Table 3. The major parameters and input required to initialize and execute the ecological class Extended Stock Assessment Models (ESAM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	ESAM MRMs-Ecology								
	Model	S-R							
		Required Inputs			N				In NEUS, usually 40+ yrs (1963-present)
		R	Vector of Recruits	D		biomass or #	Survey data, age data	Y	
		SSB	Vector of Spawning Stock Biomass	D		biomass or #	Survey data, Age data, Landings data	Y	
		various	any covariates	D		variable	food habits data, NEUS FW Models	variable	
		Required Parameters	depending upon funcitonal form:						
		α_{ij}	scalar	S		unitless	dervied	N	
		β_{ij}	Exponential modifier	S		unitless	dervied	N	
		γ_{ij}	Exponential modifier for covariates	S		unitless	dervied	N	
		$F_{xx\%}$	Fishing Mortality	S		rate, B per yr	dervied	Y	
		optional βs	covariates	S		unitless	various	N	

Table 3, continued. The major parameters and input required to initialize and execute the ecological class Extended Stock Assessment Models (ESAM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	ESAM MRMs-Ecology								
	Model	SS Prod							
		Required Inputs			N				In NEUS, usually 40+ yrs (1963-present)
		B	Vector of biomass	D		Biomass (e.g. mt)	Survey data	Y	
		L	Vector of landings (or catch)	D		Biomass (e.g. mt)	Landings data	Y	
		various	covariates	D		variable	food habits data, NEUS FW Models	Y	
		Required Parameters							
		r (derives Fmsy)	exponential rate of growth	S		rate, B per yr	derived	Y	
		K (derives Bmsy)	carrying capacity	S		biomass	derived	Y	
		optional βs	other tuning measures, associated with covariates	S		unitless	food habits data, NEUS FW Models, derived	Y	

Table 3, continued. The major parameters and input required to initialize and execute the ecological class Extended Stock Assessment Models (ESAM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	ESAM MRMs-Ecology								
	Model	Age Structured			N				In NEUS, usually 40+ yrs (1963-present)
		Required Inputs							
		$\mathbf{N_{i,a}}$	Matrix of N	D		#	Survey data, age data	Y	
		$\mathbf{B_{i,a}}$	Matrix of B	D		biomass	Survey data, age data	Y	
		$\mathbf{W_{i,a}}$	Wt-at-age	S		biomass	Survey data, age data	Y	
		$\mathbf{O_{i,a}}$	Age-at-matruity	S		year	Survey data, age data	Y	
		$\mathbf{C_{i,a}}$	Catch-at-age	D		biomass	Landings data, age data	Y	
		various	covariates, usually in matrices at age	D		various	food habits data, NEUS FW Models	variable	
		Required Parameters							
		q, λ	Selectivity & Catchability	S		unitless	Survey data, model dervied	N	
		g	Growth between ages; in some forms	S		unitless	Age data	Y	
		F	Total Fishing Mortality	S		unitless	derived	Y	
		M2	Total Predation Mortality	S		unitless	derived	Y	
		M1	Total other Natural Mortality	S		unitless	derived	N	
		optional βs	covariates	S		unitless	derived	varies	

Table 3, continued. The major parameters and input required to initialize and execute the ecological class Extended Stock Assessment Models (ESAM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	ESAM MRMs-Ecology								
	Model	Ecological Footprints			N				In NEUS, usually ~40 yrs (1973-present)
		Required Inputs							
		B_i	biomass or abundance of predator	D		biomass	Survey data	Y	
		C_i	consumption of predator	D		biomass per yr	food habits data, NEUS FW Models	Y	
		L_i	landings or catch of predator	D		biomass per yr	Landings data	Y	
		length	size structure of predator	both		cm	Age data, survey data	Y	
		S_i	mean stomach contents	D		biomass	food habits data	Y	
		Required Parameters							
		α_{ij}	scalar	S		unitless	derived, Literature	N	
		β_{ij}	Exponential modifier	S		unitless	derived, Literature	N	

Table 3, continued. The major parameters and input required to initialize and execute the ecological class Extended Stock Assessment Models (ESAM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	ESAM MRMs-Ecology								
	Model	Ecological Footprints			N				In NEUS, usually ~40 yrs (1973-present)
		Required Inputs							
		B_i	biomass or abundance of predator	D		biomass	Survey data	Y	
		C_i	consumption of predator	D		biomass per yr	food habits data, NEUS FW Models	Y	
		L_i	landings or catch of predator	D		biomass per yr	Landings data	Y	
		length	size structure of predator	both		cm	Age data, survey data	Y	
		S_i	mean stomach contents	D		biomass	food habits data	Y	
		Required Parameters							
		α_{ij}	scalar	S		unitless	derived, Literature	N	
		β_{ij}	Exponential modifier	S		unitless	derived, Literature	N	

Table 4. The major parameters and input required to initialize and execute the environmental class Extended Stock Assessment Models (ESAM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	ESAM MRMs-Environmental								
	Model	S-R							
		Required Inputs			N				In NEUS, usually 40+ yrs (1963-present)
		R	Vector of Recruits	D		biomass or #	Survey data, age data	Y	
		SSB	Vector of Spawning Stock Biomass	D		biomass or #	Survey data, age data	Y	
		various	any covariates	D		variable	Oceanographic data, Climatological data	variable	
		Required Parameters	depending upon funcitonal form:						
		α_{ij}	scalar	S		unitless	derived	N	
		β_{ij}	Exponential modifier	S		unitless	derived	N	
		γ_{ij}	Exponential modifier for covariates	S		unitless	derived	N	
		$F_{xx\%}$	Fishing Mortality	S		rate, B per yr	derived	Y	
		optional βs	covariates	S		unitless	derived	N	

Table 4, continued. The major parameters and input required to initialize and execute the environmental class Extended Stock Assessment Models (ESAM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	ESAM MRMs-Environmental								
	Model	SS Prod							
		Required Inputs		usually time series	N				In NEUS, usually 40+ yrs (1963-present)
		B	Vector of biomass	D		Biomass (e.g. mt)	Survey data	Y	
		L	Vector of landings (or catch)	D		Biomass (e.g. mt)	Landings data	Y	
		various	covariates	D		variable	Oceanographic data, Climatological data	varies	
		Required Parameters							
		r (derives Fmsy)	exponential rate of growth	S		rate, B per yr	derived	Y	
		K (derives Bmsy)	carrying capacity	S		biomass	derived	Y	
		optional βs	other tuning measures, associated with covariates	S		unitless	derived	varies	

Table 4, continued. The major parameters and input required to initialize and execute the environmental class Extended Stock Assessment Models (ESAM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	ESAM MRMs-Environmental								
	Model	Age Structured			N				In NEUS, usually 40+ yrs (1963-present)
		Required Inputs							
		$\mathbf{N_{i,a}}$	Matrix of N	D		#	Survey data, age data	Y	
		$\mathbf{B_{i,a}}$	Matrix of B	D		biomass	Survey data, age data	Y	
		$\mathbf{W_{i,a}}$	Wt-at-age	S		biomass	Survey data, age data	Y	
		$\mathbf{O_{i,a}}$	Age-at-matruity	S		year	Survey data, age data	Y	
		$\mathbf{C_{i,a}}$	Catch-at-age	D		biomass	Landings data, age data	Y	
		various	covariates, usually in matrices at age	D		various	Oceanographic data, Climatological data	varies	
		Required Parameters							
		q, λ	Selectivity & Catchability	S		unitless	Survey data, model dervied	N	
		g	Growth between ages; in some forms	S		unitless	Age data	Y	
		F	Total Fishing Mortality	S		unitless	derived	Y	
		M2	Total Predation Mortality	S		unitless	derived	Y	
		M1	Total other Natural Mortality	S		unitless	derived	N	
		optional βs	covariates	S		unitless	derived	varies	

Table 5. The major parameters and input required to initialize and execute the multispecies class of Minimal Realistic Models (MRM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Multispecies MRMs								
	Model	MS PROD			N				Variable, is a simulator, but typically 1963-2010; 30-50 yr runs
		Required Inputs							
		N_i	Biomass or abundance of each stock, i.	D		biomass or #	Survey data	N	
		S_{ij}	Spatial overlap between each pair of stocks, i and j.	S		unitless	Survey data	N	
		PelDem	Pelagic or demersal designation	S		unitless	Survey data	N	
		Required Parameters							
		r_i	Growth rate for each stock, i.	S		unitless	Survey data, age data, Assessment models	Y (if stochasticity used)	
		K_g	Carrying capacities for each guild, g.	S		biomass or #, usually mt	Survey data, Assessment models	N	
		K_s	System carrying capacity	S		biomass or #, usually mt	Survey data, Assessment models	N	
		α_{ij}	Predation interaction strength between each predator, j, and prey, i.	S		unitless	food habits data, Literature	N	
		β_{ig}	Between guild competition coefficients of each guild g on each individual stock i within a specific guild.	S		unitless	Food habits data, Literature	N	
		β_{ij}	Within guild competition coefficients between each pair of stocks I and j	S		unitless	Food habits data, Literature	N	

Table 5, continued. The major parameters and input required to initialize and execute the multispecies class of Minimal Realistic Models (MRM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Multispecies MRMs								
	Model	MSYPR			N				In NEUS, usually 40+ yrs (1963-present)
		Required Inputs							
		R	Vector of Recruits	D		biomass or #	Survey data, age data	Y	
		SSB	Vector of Spawning Stock Biomass	D		biomass or #	Survey data, age data	Y	
		various	gear types	S		variable	Landings data, economic data	varies	
		Required Parameters							
		α_{ij}	scalar	S		unitless	derived	N	
		β_{ij}	Exponential modifier	S		unitless	derived	N	
		γ_{ij}	Exponential modifier for covariates	S		unitless	derived	N	
		various	interaction coefficient	S		rate, B per yr	derived	N	
		q, λ	Selectivity & Catchability	S		unitless	derived, survey data, landings data	N	
		$F_{xx\%}$	Fishing Mortality	S		unitless	derived	Y	

Table 5, continued. The major parameters and input required to initialize and execute the multispecies class of Minimal Realistic Models (MRM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Multispecies MRMs								
	Model	MVTS-Gompertz			N				In NEUS, usually 40+ yrs (1963-present)
		Required Inputs							
		Abundance Estimates				Biomass	survey data	Y	
		Catch or Fishing Effort				Biomass or DAS	landings data	Y	
		Environmental Data				various	various	Y	
		Required Parameters							
		β_{ij}	elements of intercept vector			unitless	derived	N	
		α_{ij}	elements of transition matrix			unitless	derived	N	
		γ_{ij}	elements of covariate vector			unitless	derived	N	

Table 5, continued. The major parameters and input required to initialize and execute the multispecies class of Minimal Realistic Models (MRM), with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Multispecies MRMs								
	Model	MS SPMW							
		Required Inputs			N				In NEUS, usually 40+ yrs (1963-present)
		B_i	Vector of biomass	D		Biomass (e.g. mt)	Survey data	Y	
		L_i	Vector of landings (or catch)	D		Biomass (e.g. mt)	Landings data	Y	
		various	covariates	D		variable	various	varies	
		Required Parameters							
		r (derives Fmsy)	exponential rate of growth	S		rate, B per yr	derived	Y	
		K (derives Bmsy)	carrying capacity	S		biomass	derived	Y	
		α_{ij}	Ecological interaction coefficient between each predator, j, and prey, i.	S		unitless	food habits data	N	
		optional βs	other tuning measures, associated with covariates	S		unitless	derived	varies	

Table 5, continued. The major parameters and input required to initialize and execute the EMs, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Multispecies MRMs								
	Model	MSVPA-X							
		Required Inputs			N				In NEUS, usually 40+ yrs (1963-present); 1973-2002 typical/latest
		$\mathbf{N_{i,a}}$	Matrix of N	D		#	Survey data, age data	Y	
		$\mathbf{B_{i,a}}$	Matrix of B	D		biomass	Survey data, age data	Y	
		$\mathbf{W_{i,a}}$	Wt-at-age	S		biomass	Survey data, age data	Y	
		$\mathbf{O_{i,a}}$	Age-at-matruity	S		year	Survey data, age data	Y	
		$\mathbf{L_{i,a}}$	Catch-at-age	D		biomass	Landings data, age data	Y	
		$C_{i,j,a}$	Consumption	D		biomass per yr	food habits data	Y	
		$\nu_{i,j,a}$	vulnerability/suitability	S		unitless	food habits data	N	
		S_i	Stomach contents	D		biomass	food habits data	Y	
		SO_{ij}	Spatial overlap between each pair of stocks, i and j.	S		unitless	Survey overlap matrix	N	
		AB	altnerate prey biomass	S		biomass	Survey data, process studies, NEUS FW Models	N	
		w_{ij}	pred/prey wt ratio	S		unitless	food habits data	N	
		various	covariates, usually in matrices at age	D		various	Oceanographic data, Climatological data	varies	

Table 5, continued. The major parameters and input required to initialize and execute the multispecies class of Minimal Realistic Models (MRM), with notations of the major structural features.

	Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Required Parameters							
q, λ	Selectivity & Catchability	S		unitless	Survey data, model dervied	N	
g	Growth between ages; in some forms	S		unitless	Age data	Y	
F	Total Fishing Mortality	S		unitless	derived	Y	
M2	Total Predation Mortality	S		unitless	derived	Y	
M1	Total other Natural Mortality	S		unitless	derived/set	N	
$A_{i,j,a}$	Preference/prey selectivity	S		unitless	food habits data, Literature	N	
α_{ij}	consumption scalar	S		unitless	food habits data	N	
β_{ij}	Consumption Exponential modifier	S		unitless	food habits data	N	
$\eta_{ia,jb}$	size selectivity	S		unitless	food habits data	N	

note, there are other possible parameters depending upon the functional forms of the various submodels used, but these represent the major, consistently used ones across various applications of MSVPA and particularly MSVPA-X

Table 6. The major parameters and input required to initialize and execute the Aggregate Production class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Aggregate Production								
	Model	AggPROD v of MS PROD			N				Variable, is a simulator, but typically based on data from 1963-2010; 30-50 yr runs
		Required Inputs							
		N_i	Biomass or abundance of each group, i.	D		biomass (mt) or numbers per year	Survey data	N	
		S_{ij}	Spatial overlap between each pair of stocks, i and j.	S		unitless	Survey data	N	
		PelDem	Pelagic or demersal designation	S		unitless proportion (usually 1 or 0)	Survey data	N	
		Required Parameters							
		r_i	Growth rate for each stock, i.	S		unitless	Survey data, age data, Assessment models	Y (if stochasticity used)	
		K_g	Carrying capacities for each guild, g.	S		biomass (mt) or numbers	Survey data, Assessment models	N	
		K_s	System carrying capacity	S		biomass (mt) or numbers	Survey data, Assessment models	N	
		α_{ij}	Aggregate predation interaction strength between each predator guild, j, and prey guild, i.	S		unitless	Food habits data, Literature	N	
		β_{ij}	Between guild competition coefficients of each guild j on each guild i.	S		unitless	Food habits data, Literature	N	

Table 6, continued. The major parameters and input required to initialize and execute the Aggregate Production class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Aggregate Production **Model**	ASP-SPMW							
		Required Inputs			N				In NEUS, usually 40+ yrs (1963-present)
		B_i	Aggregated Biomass Indices/Time Series; Needs to be combined across spp, usually in absolute but can be in relative terms of an index	D		Biomass	Survey data	Usually Not, but can be	
		L_i	Aggregated Landings Time Series; Needs to be combined across spp	D		Biomass per year	Landings data	Usually Not, but can be	
		various	Optional Environmental or Ecological Covariates; e.g., AMO, NAO, SST, Predator Biomass	D		Various, may be as anomalies	variable; Oceanographic data, Climatological data, food habits data	Usually Not, but can be	
		Required Parameters							
		r	growth rate	S		Biomass per year	derived	N	
		K	carrying capacity	S		Biomass	derived	N	
		optional βs	covariates	S		variable	derived	N	

Table 6, continued. The major parameters and input required to initialize and execute the Aggregate Production class of models, with notations of the major structural features.

				Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Aggregate Production									
	Model	ASP-SPMW-Dynamic								
		Required Inputs				N				In NEUS, usually 40+ yrs (1963-present)
		B_i	Aggregated Biomass Indices/Time Series; Needs to be combined across spp, usually in absolute but can be in relative terms of an index		D		Biomass	Survey data	Y	
		L_i	Aggregated Landings Time Series; Needs to be combined across spp		D		Biomass per year	Landings data	Y	
		various	Optional Environmental or Ecological Covariates; e.g., AMO, NAO, SST, Predator Biomass		D		may be as anomalies	variable; Oceanographic data, Climatological data, food habits data	varies	
		Required Parameters								
		r	growth rate		D		Biomass per year	derived	Y	
		K	carrying capacity		D		Biomass	derived	Y	
		optional βs	covariates		D		variable	derived	Y	

Table 6, continued. The major parameters and input required to initialize and execute the Aggregate Production class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Aggregate Production								
	Model	Agg v of ASPIC							
		Required Inputs			N				In NEUS, usually 40+ yrs (1963-present)
		B_i	Aggregated Biomass Indices/Time Series; Needs to be combined across spp, usually in absolute but can be in relative terms of an index	D		Biomass	Survey data	Usually Not, but can be	
		L_i	Aggregated Landings Time Series; Needs to be combined across spp	D		Biomass per year	Landings data	Usually Not, but can be	
		various	Optional Environmental or Ecological Covariates; e.g., AMO, NAO, SST, Predator Biomass	D		Various, may be as anomalies	variable; Oceanographic data, Climatological data, food habits data	Usually Not, but can be	
		Required Parameters							
		r	growth rate	S		Biomass per year	derived	Y	
		K	carrying capacity	S		Biomass	derived	Y	
		optional βs	covariates	S		variable	derived	N	

Table 6, continued. The major parameters and input required to initialize and execute the Aggregate Production class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Aggregate Production								
	Model	Agg Mod - Overholtz/SAS							
		Required Inputs			N				In NEUS, usually 40+ yrs (1963-present)
		B_i	Aggregated Biomass Indices/Time Series; Needs to be combined across spp, usually in absolute but can be in relative terms of an index	D		Biomass	Survey data	Usually Not, but can be	
		L_i	Aggregated Landings Time Series; Needs to be combined across spp	D		Biomass per year	Landings data	Usually Not, but can be	
		various	Optional Environmental or Ecological Covariates; e.g., AMO, NAO, SST, Predator Biomass	D		varies, may be as anomalies	variable; Oceanographic data, Climatological data, food habits data	Usually Not, but can be	
		Required Parameters							
		r	growth rate	S		Biomass per year	derived	N	
		K	carrying capacity	S		Biomass	derived	N	
		optional βs	covariates	S		variable	derived	N	

Table 6, continued. The major parameters and input required to initialize and execute the Aggregate Production class of models, with notations of the major structural features.

				Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Aggregate Production									
	Model	Agg Testing of MS PROD				N				Variable, is a simulator, but typically based on data from 1963-2010; 30 yr runs
		Required Inputs								
		N_i	Biomass or abundance of each group, i.		D		biomass (mt) or numbers per year	Survey data	N	
		S_{ij}	Spatial overlap between each pair of stocks, i and j.		S		unitless	Survey data	N	
		PelDem	Pelagic or demersal designation		S		unitless proportion (usually 1 or 0)	Survey data	N	
		Required Parameters								
		r_i	Growth rate for each stock, i.		S		unitless	Survey data, age data, Assessment models	Y (if stochasticity used)	
		K_i	Carrying capacities for each stock, i.		S		biomass (mt) or numbers	Survey data, Assessment models	N	
		K_s	System carrying capacity		S		biomass (mt) or numbers	Survey data, Assessment models	N	
		α_{ij}	Predation interaction strength between each predator, j, and prey, i.		S		unitless	Food habits data, Literature	N	
		β_{ii}	Between stock competition coefficients of each stock i on each individual stock j.		S		unitless	Food habits data, Literature	N	

Table 7. The major parameters and input required to initialize and execute the energy transfer class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Energy Transfers (TL transfer, food web, network, etc.)								
	Model	Linear Production Potential			N				1997-2002
		Required Inputs							
		PP	Primary Production	S		biomass per unit area per year	Satellite Imagery, VGPM2 model	Y	1997-2002
		TL_i	Mean trophic level of the catch	S		unitless	food habits data	N	Based on data from 1973-2008
		Required Parameters							
		R	Retention Rate; Fraction of photosynthetic products retained within the system	S		unitless (proportion)	Literature	N	
		f	Fraction of new production	S		unitless	Literature, process studies, satellite imagery	N	
		TE_i	Transfer efficiencies between successive trophic levels	S		unitless (proportion)	NEUS FW Models; Literature	N	

Table 7, continued. The major parameters and input required to initialize and execute the energy transfer class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Energy Transfers								
	Model	Stochastic Production Potential			N				1997-2002
		Required Inputs							
		PP	Primary Production	D		biomass per unit area per year	Satellite Imagery, VGPM2 model (w/ normal distribution instead of one value)	Y	1997-2002
		TL_i	Mean trophic level of the catch	S		unitless	food habits data	Y	Based on data from 1973-2008
		Required Parameters							
		R	Retention Rate; Fraction of photosynthetic products retained within the system	S		unitless (proportion)	Literature	N	
		f	Fraction of new production	S		unitless	Literature, process studies, satellite imagery	N	
		TE_i	Transfer efficiencies between successive trophic levels	D		unitless (proportion)	NEUS FW Models; Literature (w/ Beta distribution instead of one value)	Y	

Table 7, continued. The major parameters and input required to initialize and execute the energy transfer class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Energy Transfers								
	Model	Ecopath			Possible, but not in NEUS				
		Required Inputs							1996-2000
		B_i	Biomass	S		biomass	Survey data, process studies	Y	
		C_i/B_i	Consumption to biomass	S		unitless	food habits data, Literature	Y	
		P_i/B_i	Production to biomass	S		unitless	Survey data, age data, Literature	Y	
		DC_{ij}	Diet composition	S		unitless	food habits data	Y	
		L_i	Landings	S		biomass per yr	Landings data	Y	
		AE_i	Assimilation efficiency	S		unitless	Literature	N	
		Required Parameters							
		EE_i	Ecotrophic effiecieny	S		unitless	derived	Y	
		Det_i	flow to detritus	S		biomass per yr	Survey data, process studies, Literature	N	
			Data pedigree	S		unitless	User Sets	Y	
		TL_i	trophic level	S		unitless	derived; food habits data	N	
		R_i/B_i	Respiration to biomass	S		unitless	Survey data, process studies, Literature	N	
		UAC_i	Unassimilated consumption	S		unitless	derived	N	
		Z_i	Total mortality	S		biomass per year; partionable	derived	N	

Table 7, continued. The major parameters and input required to initialize and execute the energy transfer class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Energy Transfers								
	Model	Econetwrk			N				1996-2000
		Required Inputs							
		B_i	Biomass	S		biomass	Survey data, process studies	Y	
		C_i/B_i	Consumption to biomass	S		unitless	food habits data, Literature	Y	
		P_i/B_i	Production to biomass	S		unitless	Survey data, age data, Literature	Y	
		R_i/B_i	Respiration to biomass	S		unitless	Survey data, process studies, Literature	N	
		DC_{ij}	Diet composition	S		unitless	food habits data	Y	
		L_i	Landings	S		biomass per yr	Landings data	Y	
		AE_i	Assimilation efficiency	S		unitless	Literature	N	
		Required Parameters							
		EE_i	Ecotrophic effiecieny	S		unitless	derived	Y	
		Det_i	flow to detritus	S		biomass per yr	Survey data, process studies, Literature	N	
			Data pedigree	S		unitless	User Sets	Y	
		TL_i	trophic level	S		unitless	derived; food habits data	N	
		UAC_i	Unassimilated consumption	S		unitless	derived	N	
		Z_i	Total mortality	S		biomass per year; partionable	derived	N	

Table 7, continued. The major parameters and input required to initialize and execute the energy transfer class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Energy Transfers								
	Model	GOMAGG			N				Variable, is a simulator, but typically based on data from 1963-2008; 20 yr runs
		Required Inputs							
		DC_{ij}	Diet composition	S		unitless	food habits data	N	
		B_i	Biomass	S		biomass	Survey data	N	
		G_{ij}	Flow of biomass	D		biomass per yr	Survey data, Landings data, food habits data, NEUS FW Models	N	
		Required Parameters							
		P_i/C_i	production to consumption rate	S		unitless	Age data, food habits data	N	
		b_k	transfer rate	S		biomass per yr	food habits data, NEUS FW models	N	
		M_i	other mortality	S		unitless	food habits data, NEUS FW models, Landings data	N	
Model Class	Energy Transfers								
	Model	Topological Webs			N				1973-1999
		Required Inputs							
		S	Number of spp	S		unitless	food habits data	N	
		L	Identifed linkages per spp (i.e., species interactions)	S		unitless	food habits data	N	
		Required Parameters							
		C	Connectivity	S		unitless	derived	N	

Table 8. The major parameters and input required to initialize and execute the full system class of models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Full System			Both, mainly dynamic	Y			Y	In NEUS, usually 40+ yrs (1964-2004 for calibration); with 10 year projections; extended runs planned
	Model	Atlantis	space prohibits all from being listed here; see Link et al. in press for a much fuller description of these input and parameter details and Link et al. 2011 for a briefer synopsis;						
			There are 45 biological groups, 18 fleets, 30 spatial boxes, 5 depth layers, 12 hr time steps, 40 yrs of time series to tune to, and 50 yr model runs; all of which has been calibrated at 4 different levels				Survey data, Age data, Landings data, food habits data, Oceanographic Data, Climatological Data, Economic Data	Y	
			Most can be loosely classed into hydrodynamic variables, physical forcing variables, biotic state variables and vital rate estimates, fleet dynamics, market drivers, and management measures						

Table 8, continued. The major parameters and input required to initialize and execute the full system class of models, with notations of the major structural features.

		Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Required Inputs								
	>1000 with age structure & w/out spatio-temporal replication							
	>200 w/out age structure w/out spatio-temporal replication							
Required Parameters								
	>8000 w/out spatio-temporal replication							

Table 9. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	AAC			N				N/A; for NEUS derived from data in 1973-2004
		Required Inputs							
		DC_{ij}	Percentage of each prey as proportion of a predator's diet composition	S		Unitless (proportion)	food habits data	N	
		r_i	Growth rate	S		Unitless	Survey data, age data	N	
		N (or B)	Abundance or biomass	S		biomass (metric tons) or #	Survey data	N	
		Required Parameters							
		E_i	Assimilation Efficiency; Proportion of what predator eats that is used for growth.	S		Unitless (proportion)	Literature	N	
		C_i	Clearance rate; maximum ingestion rate by a predator, more commonly understood as handling time	S		biomass per day	food habits data	N	
		S_i	Consumption rate; derived from mean stomach contents	S		biomass per day (per unit predator biomass)	food habits data	N	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	Donut Selectivity Model			N				N/A, for NEUS based on data from 1973-1999
		Required Inputs							
		P_{ij}	relative prey abundance	S		unitless	Survey data, process studies	N	
		O_{ij}	Overlap	S		unitless	Survey data	N	
		Required Parameters							
		Rd_{ij}	Detection rank	S		rankings	1st principles, food habits data	N	
		Rr_{ij}	Reaction rank	S		rankings	1st principles, food habits data	N	
		Rc_{ij}	Capture rank	S		rankings	1st principles, food habits data	N	
		Ri_{ij}	Ingestion rank	S		rankings	1st principles, food habits data	N	
		$R1_{ij}$	"Icing" rank	S		rankings	1st principles, food habits data	N	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	PSA							
		Required Inputs-Productivity			N			Can be in form of rank certainties, but usually not	N/A; for NEUS derived from data in 1973-2006
			r, intrinsic rate of growth	S		rankings	Survey data, age data	N	
			Maximum Age	S		rankings	Survey data, age data	N	
			Maximum Size	S		rankings	Survey data, age data	N	
			von Bertalanffy Growth Coefficient (k)	S		rankings	Survey data, age data	N	
			Estimated Natural Mortality	S		rankings	food habits data	N	
			Measured Fecundity	S		rankings	Age data	N	
			Breeding Strategy	S		rankings	Age data	N	
			Recruitment Pattern	S		rankings	Survey data, age data	N	
			Age at Maturity	S		rankings	Age data	N	
			Mean Trophic Level	S		rankings	food habits data	N	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	PSA							
		Required Inputs-Susceptibility							
			Management Strategy	S		rankings	Mgt Plans, Socioeconomic data	N	
			Areal Overlap	S		rankings	Survey data, Landings data	N	
			Geographic Concentration	S		rankings	Survey data, Landings data	N	
			Vertical Overlap	S		rankings	Survey data, Landings data	N	
			Fishing rate relative to M	S		rankings	derived	N	
			Biomass of Spawners (SSB) or other proxies	S		rankings	Survey data	N	
			Seasonal Migrations	S		rankings	Survey data	N	
			Schooling/Aggregation and Other Behavioral Responses	S		rankings	Survey data	N	
			Morphology Affecting Capture	S		rankings	Survey data	N	
			Survival After Capture and Release	S		rankings	process studies, Literature	N	
			Desirability/Value of the Fishery	S		rankings	Economic data	N	
			Fishery Impact to EFH or Habitat in General for Non-targets	S		rankings	process studies, Literature	N	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	LeMans							Variable, is a simulator, but set up for GB based on data from 1963-2000; ran for 25 years
		Required Inputs			N				
		$L_{i,t}$	length	S		cm	Survey data, age data	N	
		k_i	growth rate	S		rate	Survey data, age data	N	
		S_i	Spawning stock biomass	D		biomass	Survey data, age data	N	
		R_i	recruits	D		#	Survey data, age data	N	
		$N_{i,j}$	Abundance at size	D		#	Survey data, age data	N	
		DC_{ij}	Diet composition	S		unitless	food habits data	N	
		Required Parameters							
		a_i	The intercept parameter of the length–weight relationship for species i	S		unitless	derived	N	
		b_i	The slope parameter of the length–weight relationship for species i	S		unitless	derived	N	
		$L_{\infty,i}$	Asymptotic length parameter of the von Bertalanffy growth equation	S		cm	derived	N	
		k_i	Growth parameter of the von Bertalanffy growth equation	S		rate	derived	N	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	LeMans							
		Required Parameters							
		$\phi_{i,j}$	The proportion of species i in size class j that move to the next size class in a single time step	S		unitless	Survey data, age data	N	
		α_i	Productivity parameter of the Ricker stock–recruitment equation for species i	S		unitless	derived	N	
		β_i	Density dependence parameter of the Ricker stock-recruitment equation for species i	S		biomass	derived	N	
		$S_{max,i}$	The maximum observed spawning stock biomass of species i	S		biomass	Survey data, age data	N	
		κ_i	Curvature parameter for the maturity ogive of species i	S		unitless	derived	N	
		L_{M50}	The length at which 0.5 of species i are mature	S		cm	Survey data, age data	N	
		$\omega_{i,j}$	The proportion of species i in size class j that are mature	S		unitless	Survey data, age data	N	
		$F_{i,j}$	Instantaneous rate of fishing mortality on species i in size classj	S		rate	derived	N	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	LeMans							
		φ_i	A binary variable indicating whether species i is fished	S		unitless	Landings data	N	
		F_{max}	The maximum annual fishing mortality rate for a fully recruited fish	S		unitless	derived	N	
		η	Steepness parameter for the fishing selectivity ogive	S		unitless	Survey data, age data, Landings data	N	
		L_{F50}	The length at which 0.5 selection by the fishery occurs	S		cm	Survey data, age data, Landings data	N	
		$M1_{i,j}$	Natural (nonmodelled) mortality for species i in size classj	S		rate	derived	N	
		Ψ,υ	Parameters of the beta distribution for M1	S		unitless	derived	N	
		$M2_{i,j}$	Predation mortality for species i in size classj	S		rate	derived	N	
		$\tau_{m,i}$	The preference for prey species m by predator species i	S		unitless	food habits data	N	
		$\zeta_{n,j}$	Size preference for prey of size n by predator of size j	S		unitless	food habits data	N	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	LeMans							
		$v_{i,j,m,n}$	The relative preference (suitability) for predator i of size j of prey m of size n	S		unitless	food habits data	N	
		$I_{i,j}$	The ration (ingestion rate) that must be consumed by species i in size class j to account for modeled growth in a given time step	S		biomass	food habits data	N	
		Ge_j	The growth efficiency (proportion of food consumed that is converted to body mass) of fish in size class j	S		unitless	Literature	N	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc							
	Model	Size Spectra			N			Variable, in NEUS usually 40+ yrs (1963-present)
		Required Inputs						
		B per size unit	biomass (or sometimes abundance)	can be both	mass or mass per unit area	Survey data, Age data, Landings data, food habits data	N	
		log of size	size bins	can be both	length, often cm or derivatives thereof	Survey data	N	
		Required Parameters						
		β	slope	S	unitless	derived	Y	
		α	intercept	S	unitless	derived	Y	
Model Class	Misc							
	Model	CCA/CanCorr/RDA			Can be, usually not			Variable, in NEUS, usually 40+ yrs (1963-present)
		Required Inputs						
		Y	Matrix of times series of various response -- usually biotic (e.g. fish abunances)-- variables	D	various	Survey data, Age data, Landings data, food habits data, Oceanographic Data, Climatological Data, Economic Data	Y	
		X	Matrix of times series of various explanatory- usually human (e.g. landings), and environmental (e.g. SST)-- variables	D	various	Survey data, Age data, Landings data, food habits data, Oceanographic Data, Climatological Data, Economic Data	Y	
		Required Parameters						
		U	Eigenvectors to establish canonical "regression"	S	unitless	derived	Y	
		Y^U	fitted canonical response	S	unitless	derived	Y	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	DFA/MAFA			Can be, usually not				Variable, in NEUS, usually 40+ yrs (1963-present)
		Required Inputs							
		Y	Matrix of times series of various response -- usually biotic (e.g. fish abunances)-- variables	D		various	Survey data, Age data, Landings data, food habits data, Oceanographic Data, Climatological Data, Economic Data	Y	
		X	Matrix of times series of various explanatory- usually human (e.g. landings), and environmental (e.g. SST)-- variables	D		various	Survey data, Age data, Landings data, food habits data, Oceanographic Data, Climatological Data, Economic Data	Y	
		Required Parameters							
		$\mathbf{Z_t}$	trend/s relating across MV time series canonical relationships	S		unitless	derived	Y	

Table 9, continued. The major parameters and input required to initialize and execute the miscellaneous models, with notations of the major structural features.

			Data description	Inputs Static (S) or Dynamic (D)	Spatially resolved (Y or N) [does not mean it is not done for different regions, but directly in the model]	units	Origin, source, or method for derivation of value	Variance incorporated (Y or N)	Timeframe for derivation of value
Model Class	Misc								
	Model	PCA/MDS			Can be, usually not				Variable, in NEUS, usually 40+ yrs (1963-present)
		Required Inputs							
		$\mathbf{A_i}$	Matrix of times series of various biotic (e.g. fish abunances), human (e.g. landings), and environmental (e.g. SST) variables	D		various	Survey data, Age data, Landings data, food habits data, Oceanographic Data, Climatological Data, Economic Data	Y	
		Required Parameters							
		λ	Eigenvalues to derive component scores & weighting	S		unitless	derived	Y	
		$\boldsymbol{\mu}$	Eigenvectors to derive principal canonical axes	S		unitless	derived	Y	