AQUACULTURE *update*

IncubWin: A New Windows 95/98/NT Computer Program for Predicting Embryonic Stages in Pacific Salmon and Steelhead Trout

A computer program, "Incub", was developed that allowed hatchery managers to predict the development rates of six salmonid species during egg incubation and early larval development in response to temperature (Jensen 1988). It was written in Microsoft[R] QuickBASIC 4.0 for Microsoft[R] DOS. Since that time, computer operating systems have changed considerably, with Windows[R] 95, 98, and NT being the most common ones used today. Hence, a new program, "IncubWin," was developed to run on Windows 95/98/NT[R] operating systems.

The program is based on relationships between incubation temperature and embryonic development rates for eggs of Pacific salmon (chinook, *Oncorhynchus tshawytscha*; chum, *O. keta*; coho, *O. kisutch*; pink*, O. gorbuscha*; sockeye, *O. nerka*) and steelhead trout (*O. mykiss*). A total of 150 mathematical models for embryonic stages, for hatching, and for maximum alevin wet weight (MAWW), ponding, or emergence have been incorporated into the program. Hence, the user can easily determine the time (i.e., in hours, days, or °C-days) it takes eggs or larvae for any of the six species to attain a specific stage of development at various temperatures. A paper describing IncubWin has been published (Jensen 1999). The program can be obtained by downloading "IncubWin.zip" from the Fisheries and Oceans Canada Science Branch Web Site

(http://www-sci.pac.dfo-mpo.gc.ca/ aqua/sirp/incubwin.htm).

EMBRYONIC DEVELOPMENT.
Development staging consists of embryonic stages 1 to 23, 50% hatch (stage 24), and MAWW, ponding, or fry emergence (stage 25). In addition, a series of colour photographs by Frank Velsen (1980) have been included in the program to illustrate embryonic development. Table 1 provides abbreviated descriptions of the 25 stages.

COMPUTER PROGRAM FEATURES.
The program allows the user to first choose a species and second to choose the type of calculation, namely: -
1.   Single Stage-Single Temperature
2.   Single Stage-Range of Temperatures
3.   25 Stages-Single Temperature
4.   25 Stages-Range of Temperatures.
For calculation-type 1 and 2 above, colour photographs for corresponding stages are displayed (Figure 1). The program then is designed to predict the time (i.e., in hours, days, or °C-days) it takes eggs or larvae for any of the six species to attain a specific stage of development (from fertilization to MAWW) at various temperatures. The results can be saved as text files for use in other applications such as spreadsheet programs, or can be sent directly to a printer. This program should have many applications for salmonid researchers, hatchery managers and students.

Table 1. Brief descriptions of the 25 embryonic and larval stages that are calculated in IncubWin.

Stage number	Description
1	Fertilization - bipolar differentiation
2	2 cell - 1st cleavage
3	4 cell
4	8 cell
5	16 cell
6	32 cell
7	Morula (many small cells)
8	Flattening of blastodisc
9	Epiboly and convergence: germ ring
10	Epiboly and convergence: 1/3 epiboly
11	Epiboly and convergence: 1/2 epiboly
12	Epiboly and convergence: 3/4 epiboly
13	Epiboly and convergence: narrowing of germ ring
14	Epiboly and convergence: yolk plug closed
15	Trunk-tail mound raised
16	Tail bud free
17	Heart beat starts
18	1/4 yolk vascularized
19	2/3 yolk vascularized
20	Eyed; 3/4 yolk vascularized
21	Caudal flexing
22	Operculum covers first branchial slit
23	Beginning of hatch
24	50% hatch
25	MAWW, emergence, or ponding

Figure 1. Page captured from IncubWin, illustrating the selection of a developmental stage with corresponding photograph.
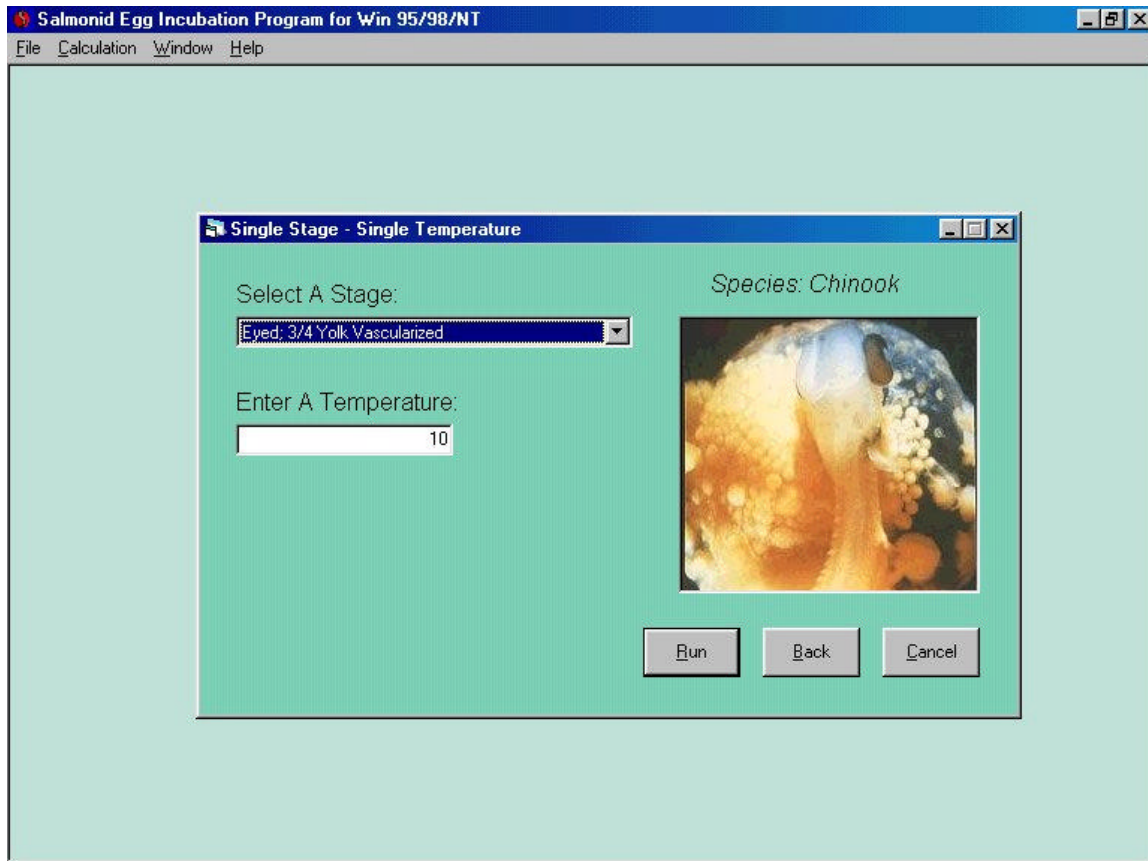
References

Jensen, J.O.T. 1988. A microcomputer program for predicting embryonic development in Pacific salmon and steelhead trout. World Aquaculture19(4): 80-81.

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Velsen, F.P.J. 1980. Embryonic development in eggs of sockeye salmon, *Oncorhynchus nerka*. Can. Spec. Publ. Fish. Aquat. Sci. 49: 19 p.

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