual minimum in surface waters	Pershing et al., 2005; Johnson et al., 2010; Johnson et al., 2016
Zooplankton	*Calanus finmarchicus*	Northwest Atlantic			Mean diapause duration is 200 days with onset in late summer		Durbin et al., 2000; Johnson et al., 2008; Melle et al., 2014;
Zooplankton	*Centropages hamatus*	Georges Bank			*Centropages hamatus dominates biomass*		Kane, 1993; Manning & Buckling, 2005

Functional Group	Species	Gulf of Maine Region	Winter	Spring	Summer	Fall	References
Zooplankton	*Calanus finmarchicus, Temora longicornis, Centropages typicus*	Coastal waters of central and western Gulf of Maine		Peak abundance; *Calanus finmarchicu* s dominates in the early spring	*Temora longicorni s* dominates biomass from late July to early August	*Centropages typicus* dominates from approximately October to January	Kane, 1993; Manning & Buckling, 2005
Zooplankton	*Centropages* spp; *Pseudocalanus* spp; *C. finmarchicus*	Cape Cod Bay	Centropages spp. dominate during early winter and Pseudocalanus spp. during late winter.	C. finmarchicus and Pseudocalanus spp. dominate during early spring. Sluggish currents allow for retention and aggregation of plankton.		Centropages spp. dominate during the fall.	Conversi et al., 2001; Bessinger et al., 2003; MERCINA, 2004; DeLorenzo Costa et al., 2006; Greene and Pershing, 2007; Jiang et al., 2007; Kane, 2007; Leeney et al., 2009; Pendleton et al., 2009
Zooplankton	*Sagitta elegans*	Coastal waters of GOM	Adult individuals dominate the population and are evenly distributed along the coast of Maine		Peak abundance, dominated by immature individuals	Population concentrates to the southwest	Sherman & Schaner 1968; Pettigrew et al., 2005
Macro-invertebrates	Longfin squid *(Doryteuthis pealeii)*		Offshore migration	Late spring, early summer spawning and cohort	Inshore migration	Late summer, early fall spawning and cohort	Black et al., 1987; Jacobson, 2005
Macro-invertebrates	Northern shortfin squid (*Illex illecebrosus*)		Spawning in southern latitudes	Primarily occur offshore	Migrate north via the Gulf Stream and occur in more inshore waters	Migration offshore and out of the GOM	Black et al., 1987; Hendrickson & Holmes, 2004
Macro-invertebrates	American lobster *(Homarus americanus)*			Molt and move from deep offshore waters into shallow coastal areas			Cooper & Uzmann, 1971; Aiken 1980; Dunnington et al., 2005; Glenn & Pugh, 2006; Mills et al., 2013
Macro-invertebrates	Acorn barnacle (*Semibalanus balanoides*)	Bay of Fundy			Reproduction is timed with adults developing immature oocytes between May-June; by late July-early September sperm are produced to fertilize brooded embryos		Bouchard & Aiken 2012
Macro-invertebrates	Northern shrimp *(Pandalus borealis)*	western Gulf of Maine	Females migrate near shore to hatch brood, mature males begin sex transition	Larval development in inshore waters, females migrate back offshore	Postlarvae settle to benthos	Mating and spawning in offshore waters	Shumway et al., 1985
Fish	Multiple ichthyoplankton species	Coastal waters of central and western Gulf of Maine		Peak abundance of larvae, March-April to May-June, depending on species and latitude (earlier in south compared to north)			Townsend, 1983; Townsend, 1984
Fish	Atlantic herring (*Clupea harengus*)	Georges Banks and coastal habitats				Spawning occurs between October-November close to shore	Richardson et al, 2010; Wurtzell et al., 2016

Functional Group	Species	Gulf of Maine Region	Winter	Spring	Summer	Fall	References
Fish	Alewife (*Alosa pseudoharengus*)	Coastal and inland freshwater habitats		Adult spawning migration is initiated when water temperatures are between 5-10 ºC. Spawning is initiated at temperatures of 10-22 ºC			Rounsefell, & Stringer, 1945; Loesch, 1987
Fish	Blueback herring (*Alosa aestivalis*)	Coastal and inland freshwater habitats		Adult spawning migration overlaps with alewife but is generally initiated 3-4 weeks later. Peak spawning occurs about 2-3 weeks after alewife			Collette & Klein-MacPhee, 2002; Saunders et al., 2006; Alexander et al., 2017
Fish	Lamprey (*Petromyzon marinus*)	Coastal and inland freshwater habitats		Highly variable timing of movements into spawning habitats, likely influenced by pheromone cues, which can be affected by fluctuating flow conditions			Hogg et al., 2013
Fish	Haddock (*Melanogrammus aeglefinus*)	Scotian Shelf, Georges Bank		Earlier spring primary production blooms support larger larval recruitment events and higher fish survival index		Size, location and timing of fall primary production bloom the year prior to spawning affects the quantity and/or quality of gametes and is associated with magnitude of recruitment events	Platt et al., 2003; Friedland et al., 2008; Trzcinski et al. 2013; Leaf & Friedland, 2014; Friedland et al. 2015
Fish	Bluefin tuna (*Thunnus thynnus*)				Post spawning bluefin tuna migrate to temperate regions to forage on prey with high energy densities. Bluefin tuna migrations coincide with the locations and timing of Atlantic herring (Clupea harengus) in the GOM, which have been shown through diet studies to be a major prey in teh northwest Atlantic shelf.	Bluefin tuna remain in the GOM until November and then migrate out to other Atlantic habitats	Crane, 1936; Lawson et al., 1998; Chase, 2002; Pleizier et al., 2012; Logan et al., 2015
Elasmobranch	Basking shark *(Cetorhinus maximus)*	Cape Cod Bay, Great South Channel, Bay of Fundy			Migrate into region; distribution particularly in the Bay of Fundy is affected by prey availability, bathymetry, SST, and chlorophyll-a		Campana et al., 2008; Gore et al., 2008; Siders et al., 2013; Curtis et al., 2014

Functional Group	Species	Gulf of Maine Region	Winter	Spring	Summer	Fall	References
Marine mammal	Atlantic Right Whale *(Eubalaena glacialis)*	Cape Cod Bay & Great South Channel	Arrival in Cape Cod Bay around January or February	Peak abundance of whales (by number of animals sighted) in March or April	Peak number of right whales occurs in the Great South Channel May through July		Gaskin, 1987; Murison & Gaskin, 1989; Brown et al., 1995; Kenney et al., 1995; Mayo et al., 2018
Marine mammal	Atlantic Right Whale *(Eubalaena glacialis)*	Bay of Fundy, Scotian Shelf & Deep basins	Known to occur on Outer Falls in December and January, but survey coverage is poor	Known to occur on Jeffreys Ledge, but survey coverage is poor	Between early to mid-summer and mid-fall the majority of sightings occur in the Bay of Fundy and on the Nova Scotian Shelf, especially Roseway Basin		Gaskin, 1987; Murison & Gaskin, 1989; Brown et al., 1995; Kenney et al., 1995
Marine mammal	Grey seal (*Halichoerus grypus)*	Scotian Shelf and Georges Bank; Sable Island, Gulf of St. Lawrence	Breeding at haul out sites during January	The Sable Island stock has a post-breeding pelagic phase from February until April, and return to Sable Island for their spring molt	Foraging	Foraging increases to prepare for the upcoming breeding season	Lesage & Hammill, 2001; Lesage et al., 2001; Boehme et al., 2012; Klimova et al., 2014;
Marine mammal	Harbor seal *(Phoca vitulina)*		Preference for ice-free waters compels harbor seals to move to Southern New England and Maine coastal waters in winter and spring.				Baechler et al., 2002; Gilbert et al., 2005; Waring et al., 2006; Bowen et al., 2007; Waring et al., 2010;
Seabird	Roseate, common, and arctic terns: (*Sterna dougallii, S. hirundo, S. paradisaea*)			Breeding	Chick rearing: Common tern first and peak hatch dates on Seal and Stratton Islands occurred approximately June 20, and 28th; earliest hatches were June 15 and 24 between 1991-2002		Hall and Kress 2004
Seabird	Shearwaters (Procellariidae)	Georges Banks, Bay of Fundy		Arrival: Great shearwaters arrive on Georges Banks last week of May and into June	Departure of Great shearwaters starting in August for breeding isalnds in South Atlantic or young birds moving up to Bay of Fundy.	Most birds reaching spots south of the equator by end of September; Fall migration out of GOM completed by mid-November	Nisbet et al., 2013
Seabird	Gulls (Laridae)			Energetic plankton feeding occurs typically in March in New England, which can last for weeks, through April			Vermeer et al., 1987
Seabird	Auks (Alcidae): Atlantic Puffin (*Fratercula arctica*); Razorbill (*Alca torda*); Common Murre (*Uria aalge*)			Arrive late April / early May, lay single egg mid to late May	Puffins, razorbills and murres hatch eggs, raise chicks	Auk chicks leave nest and go out to sea, late July (razorbills, murres) through late August (puffins)	Diamond & Devlin, 2003

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