VITALIS

Vitalis is *still* vital

Brood fish nutrition has a profound influence on the quantity, quality and performance of the offspring. Vitalis provides the ultimate package, containing the complete balance of essential nutrients to ensure optimal sperm and egg development while providing sufficient energy to aid transition from endogenous to exogenous feeding in the larvae.

SKRETTING
a Nutreco company

The importance of nutrition

The ability to succeed in reproduction is influenced by a number of factors. While genetic background, farming environmental conditions and health status all have a role to play, nutrition has been proven to have a significant influence on:

- Reproductive physiology of brood fish and their ability to spawn and produce good quality gametes
- Quantity of eggs (fecundity)
- Quality of eggs
- Quality of yolk-sac fry
- Initial performance of the larvae and fry before they become established onto feed

Optimal brood fish nutrition aims to maximise the number and quality of offspring. The nutritional requirements of brood fish not only prescribe their ability to spawn but also determine the quality of the eggs and yolk-sac fry. Good quality eggs and larvae are defined as those with the highest survival and performance characteristics.

Specific brood fish diets should be fed early enough in the reproductive cycle and throughout the period of vitellogenesis and oocyte maturation to ensure maximum survival and performance; approximately 9 -12 months before spawning.

The nutritional requirements of brood fish not only prescribe their ability to spawn but also determine the quality of the eggs and yolk-sac fry.

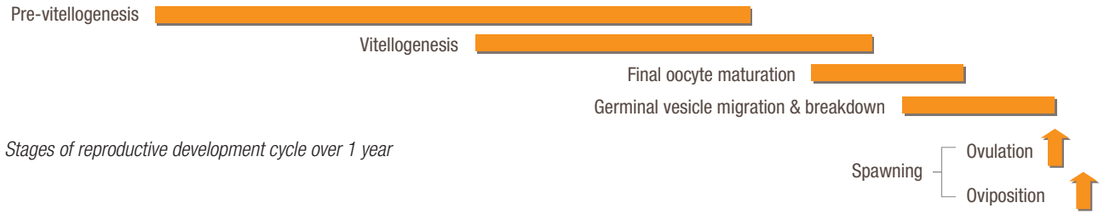
Stages of reproductive development

In general, fish have a period of ovarian development (pre-vitellogenesis) when the numbers of presumptive eggs are laid down in the ovary. Following this there is a stage of development known as vitellogenesis, where yolk precursor (vitellogenin) is assembled in the liver and then transported in the blood to the ovary where it is sequestered under hormonal control by the developing follicle.

The period of vitellogenesis in all fish, irrespective of whether they are monthly or annual single or multiple spawners, is of profound importance and it is at this stage that the major portion of the volume of the egg is formed. This may involve a 200 million fold increase in volume from the approximately 10 micron diameter egg, which was laid down at the start of the ovarian development, to the fully mature egg.

The liver plays a central role in the handling of dietary nutrients and the assembly of the vitellogenin yolk precursor, so it is essential that the brood female is free from disease and not exposed to poor water quality, variations in diet or ration or other forms of stress as these may reduce liver function and in turn interrupt vitellogenesis and egg production.

After vitellogenesis is completed, the developing oocyte goes through a process of final maturation. This involves a complex range of changes in the oocyte including a movement of the initially centrally positioned nucleus or germinal vesicle to the edge of the oocyte and the dissolution of the nuclear membrane so that fertilisation by the sperm nucleus can occur; these are known as germinal vesicle migration and germinal residue breakdown respectively. Finally, the fully ripened oocyte is ovulated (expelled from the ovary) into the body cavity (salmonids) or oviducts (most other fish) and then spawned in a process known as oviposition.

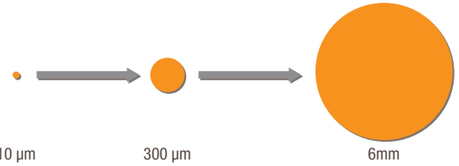


Stages of reproductive development cycle over 1 year

The growth of the salmonid oocyte

Most of the egg volume is formed during the vitellogenesis stage, regardless of the spawning pattern.

The health status of the fish is important, and the liver is essential in this process. The growth of the oocyte is a 200 million fold increase in volume. The quality of the eggs is predominantly determined during vitellogenesis, however the final spawning result is also affected by the nutritional status of the brood fish fish during all stages.



Oocyte maturation can involve a 200 million fold increase in volume from approximately 10 µm diameter to a fully mature egg

The growth of the oocyte is a 200 million fold increase in volume

Induction of sexual maturation

The developmental stages of pre-vitellogenesis, vitellogenesis and final oocyte maturation, ovulation and oviposition are controlled by the hormones of the brain-pituitary-gonadal axis. The secretion and serial changes in levels of these hormones are essential for the proper course of reproduction.

The induction of the sexual maturation cycle is a very complex process, beginning with the release of gonadotropin-releasing hormone (GnRH) from the hypothalamus in the brain.

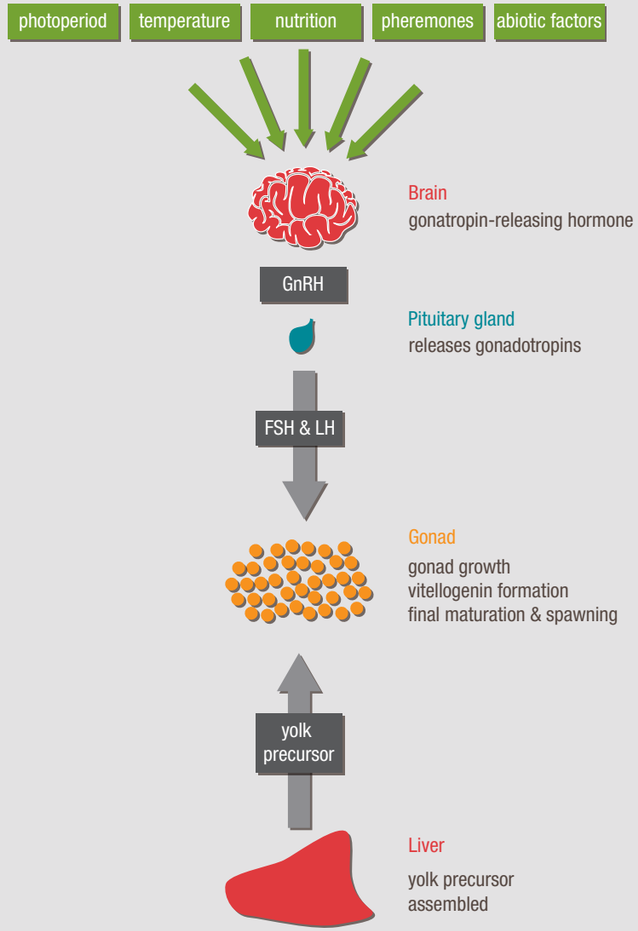
A number of factors have an impact on the release of GnRH, such as:

- Photoperiod
- Temperature
- Nutrition
- Pheromones or other signal substances from other fish that are ready to spawn
- Abiotic factors such as pollutants often have a negative impact on reproduction

GnRH simulates the pituitary gland to release gonadotropins: first the follicle stimulating hormone (FSH) and later the luteinising hormone (LH). FSH and LH stimulate production of sex steroids in the gonads, leading first to gonad growth and later to final maturation and spawning.

In addition to being cued by a number of hormonal, behavioural and environmental factors, the secretion of hormones is influenced by a series of nutrients - in particular the quantity and proportion of the essential polyunsaturated fatty acids DHA, EPA and AA and also by the essential amino acids, vitamins and microelements. Changes in levels or deficiencies of these nutrients in the diets would hence be expected to be reflected in differences in reproductive performance of the brood fish at all stages of gonadal development and in turn the numbers and quality of the eggs produced.

The secretion and serial changes in levels of hormones are essential for the proper course of reproduction



Simplified sexual maturation process showing the brain-pituitary-gonadal axis

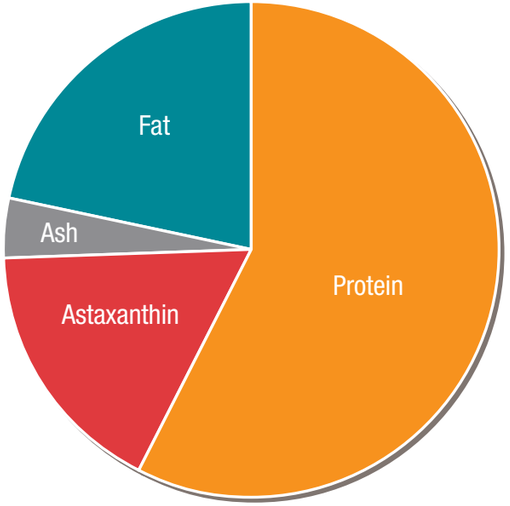
To optimise brood fish efficiency, Vitalis contains a high level of digestible protein derived from highly palatable sources

The specific nutritional requirements of brood fish

Protein
Brood fish have a much greater requirement for digestible protein and the essential amino acids than growout fish. This is primarily because proteins are the major component in vitellogenin. Low or poor quality protein levels in brood fish diets have been associated with poor fertility and egg and larval quality in a number of fish species. To optimise brood fish efficiency, Vitalis contains a high level of digestible protein derived from highly palatable sources.

Fat and fatty acids
The fatty acid (FA) composition is more important than the total fat content, as long as the requirements for essential fatty acid (EFA) are met. For salmonids, the absolute level of fat is not critical provided there is sufficient dietary energy to support gonadal growth. If the EFA requirement is not met, it can result in abnormal eggs, reduced fertilisation and hatching percentage. Vitalis is formulated with careful attention to the lipid inclusion and the balance of EFAs.

Micronutrients
A number of micronutrients have been found to be important for brood fish fish, including vitamins, minerals and carotenoids. Astaxanthin, vitamin E and vitamin C are vitally important as they all protect against oxidative damage and hence are essential for successful reproduction and good larval/fry quality. Other microingredients enhance the health status of brood fish and benefit the offspring in the instance that improved immunity is transmissible to fish eggs.



Approximate composition of salmonid eggs

VITALIS

Skretting is the global leader in providing innovative and sustainable nutritional solutions and services for the aquaculture industry. Skretting has production facilities in 19 countries on five continents, and manufactures and delivers high quality feeds from hatching to harvest for more than 60 species. The total annual production volume of feed is more than 2 million tonnes. The head office is located in Stavanger, Norway. Our purpuse is #FeedingTheFuture

www.skretting.com

SKRETTING
a Nutreco company