# Broodstock Health: *Stress Effects*

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A plankton bloom had nearly wiped out a companies' Chinook brood on the West Coast with only a few weeks to go until stripping. Luckily, there were fish on Campbell River sites that could be used at the West Coast hatchery. So, the broodstock manager oversaw the loading of the females into tanks on a Beaver (single engine bush plane). One-third SW was used, a little TMS for good measure and an oxygen bottle on a Point-Four micro bubble bar. All was fine.

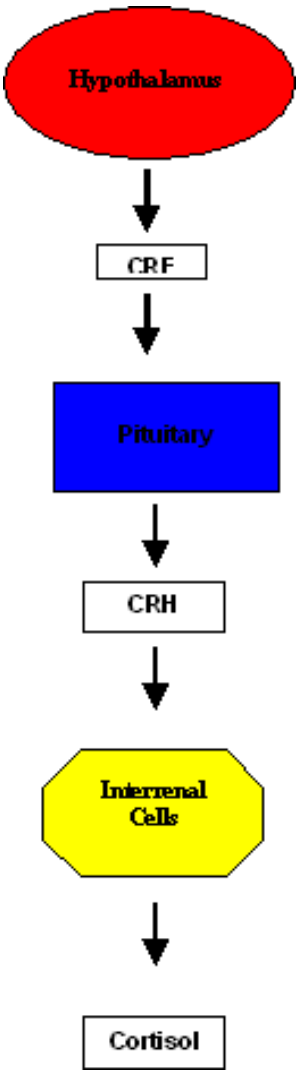
While passing over Courtenay en route to the Alberni canal the weather started getting rough, the tiny plane was tossed, if not for the courage of the fearless crew, the broodstock would be lost. Over a large airpocket, the fish, water, tanks, O2 bottle and broodstock manager experienced zero gravity. While this is normal for astronauts and fish, all here were subject to the regaining of gravity in a profound way. The rest of the transport was equally ugly because the canal was fogged in and it was a 30 min wave-topper to get to the hatchery.

On arrival, the fish were unceremoniously dumped into freshwater that was colder than the transport water. Needless to say, egg quality was not great for the survivors of the plankton bloom or the transport. To boot, the plankton survivors were mercilessly and repeatedly attacked by sea lions.

Physical trauma of these actions aside, it is no great stretch of the imagination to suggest that the stress of events impacted egg quality. At issue is the nature of the stress response and how it affects fish health. The stress response is a behavioural and physiological reaction of the fish to a perceived threat or insult.

There are two parts to the stress response: 1) the catecholamine release (adrenaline rush) and 2) the cortisol response. The former results in a heightened state of activity coupled with an escape response, while the latter has a slower response time. This slower response is similar to the maturation process in that it is mediated by the lower brain (hypothalamus), acts on the pituitary and involves the release of chemical messengers that affect the interrenal cells of the kidney (Figure 1).

This endocrine cascade from hypothalamus to pituitary to interrenal gland is the HPI axis. The hypothalamus releases corticotropin-releasing factor (CRF) along nerves that trigger the liberation of corticotropic hormone (CTH) from the pituitary into the blood. The CTH binds to cells in the kidney called interrenal cells. These cell, akin to the adrenal cortex in mammals, release glucocotricoids. In fish, this is cortisol. Cortisol is a nasty brute, or a vital hormone, depending on the view.




The normal mechanism of action for cortisol is similar to the BC Liberal budget: it stems non-essential metabolic services to combat the current crisis for a long-term goal. Instead of a Finance Minister, cortisol is the hit man. Cortisol depletes liver glycogen (stored sugars); changes free fatty acid levels in the blood, increases plasma glucose, inhibits protein synthesis and suppresses the immune response mechanisms. In essence, the cortisol response is aimed at providing energy to escape further insult; everything non-essential to keeping the fish immediately out of danger is put on hold.

The metabolic effects aside, there are two key health impacts of the cortisol response as it pertains to broodstock: immunity and reproduction.

Spawners are full of steroids; that's what makes them spawners. Besides making gametes, androgens (estrogens and testosterone) are known to repress immune function. If one has ever had the pleasure of witnessing a chum salmon spawning run, they are aware of the state of decay in senescent (aged) fish.

Androgens, like cortisol, are steroids and they both have the effect of decreasing the ability of white blood cells to produce antibodies. Cortisol also affects the total number of white blood cells and the immune organs (Maule, et al., 1989). Dr. Carl Schreck, a guru of stress and cortisol effects postulates that broodstock in the later stages of maturation may be vulnerable to stress-induced diseases because of elevated androgens and cortisol (Schreck et al., 2001).

The message here is that broodstock are at an immunological disadvantage because of the maturation process. Any additional immune suppression as a result of stressors is double indemnity.

The second point is of stress effects during maturation. For consideration here, assume that stressors are predation, handling, transport or environmental issues

and the like. Rolf (1982) points out that there are two responses to stressors: 1) sacrifice egg number and keep the body healthy (growing and fully functional) and 2) sacrifice the body and maximize gamete production. Typically, the response to stress early in vitellogenesis (egg building) is the first example, and the response to stress late in the spawning season is the second.

Stressors, whether mechanical (handling) or environmental (water quality) will effect gamete quality. Sometimes the effect is an earlier or later spawning time, but it is always associated with reduced egg performance (see Schreck et al. 2001). Stress, no matter when it occurs, negatively affects reproductive performance. The issue is managing fish health and husbandry to maximize animal care and productivity.

***Literature Cited***

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