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Lake Ozette Sockeye Life Cycle Model

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U.S. Geological Survey

Limiting Factors Analysis

Lake Ozette Sockeye Limiting Factors Analysis

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Prepared for:
The Makah Indian Tribe and NOAA Fisheries, in Cooperation With the Lake Ozette Sockeye Steering Committee

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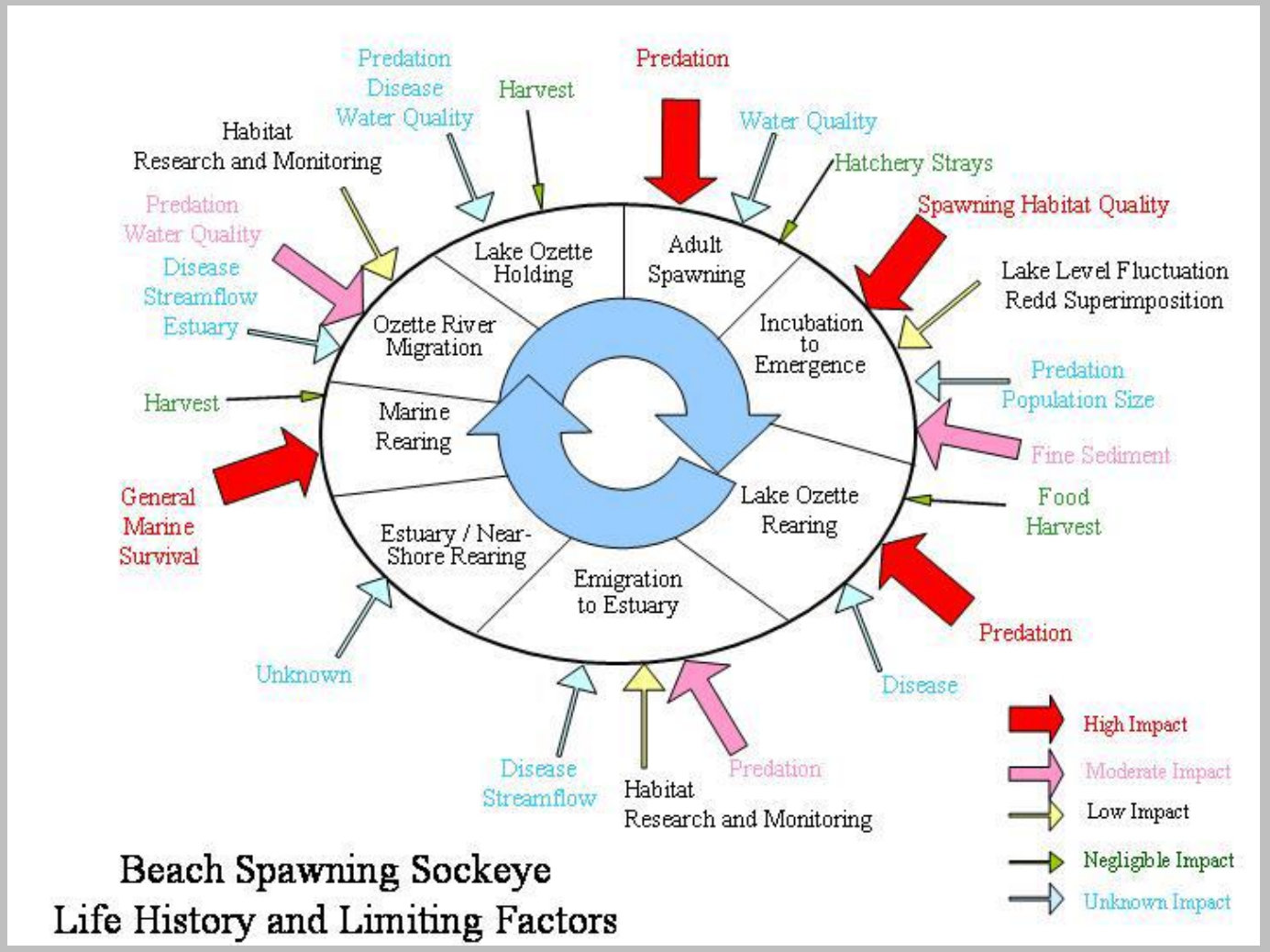
Existing Sockeye Model



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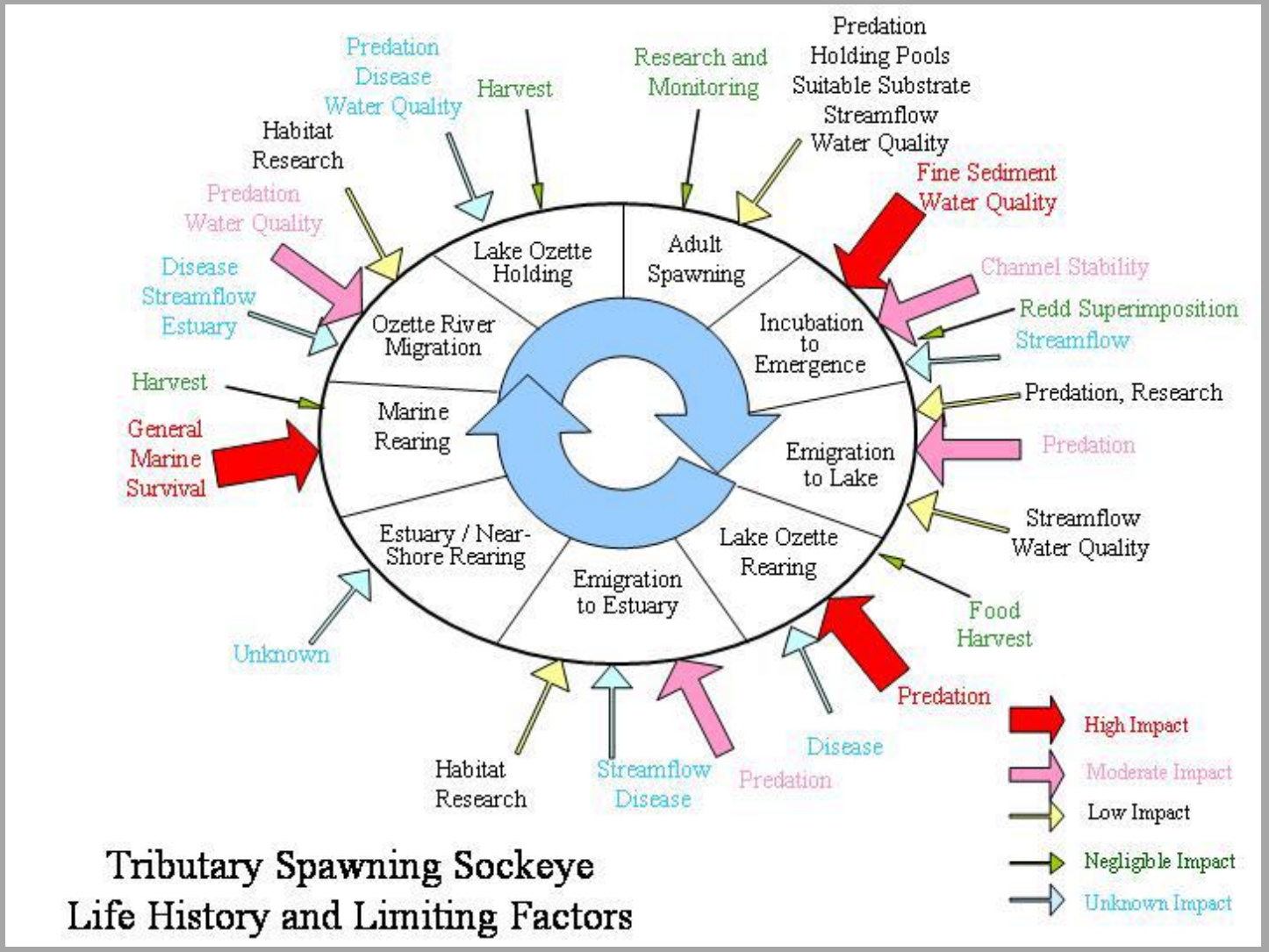
Existing Sockeye Model



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Existing Sockeye Model

surv_model_CC_8 [Compatibility Mode] - Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1		Sockeye	Output	Survival	Mortality	Predation	EVENT_G	Event_su	LF	Rating	Abundance	Predation Mortality		Event	Other Mortality			Plot Values	Predation Only	60%	20%	20%									
2	Start A	4,000	3,480	0.87	0.13	0.07	5	0.06	WQ	Moderate	0	15.0%		1	0.01			0	15.0%	16.0%	18.0%	21.0%									
3	Start B	4,000	3,480	0.87	0.13	0.07	5	0.06	Predation	Moderate	1,000	12.0%		2	0.01			1,000	12.0%	13.0%	15.0%	18.0%									
4	Start C	4,000	3,680	0.92	0.08	0.07	2	0.01	Habitat Qua	Low	2,000	9.0%		3	0.01			2,000	9.0%	10.0%	12.0%	15.0%									
5	Start D	4,000	3,680	0.92	0.08	0.07	1	0.01	Streamflow	Unknown	3,000	8.0%		4	0.03			3,000	8.0%	9.0%	11.0%	14.0%									
6	Return A1	793	650	0.82	0.18	0.15	4	0.03	Estuary	Unknown	4,000	7.0%		5	0.06			4,000	7.0%	8.0%	10.0%	13.0%									
7	Return B1	3,421	2,942	0.86	0.14	0.08	5	0.06	R&M	Low	5,000	5.8%						5,000	5.8%	6.8%	8.8%	11.8%									
8	Return C1	7,337	6,963	0.949	0.051	0.041	3	0.01			6,000	4.8%						6,000	4.8%	5.8%	7.8%	10.8%									
9	Return D1	6,867	6,468	0.942	0.058	0.048	2	0.01			7,000	4.1%						7,000	4.1%	5.1%	7.1%	10.1%									
10	Return A2	429	360	0.84	0.16	0.15	1	0.01			8,000	3.6%						8,000	3.6%	4.6%	6.6%	9.6%									
11	Return B2	6,106	5,752	0.942	0.058	0.048	2	0.01			9,000	3.2%						9,000	3.2%	4.2%	6.2%	9.2%									
12	Return C2	6,234	5,873	0.942	0.058	0.048	3	0.01			10,000	3.0%						10,000	3.0%	4.0%	6.0%	9.0%									
13	Return D2	7,319	6,580	0.899	0.101	0.041	5	0.06			20,000	1.6%						20,000	1.6%	2.6%	4.6%	7.6%									
14	Return A3	521	411	0.79	0.21	0.15	5	0.06			40,000	0.9%						40,000	0.9%	1.9%	3.9%	6.9%									
15	Return B3	6,015	5,366	0.892	0.108	0.048	5	0.06			80,000	0.5%						80,000	0.5%	1.5%	3.5%	6.5%									
16	Return C3	4,611	4,242	0.92	0.08	0.07	3	0.01																							
17	Return D3	9,389	8,995	0.958	0.042	0.032	1	0.01																							
18	Return A4	244	200	0.82	0.18	0.15	4	0.03																							
19	Return B4	3,204	2,851	0.89	0.11	0.08	4	0.03																							
20	Return C4	6,721	6,332	0.942	0.058	0.048	3	0.01																							
21	Return D4	10,885	10,450	0.96	0.04	0.03	1	0.01																							
22	Return A5	379	318	0.84	0.16	0.15	1	0.01																							
23	Return B5	6,005	5,657	0.942	0.058	0.048	3	0.01																							
24	Return C5	8,420	8,032	0.954	0.046	0.036	2	0.01																							
25	Return D5	17,599	16,895	0.96	0.04	0.03	1	0.01																							
26	Return A6	723	593	0.82	0.18	0.15	4	0.03																							
27	Return B6	8,109	7,736	0.954	0.046	0.036	1	0.01																							
28	Return C6	11,039	10,597	0.96	0.04	0.03	3	0.01																							
29	Return D6	25,314	24,656	0.974	0.026	0.016	2	0.01																							
30	Return A7	1,257	1,068	0.85	0.15	0.12	4	0.03																							
31	Return B7	10,253	9,330	0.91	0.09	0.03	5	0.06																							
32	Return C7	3,811	3,278	0.86	0.14	0.08	5	0.06																							
33	Return D7	14,445	13,868	0.96	0.04	0.03	1	0.01																							
34	Return A8	1,680	1,462	0.87	0.13	0.12	3	0.01																							
35	Return B8	2,015	1,774	0.88	0.12	0.09	4	0.03																							
36	Return C8	4,902	4,265	0.87	0.13	0.07	5	0.06																							
37	Return D8	18,106	17,382	0.96	0.04	0.03	3	0.01																							
38	Return A9	3,716	3,382	0.91	0.09	0.08	2	0.01																							
39	Return B9	1,782	1,550	0.87	0.13	0.12	1	0.01																							
40	Return C9	6,542	6,032	0.922	0.078	0.048	4	0.03																							
41	Return D9	12,866	12,094	0.94	0.06	0.03	4	0.03																							
42	Return A10	6,025	5,555	0.922	0.078	0.048	4	0.03																							
43	Return B10	1,361	1,184	0.87	0.13	0.12	3	0.01																							
44	Return C10	4,176	3,633	0.87	0.13	0.07	5	0.06																							
45	Return D10	16,152	15,183	0.94	0.06	0.03	4	0.03																							
46	Return A11	11,641	10,594	0.91	0.09	0.03	5	0.06																							

Marine Survival | Random_Mort_Parameters | Other_Mort_Params | Summary_1 | Summary_2 | sum_output | Iteration_Page | Recruits_Plot | Return_graph | Return_BY_Graph | Modeled Returns_Extincti ...

READY

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Benefits of System Dynamics Model

- User-friendly modeling environment
- Create a framework for incorporating new information
- Identify information gaps
- Evaluate consequences of potential actions
- Build consensus around a problem

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Lake Ozette Sockeye Conceptual Model

Ocean Rearing

Juvenile Emigration

Juvenile Rearing

Tributary Spawners

Emergence/Dispersal

Egg Incubation

Adult Spawning

Tributary Migration/Holding

Beach and Tributary Spawners Shared Life History Stages, Environmental Conditions, and Limiting Factors

Beach Spawners

Emergence/Dispersal

Egg Incubation

Adult Spawning

Beach Staging

Lake Holding

Adult Migration

Relative Proportion of Total Mortality by Life Stage

LOW HIGH

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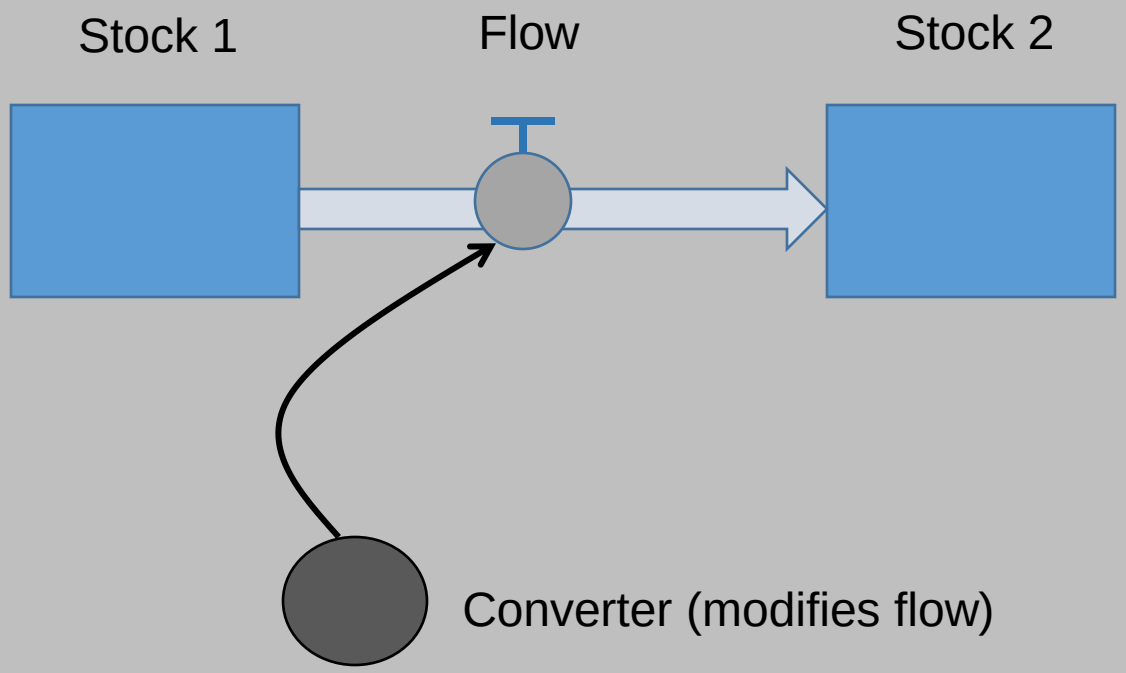
System Dynamics Model



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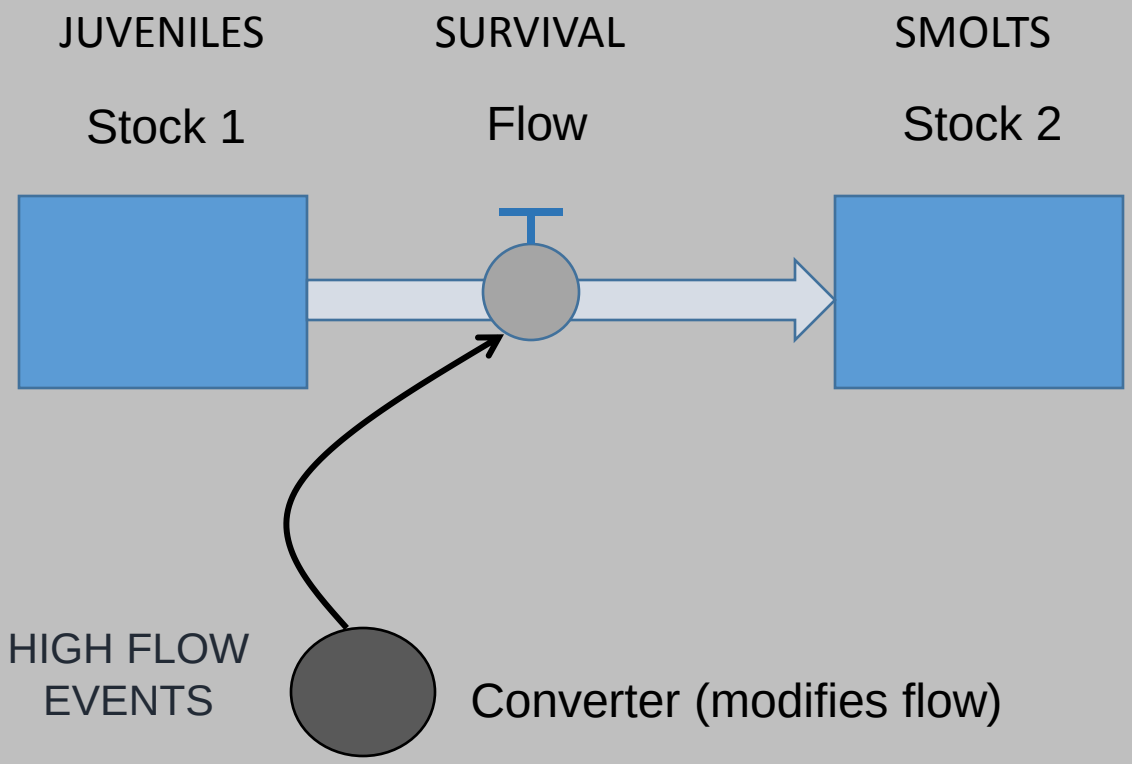
System Dynamics Model



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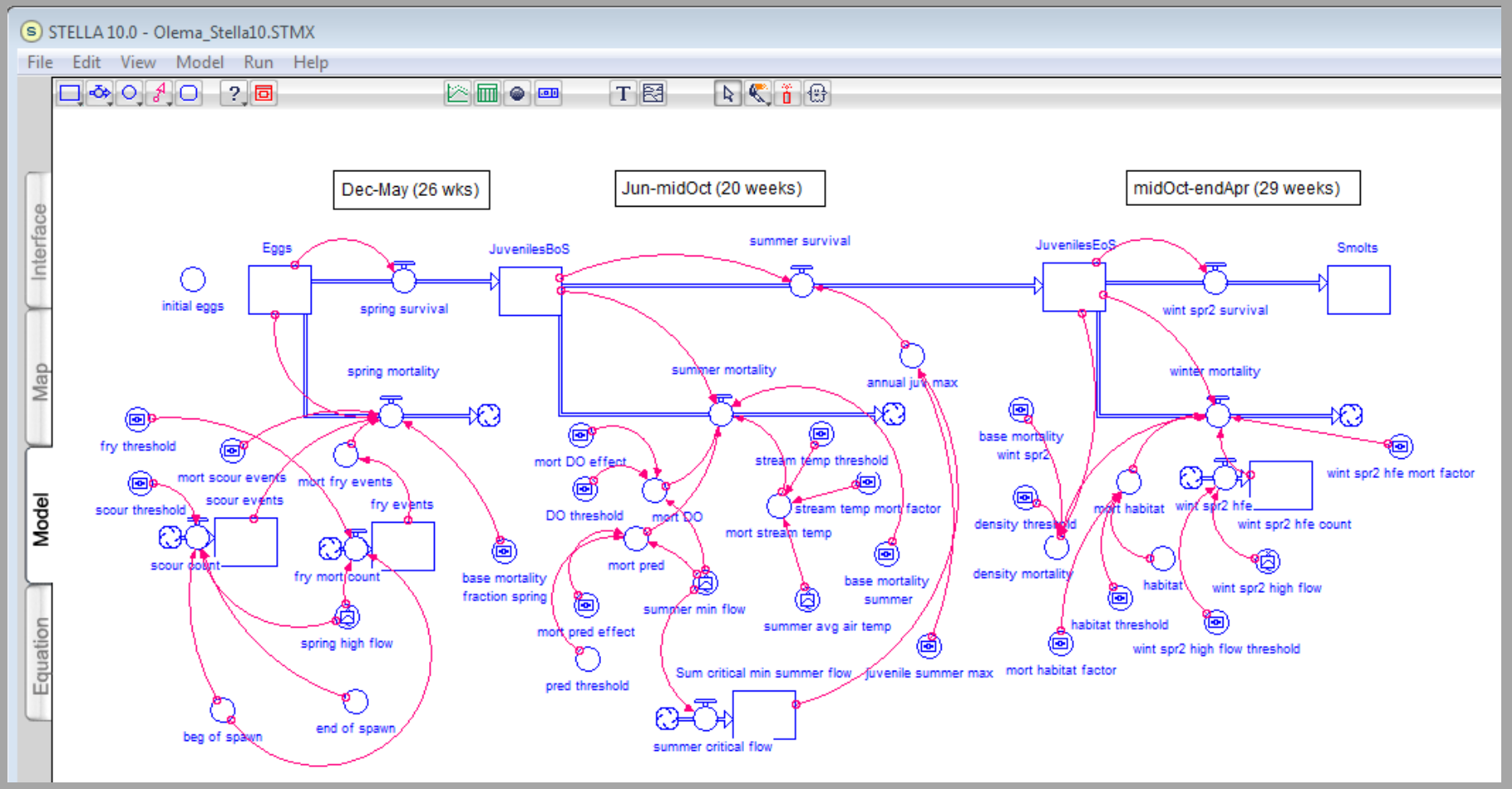
Stella® Simulation Model



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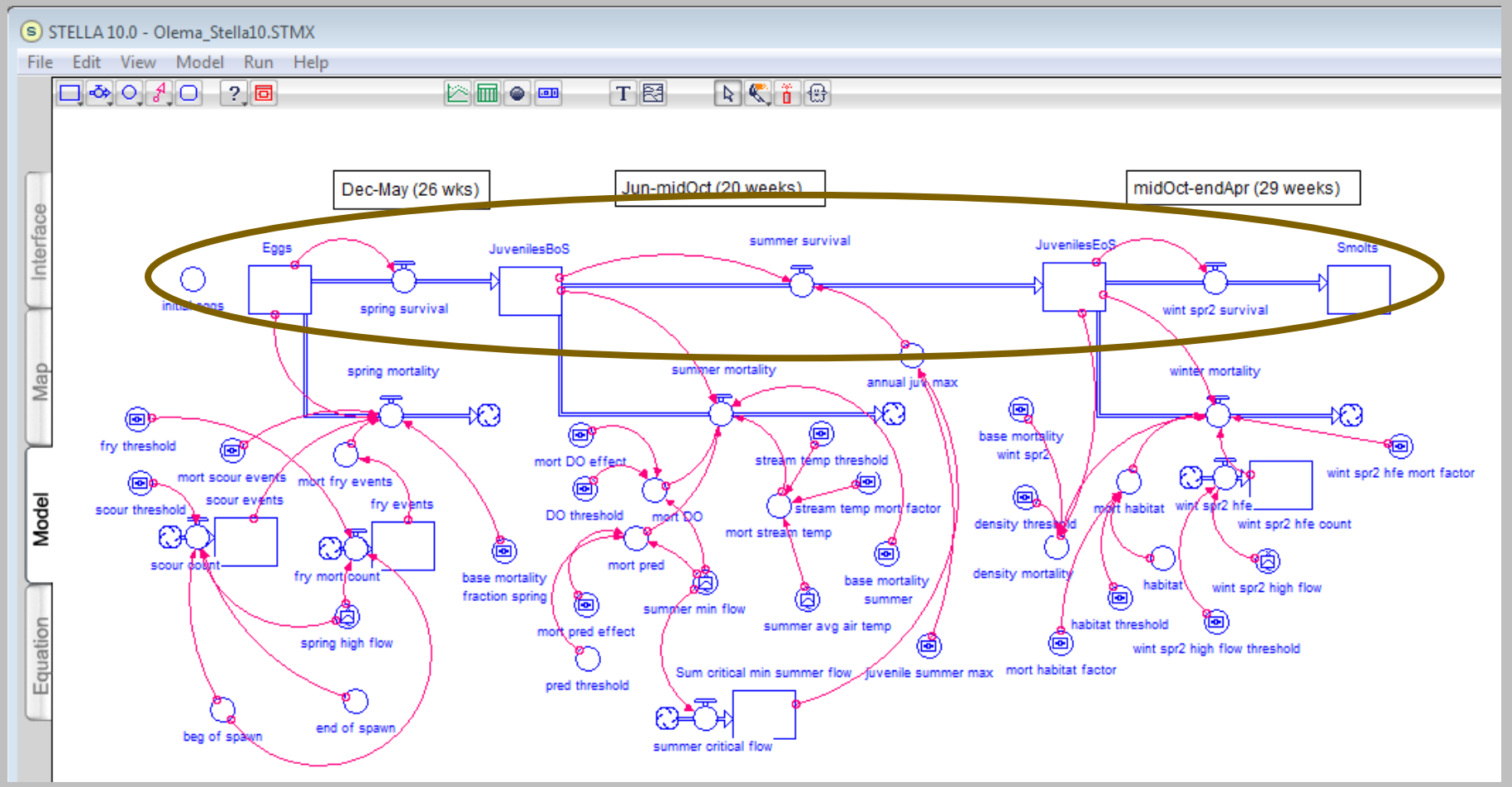
Stella® Simulation Model



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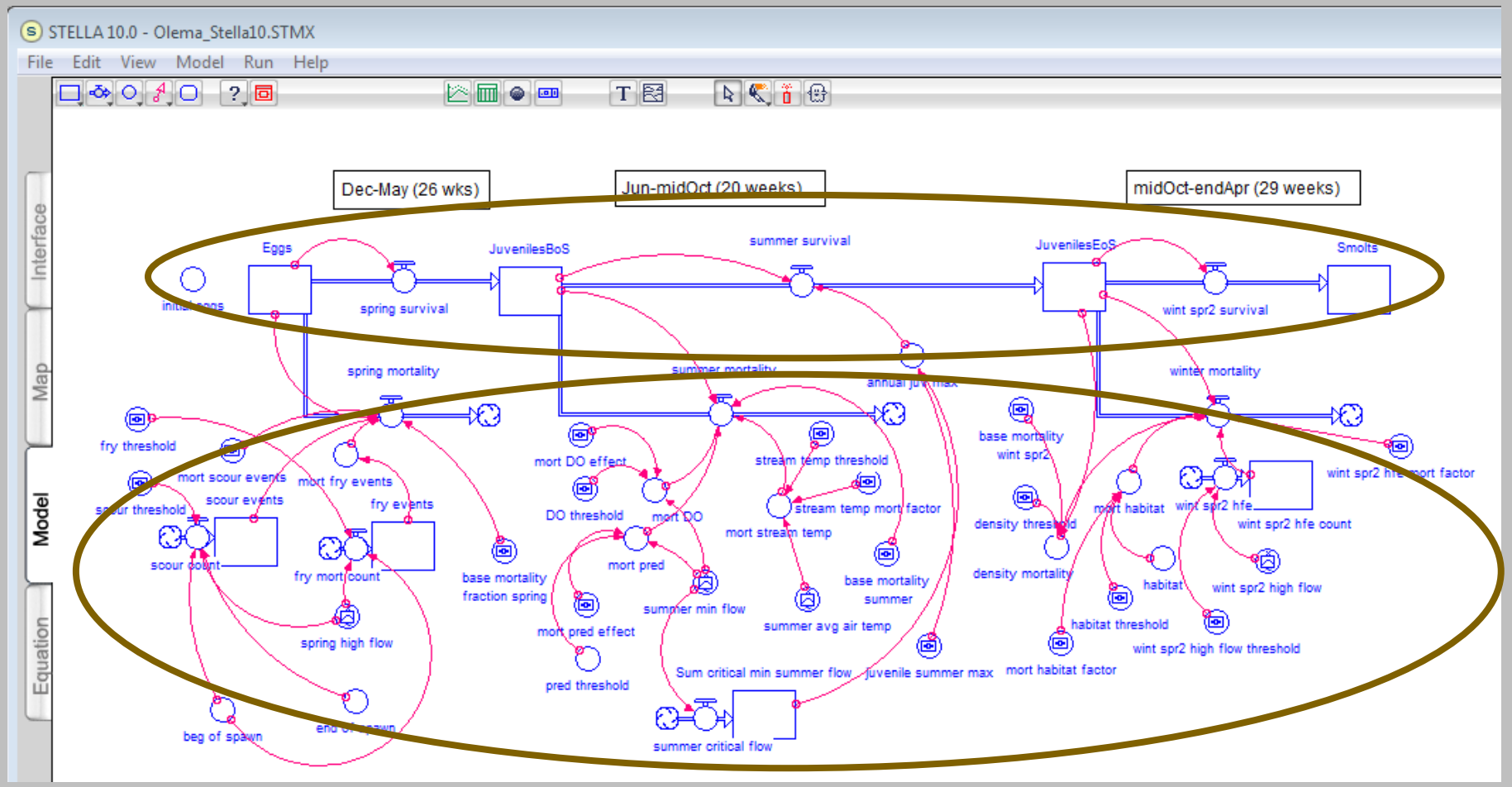
Stella® Simulation Model



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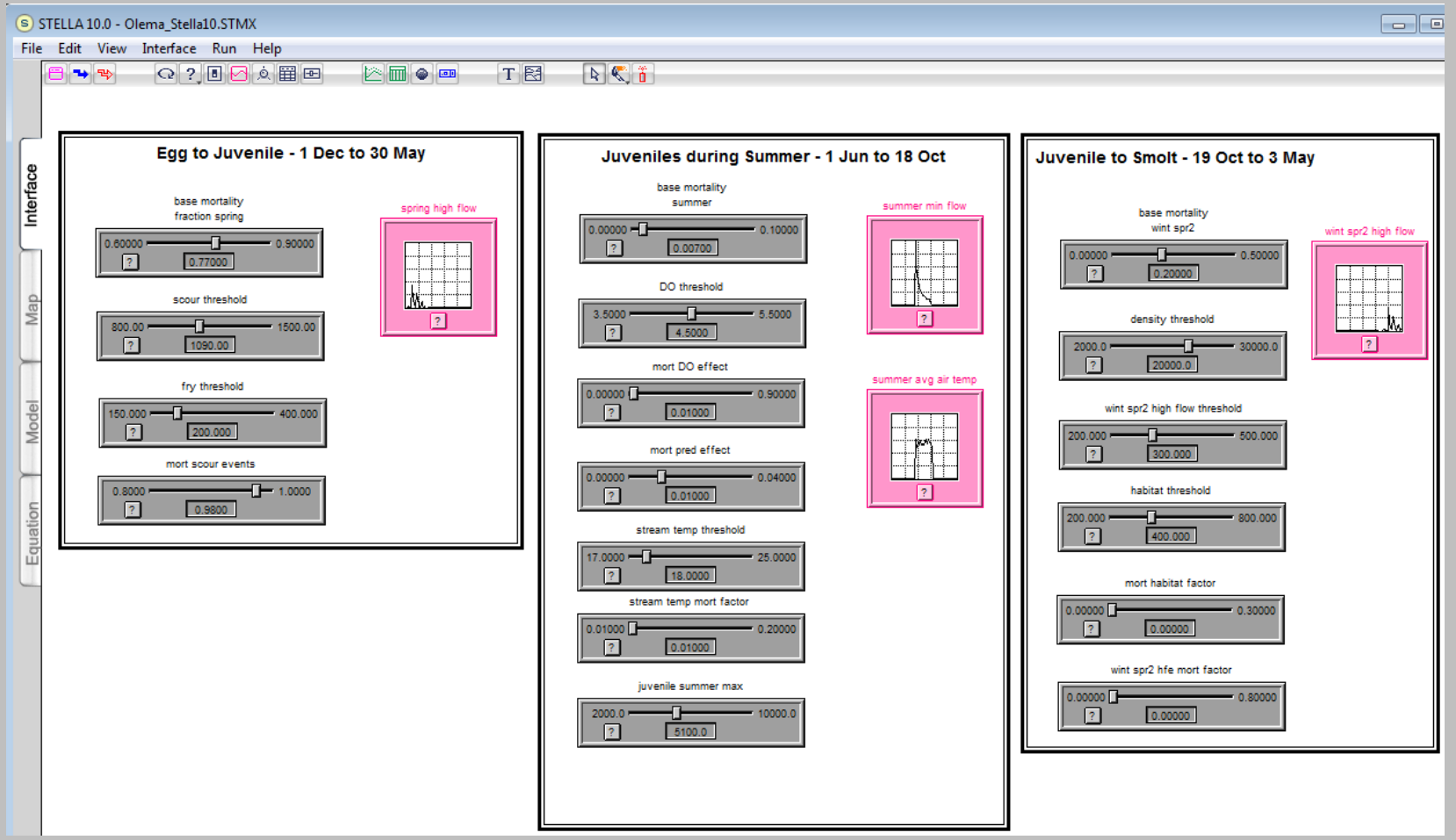
User Interface



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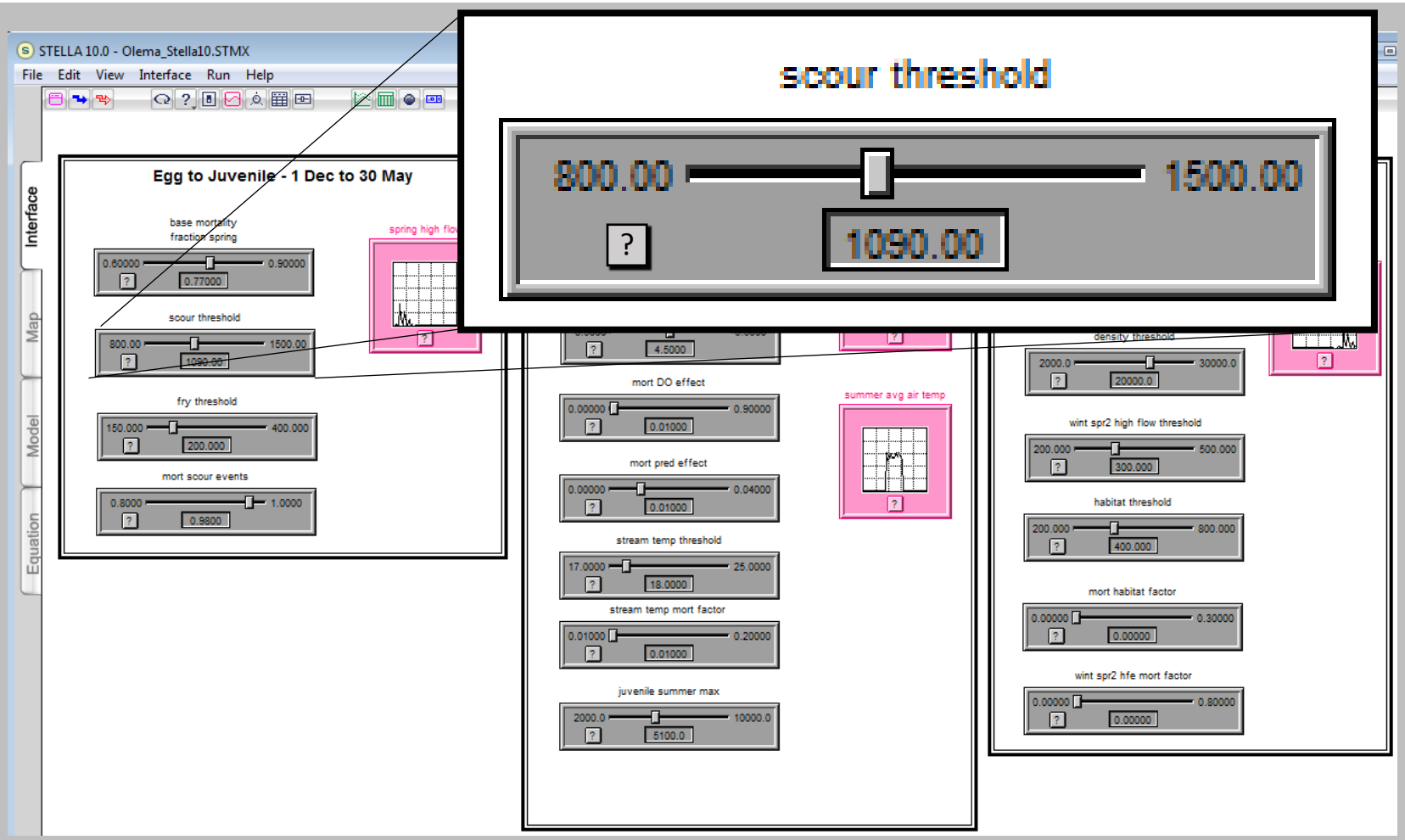
User Interface



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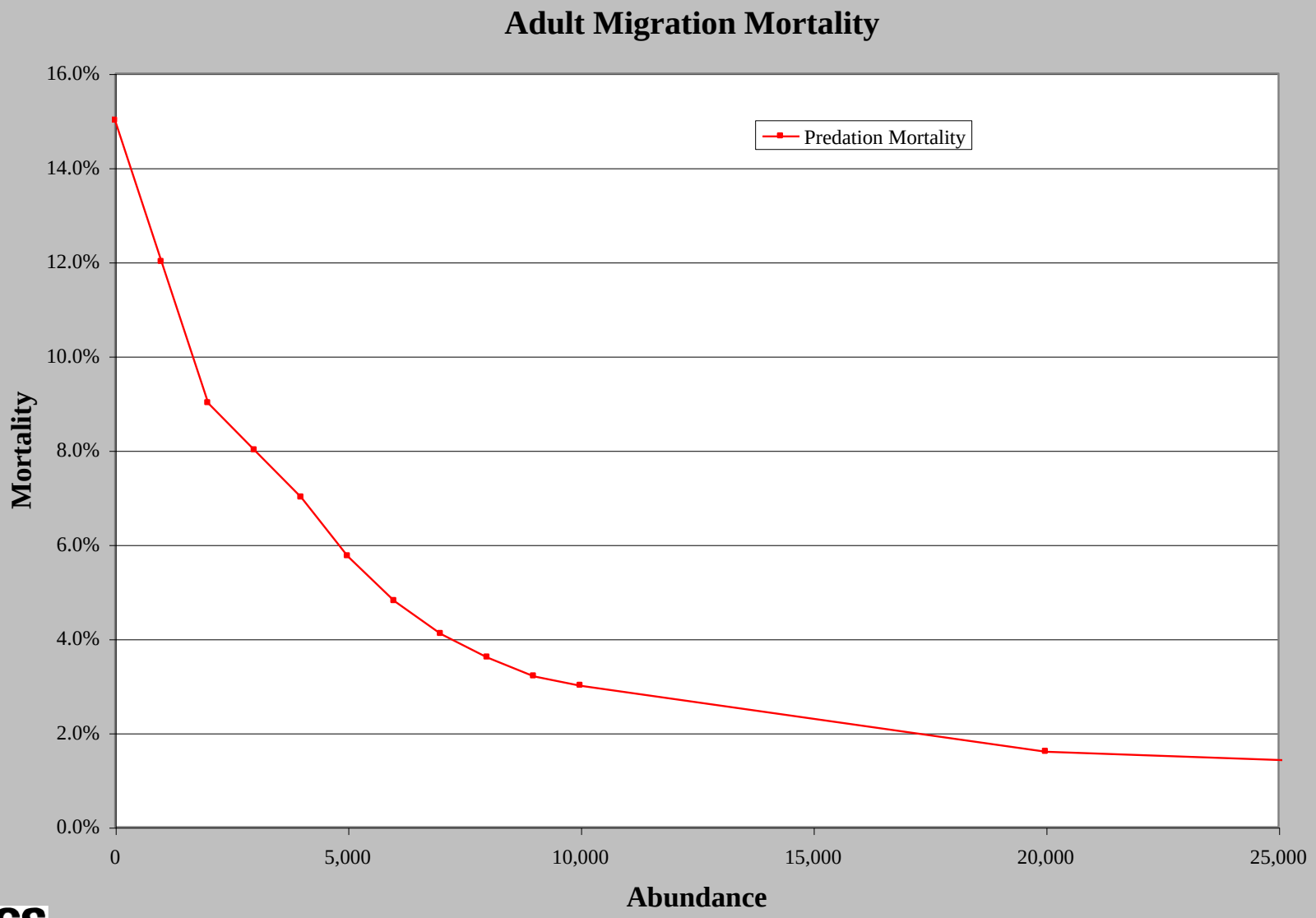
Predation during Adult Migration



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Uses for the Model

- Simulating a conceptual model
- Articulating hypotheses
- Framework for incorporating new hypotheses
- Identify data gaps and critical information needs
- Motivate research
- Experiment with environmental and management scenarios

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Thanks!

Photos: NPS