OFFSHORE MARICULTURE ESCAPES GENETIC ASSESSMENT (OMEGA) MODEL VERSION 1.0 INDEX OF USER INPUTS

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COMPONENT: SETTINGS/PREFERENCES | MODULE: SETTINGS/PREFERENCES

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Settings/Preferences	92	Autosave on close	TRUE or FALSE	
	93	Save OMEGA working state when saving scenarios	TRUE or FALSE	
	94	Calculate on any change	TRUE or FALSE	
	95	Run once or run simulations	TRUE or FALSE	
	96	Number of simulations		
	97	Apply changes when reloading inpute parameters	TRUE or FALSE	
	98	Freeze header charts	TRUE or FALSE	
	99	Auto fit viewing area	TRUE or FALSE	
	100	Display results from previous run	TRUE or FALSE	
	101	Go to regulations module after calculation	TRUE or FALSE	
	102	Use random variables in simulations	TRUE or FALSE	
	103	Generate results matrix during calculation	TRUE or FALSE	

COMPONENT: HEADER | MODULE: HEADER

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Background	1	Species		Common or scientific name of the cultured species of interest
	2	Scenario		User given name for simulation scenario
	3	Description		User given description of simulation scenario

COMPONENT: REGULATORY STANDARDS | MODULE: REGULATORY STANDARDS

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Limits	87	pHOS upper limit	%	Percentage of total spawning biomass made up of spawning escapes
	88	Escape limit	%	Percentage of the total biomass made up of escapes
	89	Natural fitness lower limit	proportion	

COMPONENT: RESULTS TABLES | MODULE: RESULTS TABLES

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Timeframe	90	Begin year	years (yrs)	Set range of years from the simulation to calculate statistics shown in results tables
	91	End year	yr	

COMPONENT: AQUACULTURE | MODULE: FISH CULTURE PROGRAM

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Culture Program Operation	4	Annual production goal per operation	metric tons (mt)	Annual harvest goal for the operation
	5	Fish size at harvest	kilograms (kg)	Average size of fish at harvest
	6	Time to reach harvest size	weeks (wks)	Total length of time fish are held in pens from transfer to harvest
	7	Production units per harvest event per year		Number of production events is the number of times fish are harvested in a year. This is equivalent to the number of times small fish are transferred to pens in a year. Multiple production units imply that fish on station are of different size classes at any given time.
	8	Survival to harvest size	proportion	Cumulative survival of fish in the pen operation (survival from transfer to pens to harvest)
Broodstock Management	9	Natural origin	%	Percent of aquaculture broodstock sourced from wild population
	10	Age youngest spawner	years (yrs)	Ages (years) of spawning fish in the aquaculture program. Age at spawning of fish sourced from the wild population is assumed to follow the maturity schedule assumed for the wild population.
	11	Age oldest spawner	yrs	
Program Operations Schedule	12	Begin year and period years	yr	Begin year is set to one. Period year defines the number of years for each operational period.
	13	Number of operations		Defines the number of operations in the simulation for each period. The number of operations can vary over the total simulation period, for example, to explore the consequence of an initial startup period when the may be one to only a few operations. A zero value removes all aquaculture operations for the period, with escapes from the previous period remaining in the wild population.
On-station Inventory	14	Fish size class (bins)	kg	Average fish weight (kg) binned by size class. This represents a growth profile of fish held in net pens.
	15	Number of cages per production unit		Number of cages or net pens used to hold fish in each size class (bin). This is for a single production unit. The total number of cages/pens in a size bin is the number multiplied by the number of Production/Harvest events in a year.
	16	Duration in each size class	wks	Number of weeks fish are in each size class (bin).
On-station von Bertalanffy Growth Functions		von Bertalanffy Growth Formula	$L = L_{max} + (L_{initial} - L_{max}) * e^{-ka}$	Used to determine the size of cultured fish relative to the natural population
	17	L_{max}	centimeters (cm)	Maximum and initial size of fish on-station
	18	$L_{initial}$	cm	
	19	k		Growth rate
		Length (cm) to weight (kg) conversion	$W = \alpha L^{\beta}$	Used to determine size/age bin to place cultured fish
	20	alpha	α	
	21	beta	β	

COMPONENT: AQUACULTURE | MODULE: ESCAPE SCENARIO

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Annual Escape Rate due to Program Leakage and Routine Cage Failure	22	Base leak rate	%	Percent of fish escaping by size bin in each pen. This is applied to the initial abundance of fish in the size bin.
	23	Cage failure probability	%	Probability of a cage/net pen failure in a year by size bin. This is applied to the total number of cages across all operations for a size bin.
	24	Adjust inventory for leakage	Y or N	Assumes leakage is accounted for in the inventory management and additional fish are transferred to the pen to account for "losses" due to leakage.
Escape due to Catastrophic Events	25	Annual probability of event	%	Probability of a severe or catastrophic event by period (defined previously in the Program Operations Schedule).
	26	Magnitude of program loss	proportion	Proportion of all fish at any given time (i.e. number of fish in a size category) during an event by period.
Release of Gametes from Net Pens		Number of gametes escaping	$Eggs = Biomass_{\geq minsize} * \%Biomass * \%Mature * Eggs\ per\ kg$	$Biomass_{\geq minsize}$ is the quantity of fish in pens greater than or equal to the minimum size category that may include mature females
	27	Mininimum size at maturity	kg	Size bin at which fish may mature in cages/net pens
	28	Percent female biomass above minimum size	%Biomass	Percentage of females among the total biomass of mature fish.
	29	Percent females releasing gametes	%Mature	Percentage of mature females that release eggs from cages
	30	Eggs per kg		Mean number of eggs per kg of female body weight

COMPONENT: AQUACULTURE | MODULE: RELATIVE SURVIVAL OF ESCAPES

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Survival Shaping Function for Escapes		Time after escape		The number of years to reach the final relative survival
	31	Initial	yrs	
	32	Final	yrs	
		Survival after escape		Survival for the smallest and largest fish in the pen operation relative to a wild fish of similar size. Age specific survival of wild fish is converted to length-specific survival to compute an equivalent survival for escapes.
	33	Initial relative survival of smallest and largest escapees	proportion	Initial relative survival is survival in the first year of escape and final is after multiple years.
	34	Final relative survival of smallest and largest escapees	proportion	
		Shaping function		Parameters to shape the relative survival logistic function
	35	Slope		
	36	Inflection	yrs	
		Environmental factors		
	37	Habitat factor	$k_{habitat}$	Adjustment factor applied to initial relative survival parameters. This was included to provide a simple means to explore the effect of pen location on survival of escapes and encounter rate with wild populations.
Release of Gametes from Net Pens		Survival of gametes from net pens		Additional survival factor applied to gametes originating from pens
	38	Initial relative survival	%	

COMPONENT: AQUACULTURE | MODULE: ENCOUNTER RATE

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Select Method 1 or Method 2	39	Encounter rate method	1 or 2	User defined value (Method 1) or estimated encounter rate (Method 2) by size class (bin)
Method 1	40	Fixed encounter rate	rate	Proportion of escapes that encounter wild population. Applies a simple rate to all size categories of escapes.
Method 2		Seasonal spatial and migration characteristics	winter, spring, summer, and fall	Estimate encounter rates by size class, based on aquaculture program site seasonal distance and direction angle to wild population, attraction angle, attraction strength, wild population target size, and size class dispersal rates
	41	Distance	km	Distance from aquaculture operation to the wild population boundary
	42	Direction	degrees	Angle of aquaculture operation to the wild population relative to the shoreline. Direction becomes more of a factor when the target site of the wild population is small, such as discrete unit of habitat critical for the survival of the wild population.
	43	Habitat/natural population target size	km	Size of the affected wild population "target." Spatial distribution is represented as an arc in the calculations.
		On-station inventory		
	44	Dispersal rate	km/wk	Rate of travel of escapes by size class
		Attraction		
	45	Angle	degrees	Angle environmental factors, such as currents, may direct escapes
	46	Strength	weak, moderate, strong	Relative strength of environmental factors pushing escapes in the direction of the attraction angle

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Genetic and Fitness Effects		Calculate fitness effects	Y or N	The phenotypic fitness model is a two-population analysis of different environmental selection regimes acting on the populations and the effect of gene flow between populations on the mean trait value. Yes (Y) – compute relative reproductive success based on computed phenotypic trait value of escapees. No (N) – use input assumptions for relative reproductive success.
	47	Fixed natural fitness		Available if "Calculate fitness effects" is set to N
		Fitness model parameters		Available if "Calculate fitness effects" is set to Y
	48	Initial trait value	P	Initial phenotypic trait value for the aquaculture and wild populations. The wild population is nearly always 100, and the aquaculture trait value is <100 with cultured broodstock or 100 with wild broodstock.
	49	Environmental optimum	theta	Phenotypic optimum for the natural and culture environments. The natural environment is always 100, and the aquaculture optimum is <100 to represent differential selective pressure.
	50	Strength of selection	omega	The strength of selection for the natural and culture environments is expressed as $\omega^2_{nat} = \omega_{nat}\sigma^2$ and $\omega^2_{culture} = \omega_{culture}\sigma^2$, where ω is the input parameter value in OMEGA.
	51	Heritability	herit	Trait heritability is h^2. Campton (2009) referenced two sets of heritabilities: $h^2 = 0.2$ (moderate) and $h^2 = 0.5$ (strong). Trait heritability is assumed to be the same for both cultured escapes and wild fish.
	52	Trait variance	variance	Trait variance σ^2. Trait variance is assumed to be the same for both cultured escapes and wild fish.
		Distribution of fitness effect across life		
	53	Spawning allocation	proportion	
	54	Juvenile survival (egg to subadult) allocation	proportion	
Relative Reproductive Success of Escapes (1st Generation)	55	Genetic effect	Y or N	Yes (Y) – compute relative reproductive success based on computed phenotypic trait value of escapees. No (N) – use input assumptions for relative reproductive success.
		Non-genetic effect		Available if "Genetic effect" is set to N
	56	Minimum		Initial reproductive success of escapes
	57	Maximum		Long-term reproductive success of escapes
	58	Slope		Parameters to shape the logistic function
	59	Inflection	yrs	
	60	Competition factor	$k_{competition}$	Relative competitive interaction

COMPONENT: NATURAL PRODUCTION | MODULE: NATURAL PRODUCTION

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Spawner-Recruit Function		Female spawning biomass		
	61	Initial biomass	mt	Initial female spawning biomass
	62	Eggs per kg		Mean number of eggs per kg of female body weight
	63	Eggs per kg CV		Coefficient of variation to include random variation in egg production
		Beverton-Holt stock-recruitment		
	64	Age at recruitment	yrs	Age for the end of the recruitment phase
	65	Capacity at recruitment age	1000s of fish	Capacity of maximum number of individuals at the end of the recruitment phase
	66	Recruitment CV		Coefficient of variation to include random variation in recruitment
Natural Survival		Natural mortality		
	67	Maximum age	yrs	Maximum age of adults in the population
	68	Survival		Mean survival rate from egg to first year and at adult
	69	Survival CV		Coefficient of variation for adult survival
	70	Apply semelparous breeding	Y or N	Yes (Y) - species is semelparous. No (N) - species is iteroparous.
		Logistic shaping function to compute age-		
	71	Slope		
	72	Inflection	yrs	Age

COMPONENT: NATURAL PRODUCTION | MODULE: GROWTH PARAMETERS

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Wild Male and Female von Bertalanffy Growth Functions		von Bertalanffy growth formula	$L = L_{max} + (L_{initial} - L_{max}) * e^{-ka}$	Used to estimate length, weight, and proportion of mature females by age
	73	L_{max}	cm	Maximum and initial size of fish
	74	$L_{initial}$	cm	
	75	$a_{initial}$	yrs	Age
	76	k		Growth rate
		Length (cm) to wt (kg) conversion	$W = \alpha L^{\beta}$	
	77	alpha	α	
	78	beta	β	
		Female maturity schedule		Logistic function to shape maturity
	79	Age of youngest spawner	yrs	Age of youngest spawning female. This forces the maturity to zero at that age
	80	Female length at 50% maturity	cm	Female length at which 50% of the population is mature. This is the logistic function inflection point.
	81	beta		Slope of the function

Aspect		User-Supplied Input or Parameter	Unit, Equation, or Descriptor	Description or Definition
Use Descending Selectivity after Terminal Recruitment?			Y or N	No (N) – ascending function only. Yes (Y) – include a descending portion for older fish that may avoid fishery because of size or distribution.
Age at Recruitment to Fishery		Age amd selectivity		
	82	Initial recruitment		Ascending selectivity only
	83	Terminal recruitment		Ascending and descending selectivity
		Logistic shaping function to compute age-		
	84	Slope		
	85	Inflection	yrs	Age
Fishing Instantaneous Mortality Rate at Full Recruiment	86	Harvest rate		F_{max}