

Mechanical Shock Sensitivity in Salmonid Eggs

Mechanical shock refers to the force on eggs that occurs as a result of disturbance to eggs, during handling (i.e., egg removal from female, pouring eggs into incubators, egg transportation, egg picking) or disturbance to egg redds (i.e., jet boats, angler wading, pile driving, or digging). Many researchers have attempted to determine the effect of such disturbances on egg survival. Tests have been conducted by pouring eggs and water from arbitrary heights, vibrating eggs, by dropping eggs in simulated gravel redds, and by simulating pressure waves on eggs. To overcome many of the difficulties and uncertainties of interpreting the egg survival responses to these various types of mechanical shock, a device was developed at the Pacific Biological Station in the early 1980s to expose salmonid eggs to standardised, quantifiable shock intensities. The device and shock tests are described in papers by Jensen and Alderdice published in 1983 and 1989. A computer program (SIRP) was also developed that can be used to model these stages in relation to temperature. The model is described in the 1992 technical report by Jensen et al.

A shock sensitivity table is presented here to help fish culturists and biologists concerned about the potential impacts of disturbances to salmonid eggs. It lists LC50 values (cm of drop height causing 50% egg mortality) from fertilization to the "eyed stage". The table shows changes in mechanical shock sensitivity for 6 salmonid species (i.e., chinook, coho, chum, pink, sockeye salmon, and steelhead {or rainbow} trout) at ATUs (°C-days) from fertilization to the "eyed stage", so that the influence of temperature is included. The data are also presented in Figure 1.

To further help in interpreting the changes in egg

sensitivity, 3 levels of sensitivity have been chosen. These levels are:

1. **Sensitive (LC50 < 100 cm)**
2. **Very Sensitive (LC50 < 40 cm)**
3. **Extremely Sensitive (LC50 < 10 cm).**

SUMMARY

- If possible **do not disturb eggs** from fertilization **until the "eyed stage"**
- Significant egg sensitivity occurs soon after fertilization with coho, chum, pink, and steelhead eggs at the **"sensitive"** level after only 0.069 ATUs (or 10 min @ 10°C).
- Chinook, coho, chum, and steelhead eggs all exhibited periods (from 40 to 170 ATUs) when eggs were **"extremely sensitive"**.
- Pink and sockeye eggs appear to be more resistant to shock during yolk-overgrowth and did not exhibit levels of **"extreme sensitivity"**.

References

- Jensen, J.O.T. and D.F. Alderdice. 1983. Changes in mechanical shock sensitivity of coho salmon (*Oncorhynchus kisutch*) eggs during incubation. *Aquaculture* 32: 303-312.
- Jensen, J.O.T. and Alderdice, D.F., 1989. Comparison of mechanical shock sensitivity of eggs of five Pacific salmon (*Oncorhynchus*) species and steelhead trout (*Salmo gairdneri*). *Aquaculture* 78: 163-181.
- Jensen, J.O.T., McLean, W.E., Rombough, P.J., and Septav, T., 1992. Salmonid incubation and rearing programs for IBM-compatible computers. Can. Tech. Rep. Fish. Aquat. Sci. 1878: 46p.

SHOCK SENSITIVITY TABLE:

The changes in sensitivity to mechanical shock are indicated by LC50s (i.e., drop height causing 50% mortality) at ATUs from fertilization to the point where no mortality occurred at a maximum drop height of 100 cm (with the exception of coho, where the maximum drop height tested was 50 cm). Shock tests were continued until hatching commenced. Three levels of egg sensitivity are indicated in the table (i.e., **<100 cm = SENSITIVE {bold}**, **<40 cm = VERY SENSITIVE {bold italics}**, and **<10 cm = EXTREMELY SENSITIVE {bold italics underlined}**). ATUs to the “**eyed stage**”, the stage at which eggs are resistant to mechanical shock, also are indicated for each species (calculated for 5°C using SIRP).

ATUs (°C-days)	LC50_chinook	LC50_coho	LC50_chum	LC50_pink	LC50_sockeye	LC50_steelhead
0.007		142.0		191.8	233.4	62.5
0.035	144.1	383.4	92.1	115.4	132.4	124.9
0.069	183.4	45.2	59.3	64.4	115.8	65.9
0.104	175.0	38.8	60.8	87.8	93.5	67.1
0.208	103.0	47.6	125.2	63.1	109.3	67.6
0.313		54.3		67.5	172.2	68.5
0.417		31.1	95.9	54.4	116.3	25.2
0.833	78.1	21.1	35.7	55.0	109.8	27.6
1.667	70.9	18.8	41.6	23.7	78.9	22.4
3.333	34.2	16.4	23.6	26.1	18.3	14.5
5.0	38.1	16.0	71.1	28.2	21.6	19.9
10.0	38.1	15.2	19.2	28.1	35.6	16.2
20.0	18.2	19.4	26.1	28.1	26.4	14.4
30.0	25.0	15.4	19.7	23.7	49.3	13.9
40.0	30.3	7.4	17.5	20.2	39.3	11.3
50.0	13.4	2.4	14.2	46.3	39.6	7.9
60.0	11.5	8.1	8.7	13.0	28.1	6.1
70.0			7.6	12.2	21.1	6.2
80.0		7.0	3.6	30.0	14.6	3.5
90.0	10.8		7.7	13.4	15.5	4.7
100.0			6.9	17.1	23.1	4.8
110.0	3.1		7.3	15.6	14.3	6.3
120.0			8.1	18.8	26.0	10.4
130.0	2.6		3.4	18.0	19.1	36.0
140.0	2.9	3.5	3.8	26.2	48.7	41.3
150.0	4.4		5.9	40.0	35.4	97.7
160.0	6.0	15.7	13.4	60.8	44.1	
170.0	1.8		15.2	103.3	61.7	"eyed stage"
180.0	20.8	59.3	32.3	95.7	76.0	
190.0	47.8		36.4		148.3	
200.0	69.8		52.3		152.7	
210.0	81.5		74.1			
220.0			73.8			
230.0	293.8	"eyed stage"				
240.0			107.0		"eyed stage"	
250.0			"eyed stage"			
260.0	"eyed stage"			"eyed stage"		

Egg Shock Sensitivity

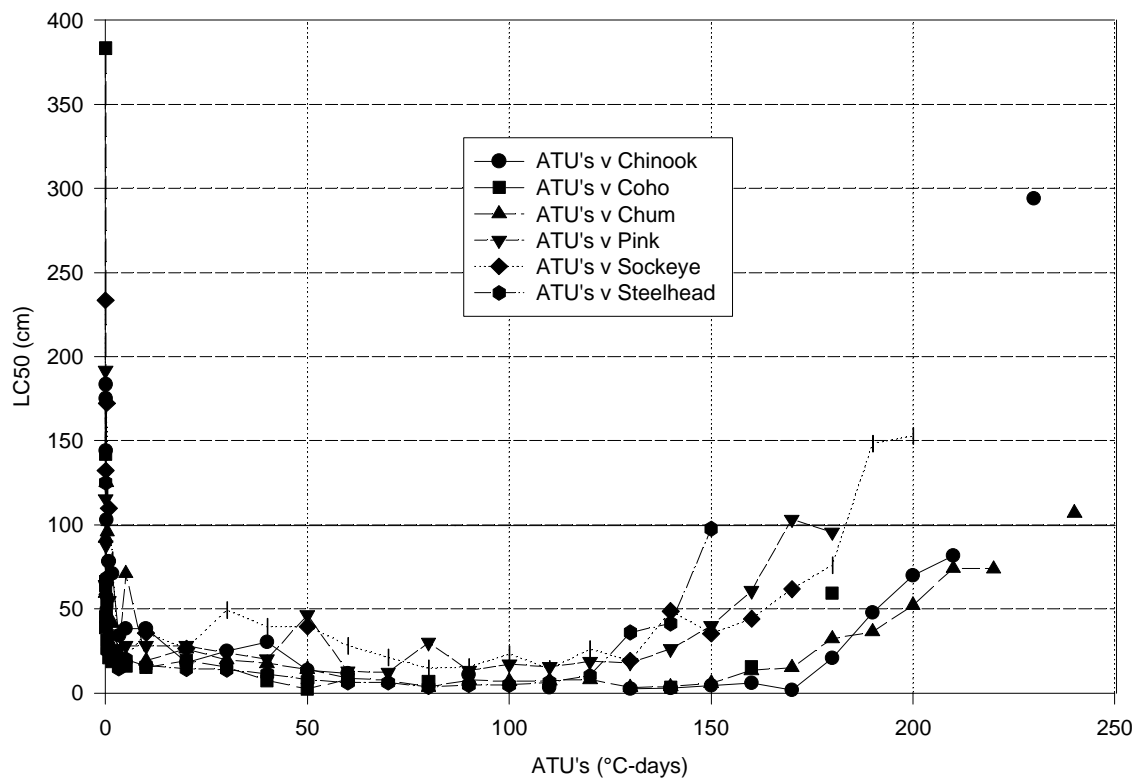


Figure 1. Illustration of changes in egg sensitivity from fertilization to the "eyed stage" for 6 species of salmonid eggs.

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