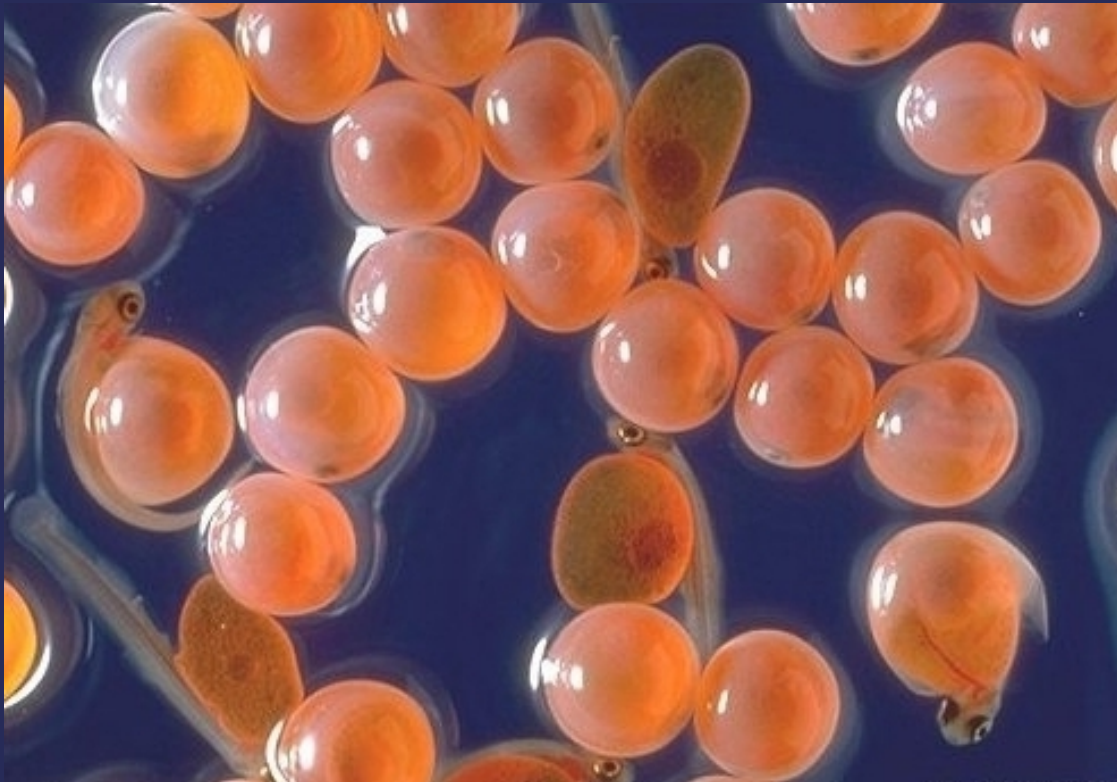


HATCHERY FEED GUIDE & YEAR BOOK 2013

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Introduction

Hatcheryfeed.com was launched in 2012 as an offshoot of Aquafeed.com, in response to requests for dedicated information for this specialized area of the industry. Over the past several months we have been adding to the site and have produced newsletters and started a Facebook page and LinkedIn discussion group to help bring hatchery operators together. The one question we continue to be asked is “Who supplies hatchery feeds?” This publication is a first attempt to answer that question.

The Hatchery Feed Guide and Year Book brings together information about hatchery feeds available on the market today. It makes no claim to be comprehensive, but we hope this first issue is a step towards making the lives of hatchery operators a little easier—at least when it comes to finding and selecting feeds. We hope you will give us some feedback on what you like and don't like and what you would like to see in the next one.

A note about the listings: we have relied entirely on information provided by suppliers in the compilation of the listings in this guide [See complete [Disclaimer](#) information]. We appreciate the time these companies have taken and the encouragement they have given us. If you supply hatchery feeds and your products are not included we apologize; please email me to make sure we contact you in time for the next issue. We also thank the editorial contributors for the articles that are included.

Please feel free to share this publication: forward it to your friends and colleagues—but please keep in intact.

Suzi Dominy

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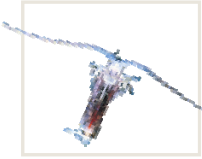


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ADVANCES IN LIVE FEED

Gunvor Øie describes the work being carried out by Scandinavian research group, SINTEF Fisheries and aquaculture, on plankton and juvenile technology

In SINTEF Fisheries and aquaculture we find a research group working with different live feed organisms. This group consists of scientists with different backgrounds; some are cybernetics, some are working with microbiology and biology, and some are biochemists. Some of the scientists have more than 25 years experience in live feed research. The group works with development of new technology and automation of processes in the live feed production and in first feeding of fish larvae.

In the future it will probably be possible to buy copepod eggs from copepod egg production plants

results in more stable and predictable production of both live feed and fish larvae. In addition to new technology some of the scientists have

focus on microbial water quality. Microbial stability in the water is important during the first period in first feeding of fish larvae.

SINTEF Fisheries and aquaculture have flexible laboratories for testing different new equipment, feed types and cultivation methods. The live feed organisms in question are rotifers, *Artemia* and copepods, in addition to different microalgae. At the moment the focus is on intensive cultivation of copepods, primarily the species *Acartia tonsa*. Production of live feed organisms for feeding marine fish larvae is an important step in rearing most of the marine fish species worldwide. Fish larvae are in a critical phase of their life cycle and there is a great need for live feed with an optimal nutritional quality. Several first feeding experiments on Atlantic cod and ballan wrasse



Photo: T. Bardal

have shown increased survival, higher growth, less deformities, better pigmentation and higher stress tolerance when copepods are used compared to traditional live feed organisms (rotifer and *Artemia*). Intensively produced copepods also facilitate cultivation of fish species that have previously been difficult to rear through the first feeding phase. One example is the ornamental fish mandarin fish,

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Photo: T. Bardal

ducing copepod eggs are established at SINTEF, and in the future it will probably be possible to buy copepod eggs from copepod egg production plants. Stable and predictable production of copepod eggs has the potential to be a profitable new industry for both aquaculture and ornamental species worldwide. **ΩHF**

which has been reared to the juvenile stage for the first time in Norway by using cultivated copepods. Another example is tuna, where small amounts of copepods together with the traditional live feed, resulted in increased growth in a small scale experiment.

In the future it will be possible to produce copepod eggs in designated facilities. Copepod eggs will be produced in large tanks, and the eggs will be harvested, washed, disinfected and stored. Boxes with copepod eggs can be transported to hatcheries for use, in a similar way as *Artemia* cysts are used today. The eggs will hatch in seawater after 24 hours and grow to a suitable size in a few days and then be transferred to fish larval tanks as a high quality diet for the fish larvae.

The use of copepods has been limited until now because their natural production is seasonal and because they are hard to produce intensively. However, new technology for pro-

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Reed Mariculture Inc: Hatchery Feeds Pioneers

REED MARICULTURE (RMI) is the world's largest producer of marine microalgae concentrates. Our Instant Algae® larviculture feeds are used by over 500 hatcheries, universities, and marine ornamental operations in more than 80 countries around the world. We also produce and distribute clean, hatchery-scale rotifer and copepods starter cultures, Otohime and TDO weaning and juvenile feeds, and related supplies.

Markets Served: Commercial aquaculture; public aquariums; public and private researchers; breeders; and aquarium retailers and hobbyists.

Cutting Edge Products: Instant Algae products are clean, effective and closer to nature than other feeds on the market. We produce whole-cell, whole-food microalgae feeds and enrichments using proprietary processes. Our products provide fish, bivalve and shrimp hatcheries with clean, convenient, long shelf-life feeds that can replace in-house microalgae. Our feeds ensure stable and rapidly-reproducing populations with excellent nutrition.

Extraordinary Customer Service: We pride ourselves on our customer service and technical support, and are also experts in world-wide shipping logistics.

History of Innovation: Reed Mariculture was

founded in 1995 by Tim Reed to grow tank-raised "urban aquaculture" oysters that would be safe and harvestable year-round using new technologies for large-scale grow out of marine microalgae, the feed for shellfish.

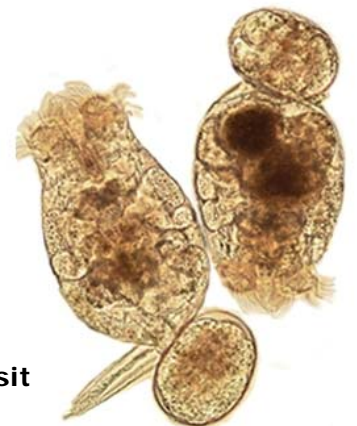
In 1998 RMI changed its focus to selling the microalgae directly to other hatcheries. RMI's current core technology is a proprietary closed-system photobioreactor design that allows microalgae to be grown in clean, controlled conditions – a radically different technology than the open-pond technology used for most commercial algae production.

In 2003 RMI expanded its larviculture products with the introduction of live zooplankton (rotifers, copepods, and Mysid shrimp), and by distributing products such as ClorAm-X (for ammonia control) and Otohime Feeds (Japanese weaning and juvenile diets).

In 2004 RMI entered the home aquarium market with the introduction of the Phyto-Feast products, super concentrates of marine microalgae formulated for feeding coral, clams and other filter feeders popular in marine reef tanks. RMI has continued to expand into the Marine Ornamental industry with the Reef Nutrition product line, which includes marine microalgae, macroalgae, rotifers, copepods, mysid shrimp, and other feeds.

In 2011 Reed Mariculture launched an exciting new product line AP-Breed – *Hatchery Solutions for Aquarists, Propagators and Breeders*. APBreed bridges commercial, ornamental and research hatchery technology and provides researchers with feed solutions customized for their unique needs.

See our product listings in this guide. For more information, visit www.reedmariculture.com or call us at: 1-877-732-3276.





EFFECTS OF DIETARY PLANT OILS ON FEMALE WHITE BASS *MORONE CHRYSOPS* EGG COMPOSITION AND PROGENY SURVIVAL

White bass have been found to require considerable amounts of n-3 LC-PUFA in the diet to achieve maximal reproductive success. By Heidi Hill.

The dramatic increase in demand (Tacon and Metian 2008) coupled with the apparent plateau in reduction fisheries landings (Pauly et al. 2002) has led to significant research into plant-based alternatives to fish meal and fish oil as ingredients in aquafeeds, including broodstock or maturation diets. Broodstock nutritional research has long focused on long-chain polyunsaturated fatty acids (LC-PUFA) found in fish oil because of their importance in providing metabolic energy and structural elements, i.e., phospholipids, for embryonic development (Sargent 1995). Plant oils do not contain intact LC-PUFA, but most provide C18 polyunsaturated fatty acids (PUFA), which some freshwater teleosts are able to desaturate and elongate into LC-PUFA in appreciable amounts (Kanazawa et al. 1979). *Morone* spp. seem to lack this ability, and replacing dietary fish oil with plant oils has resulted in significant changes in the fatty acid profile of *Morone chrysops* eggs (Lane and Kohler 2006; Lewis et al. 2010) and other tissues of *Morone* hybrids (Wonnacott et al. 2004; Lane et al. 2006; Lewis and Kohler 2008; Trushenski et al. 2008a).

Diet-related changes in *Morone* spp. gamete fatty acid composition have resulted in altered reproductive performance and early life history success (Lane et al. 2006; Lane et al. 2007; Lewis et al. 2010). In these cases, impaired performance has been associated with the accumulation of C18 PUFA, particularly 18:2n-6 (linoleic acid), at the expense of bioactive LC-PUFA such as 20:4n-6 (arachidonic acid), 20:5n-3 (eicosapentaenoic acid), and 22:6n-3 (docosahexaenoic acid). Recent evidence of preferential incorporation of 18:2n-6 into phospholipid has been observed in Atlantic salmon (Hvattum et al. 2000), sunshine bass *M. saxatilis* x *M. chrysops* (Trushenski et al. 2008b), and white bass (Lewis et al. 2010). Given the apparent ability of 18:2n-6 to competitively displace other fatty acids, including bioactive LC-PUFA, we hypothesized that oils providing different

“...we assessed the reproductive performance of female white bass fed diets containing flax, canola, or corn oil as alternatives to marine-origin lipid”

phospholipids, for embryonic development (Sargent 1995). Plant oils do not contain intact LC-PUFA, but most provide C18 polyunsaturated fatty acids (PUFA), which some freshwater teleosts are able to desaturate and elongate into LC-PUFA in appreciable amounts (Kanazawa et al. 1979). *Morone* spp. seem to lack this ability, and replacing dietary fish oil with plant oils has resulted in significant changes in the fatty acid profile of *Morone chrysops* eggs (Lane and Kohler 2006; Lewis et al. 2010) and other tissues of *Morone* hybrids (Wonnacott et al. 2004; Lane et al. 2006; Lewis and Kohler 2008; Trushenski et al. 2008a).



White bass female ready to spawn.

levels of this fatty acid might yield differential reproductive performance in white bass. Accordingly, we assessed the reproductive performance of female white bass fed diets containing flax, canola, or corn oil as alternatives to marine-origin lipid. We chose these plant oils because they represent a range of 18:2n-6 levels and thus differ in their relative ratios of n-3 to n-6 C18 PUFA (flax: 3.21:1, n-3 to n-6 C18 PUFA; canola: 0.45:1; corn: 0.02:1; see Table 1 for diet formulations).

Broodstock feeds altered egg composition and larval survival

C18 PUFA accumulated within eggs of broodstock fed diets containing plant oils during the 8-week period immediately prior to spawning, even though white bass vitellogenesis begins 5 months prior to spawning (Berlinsky et al. 1995). Broodstock fed plant oils produced eggs with similar concentrations of C18 PUFA, but eggs from flax oil-fed broodstock contained higher levels of 18:3n-3 and eggs of canola and corn oil-fed broodstock had elevated concentrations of 18:2n-6 (Table 2). These data suggest fatty acid recycling occurs continuously within the eggs during later stages of vitellogenesis. Nutrients provided via the diet immediately prior to spawning can be reflected within the eggs relatively quickly, ultimately leading to the differences in embryonic and larval survival we observed between plant oil treatments in the current study. We found dietary intake of plant oils containing elevated concentrations of 18:2n-6 negatively impacted hatch rate and cumulative larval survival at 3 DPH (Figure 1). Conversely, dietary intake of plant oils containing elevated concentrations of 18:3n-3 improved hatch rate and larval survival at 3 DPH among the n-3 LC-PUFA-deficient treatments.

Alternative oils are generally only used to dilute n-3 LC-PUFA-rich lipids in broodstock diets, and have not been directly compared to determine how their respective fatty acid profile influences broodstock physiology or reproductive output (Harel et al. 1994; Fernandez-Palacios et al. 1995; Lane and Kohler 2006; Jaya-Ram et al. 2008). Multiple broodstock nutrition trials were conducted evaluating effi-

cacy of soybean oil (Harel et al. 1994), beef tallow (Fernández-Palacios et al. 1995), and olive and linseed oil blends (Rodríguez et al. 1998) as alternatives to marine oils in gilt-head sea bream broodstock diets, although conditions were not comparable among trials, i.e., duration and source of n-3 LC-PUFA differed among studies, making direct comparison of alternative oil sources impractical. Direct comparisons of alternative oils have been conducted in other broodstock nutrition trials, though the model taxa were not carnivorous teleosts. Chinese mitten-handed crab *Eriocheir sinensis* broodstock fed soybean oil had a higher fecundity compared to broodstock fed pork lard as the primary dietary lipid source (Wen et al. 2002). Reproductive output of Nile tilapia *Oreochromis niloticus* broodstock fed soybean oil prior to spawning was enhanced compared to broodstock fed corn, coconut, or cod liver oils (Santiago and Reyes 1993). The most favorable alternative oil sources for use in broodstock feeds in the above studies contained greater concentrations of C18 PUFA than saturated fatty acids (SFA) and monounsaturated fatty acids (MUFA). Moreover, tilapia broodstock fed soybean oil (n-3 and n-6 C18 PUFA) outperformed broodstock fed corn oil (predominantly n-6 C18 PUFA), suggesting excessive dietary intake of 18:2n-6 may be detrimental to tilapia egg quality and a balanced intake of 18:2n-6 and 18:3n-3 is more favorable (Santiago and Reyes 1993). Despite study-to-study variation, some generalized themes can be teased away from these differential responses. Generally, increasing levels of 18:2n-6 have a negative effect on reproductive performance and progeny success whereas inclusion of other C18 PUFA appears less problematic. In our study, reproductive performance of female white bass increased progressively as 18:3n-3 replaced 18:2n-6 as the predominant C18 PUFA found within the plant oil source (Figure 1). Therefore, marine oil replacement with 18:3n-3-rich plant oils may not have the same ramifications for carnivorous broodstock (especially white bass) as those associated with 18:2n-6-rich plant oils (Lane and Kohler 2006). However, further research is necessary to fully validate this hypothesis.

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Table 1. Formulation and composition ($\text{g}\cdot\text{kg}^{-1}$) of experimental diets fed to female white bass for 8 weeks prior to spawning.

Ingredient	Experimental Diets		
	Flax	Canola	Corn
Menhaden meal ^a	500.0	500.0	500.0
Flax oil ^b	85.0	--	--
Canola oil	--	85.0	--
Corn oil	--	--	85.0
Wheat flour	336.8	336.8	336.8
Corn gluten	64.2	64.2	64.2
Mineral premix ^c	1.0	1.0	1.0
Vitamin premix ^d	6.0	6.0	6.0
Vitamin C	1.0	1.0	1.0
Choline (70%)	6.0	6.0	6.0
Fatty acid composition (% total fatty acid methyl esters)			
SFA ^e	20.6	23.8	20.6
MUFA ^f	23.0	24.6	26.7
18:2n-6	15.5	32.6	43.5
n-6 LC-PUFA ^g	0.5	0.4	0.6
n-6 ^h	16.0	33.1	44.3
18:3n-3	27.8	5.6	1.4
n-3 LC-PUFA ⁱ	11.9	12.7	6.8
n-3 ^j	40.3	18.4	8.4
C ₁₈ PUFA ^k	44.0	38.9	45.3
n-3 to n-6	2.5	0.6	0.2

^a Omega Protein (Houston, Texas)

^b Jedwards International, Inc. (Quincy, MA)

^c U.S. FWS Federal Premix #3

^d U.S. FWS Federal Premix #30

^e Saturated fatty acids—includes 14:0, 15:0, 16:0, 17:0, 18:0, 20:0, and 22:0.

^f Monounsaturated fatty acids—includes 16:1n-7, 18:1n-7, 18:1n-9, 20:1n-9, 22:1n-11, and 22:1n-9.

^g n-6 Long-chain polyunsaturated fatty acids—sum of all n-6 FA with chain length ≥ 20 carbon atoms and double bonds ≥ 3 ; includes 20:2n-6, 20:3n-6, 20:4n-6, and 22:2n-6

^h Also includes 18:3n-6

ⁱ Also includes 18:4n-3

^j n-3 Long-chain polyunsaturated fatty acids—sum of all n-3 FA with chain length ≥ 20 carbon atoms and double bonds ≥ 3 ; includes 20:3n-3, 20:4n-3, 20:5n-3, 22:5n-3, and 22:6n-3

^k C₁₈ Polyunsaturated fatty acids—sum of all PUFA with 18 carbon chain length.

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Table 2. Crude lipid fatty acid concentrations (mean \pm standard error; % total fatty acid methyl esters) of white bass eggs after feeding flax, canola, or corn oil for 8 weeks prior to spawning. Different letters within rows denote statistically significant differences between treatment means ($\alpha=0.05$).

Fatty Acids	Experimental Diets		
	Flax	Canola	Corn
SFA ^a	17.9 \pm 0.4	17.9 \pm 0.4	17.6 \pm 0.4
MUFA ^b	37.2 \pm 1.0	36.6 \pm 1.0	37.4 \pm 1.0
18:2n-6	9.6 \pm 1.3 b	14.8 \pm 1.4 a	15.2 \pm 1.4 a
n-6 LC-PUFA ^c	3.6 \pm 0.2	3.9 \pm 0.2	3.8 \pm 0.2
n-6 ^d	13.5 \pm 1.2 b	19.1 \pm 1.3 a	19.7 \pm 1.3 a
18:3n-3	9.0 \pm 0.6 a	3.4 \pm 0.7 b	3.4 \pm 0.7 b
n-3 LC-PUFA ^e	22.3 \pm 1.0	22.9 \pm 1.1	21.7 \pm 1.1
n-3 ^f	31.4 \pm 1.1a	26.3 \pm 1.2 b	25.2 \pm 1.2 b
C ₁₈ PUFA ^g	19.2 \pm 1.5	18.8 \pm 1.6	19.3 \pm 1.6
n-3 to n-6	2.5 \pm 0.2 a	1.6 \pm 0.2 b	1.4 \pm 0.2 b

^a Saturated fatty acids—includes 14:0, 15:0, 16:0, 17:0, 18:0, 20:0, and 22:0.

^b Monounsaturated fatty acids—includes 16:1n-7, 18:1n-7, 18:1n-9, 20:1n-9, 22:1n-11, and 22:1n-9.

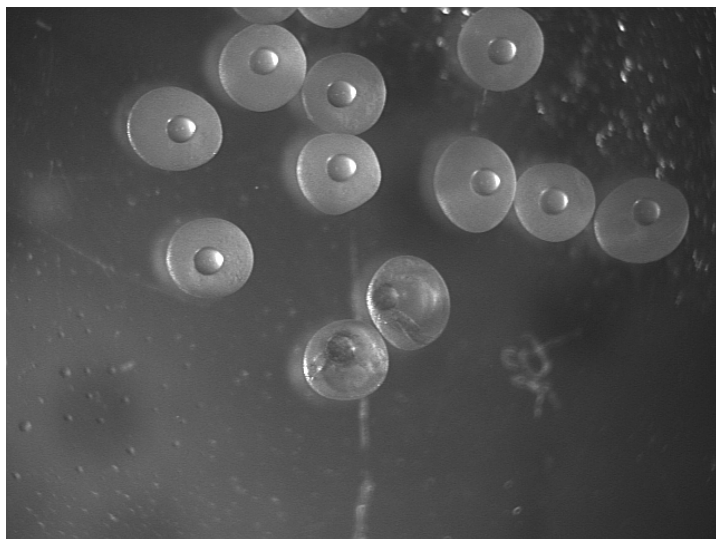
^c n-6 Long-chain polyunsaturated fatty acids—sum of all n-6 FA with chain length \geq 20 carbon atoms and double bonds \geq 3; includes 20:2n-6, 20:3n-6, 20:4n-6, and 22:2n-6

^d Also includes 18:3n-6

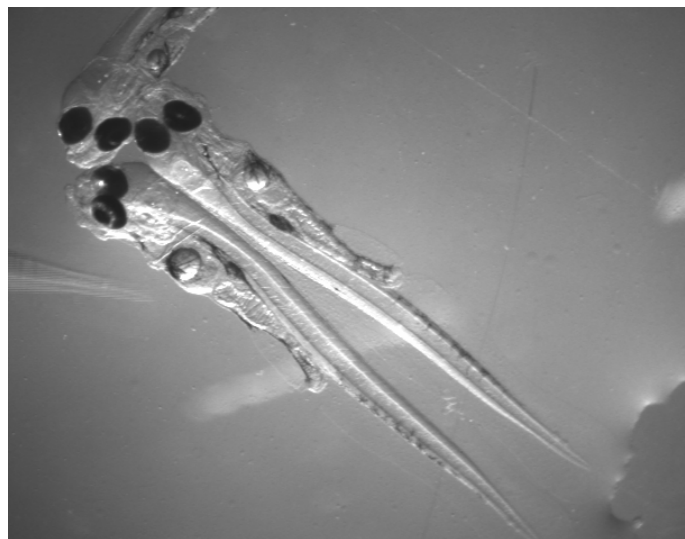
^e n-3 Long-chain polyunsaturated fatty acids—sum of all n-3 FA with chain length \geq 20 carbon atoms and double bonds \geq 3; includes 20:3n-3, 20:4n-3, 20:5n-3, 22:5n-3, and 22:6n-3

^f Also includes 18:4n-3

^g C₁₈ Polyunsaturated fatty acids—sum of all PUFA with 18 carbon chain length



Fertilized and unfertilized white bass eggs



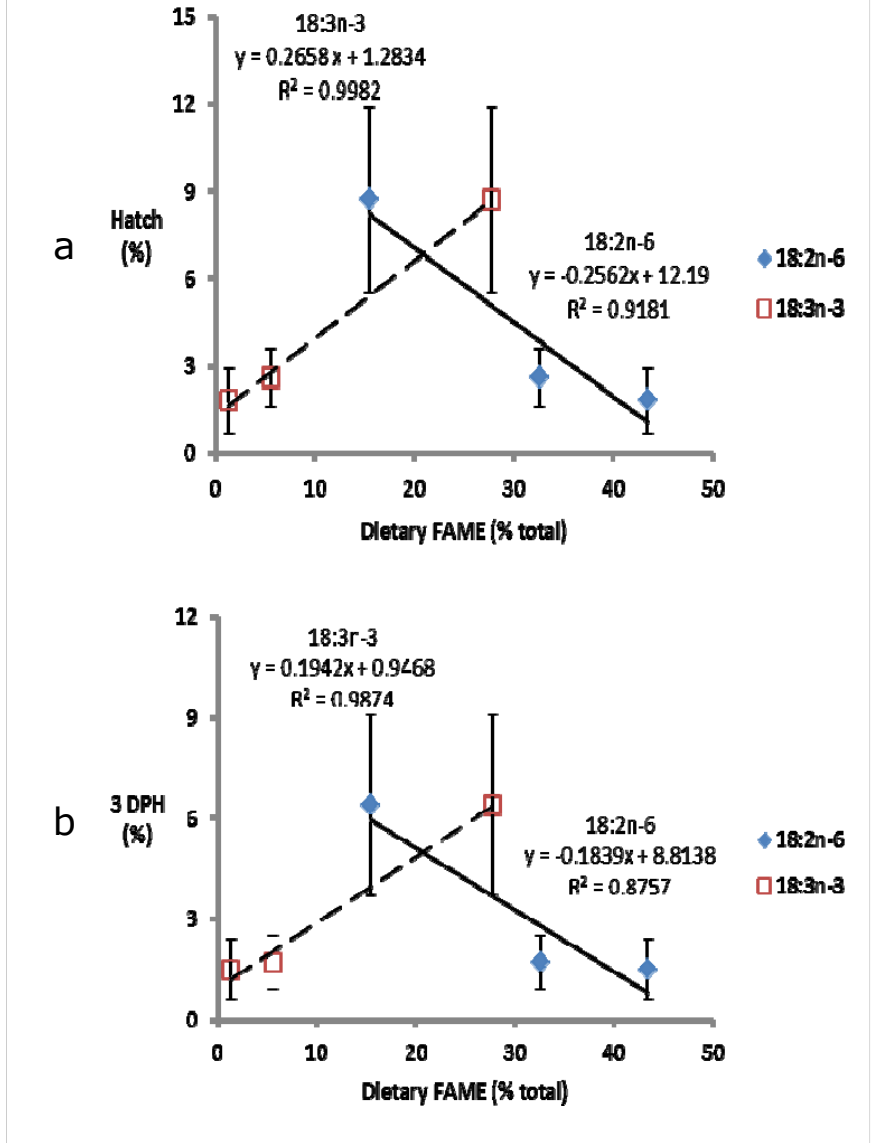
Hybrid striped bass larvae--3 days post hatch.

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All plant oil-based diets were n-3 LC-PUFA-deficient based on previously determined dietary 'requirements' for female white bass broodstock (3.9% dry matter, Lane and Kohler 2006; 4.0% Lewis et al. 2010). Though, no dietary effects were observed with regard to maternal broodstock weight (684.2 ± 70.1 g; mean \pm SD), growth ($14.3 \pm 4.1\%$), survival (100%), or fecundity ($141,000 \pm 61,000$ eggs/kg body weight) as a result of the 8-week feeding trial.

Evidence of this deficiency was apparent as reduced survival of the plant oil-fed progeny was observed in relation to broodstock fed fish oil in a previous study (Lewis et al. 2010). Replacing LC-PUFA with C18 PUFA would improve the oxidative stability of fish tissues, since C18 PUFA are less prone to lipid peroxidation than LC-PUFA (Gonzalez et al. 1992). In a previous paper (Lewis et al. 2010), we speculated that low hatch and larval survival rates among white bass larvae may be due to increased lipid peroxidation within eggs containing high concentrations of LC-PUFA. However, embryonic and larval survival were better in previous studies when broodstock were fed menhaden oil-based diets containing 4.0% n-3 LC-PUFA and eggs contained higher concentrations of LC-PUFA (with greater predisposition to oxidation). This suggests that while lipid oxidative stability may influence broodstock performance, LC-PUFA availability has an overriding effect on egg quality (Lane and Kohler 2006; Lewis et al. 2010). Physiological impacts specific to egg C18 PUFA inclusion rather than LC-PUFA displacement are currently unknown.

Figure 1. Linear regressions estimating progeny survival of female white bass fed flax, canola, or corn oil as primary dietary lipid sources for 8 weeks prior to spawning. Plots are (a) hatch and (b) 3 day post hatch (DPH) survival rates vs. dietary 18:2n-6 and 18:3n-3 intake.



Conclusions

Based on our findings, white bass require considerable amounts of n-3 LC-PUFA in the diet to achieve maximal reproductive success. Of all diets evaluated in the present and previous papers (Lane and Kohler 2006; Lewis et al. 2010) addressing female white bass broodstock nutrition, egg concentrations of n-3 LC-PUFA and embryo survival are consistently maximized by feeding 100% menhaden oil. Therefore, despite environmental and economical concerns associated with the long-

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term sustainability of marine-derived products, menhaden oil confers greater reproductive benefits relative to other tested oils. Nevertheless, plant oils with low 18:2n-6 and high 18:3n-3 content may be suitable candidates for partial marine oil substitution in broodstock diets for female white bass, and additional research is needed to determine their optimal inclusion rates.

Acknowledgments

This research would not have been possible without assistance obtaining broodstock by Keo Fish Farm. We would also like to thank Andy Coursey, Shawn Meyer, and Mike Hill for their assistance in data collection. The research was performed by the first author as a portion of a dissertation to partially meet the requirements for a Doctor of Philosophy degree in the Department of Zoology, Southern Illinois University. The project was supported by National Research Initiative Competitive Grant no. 2005-35203-15894 from the USDA Cooperative State Research, Education, and Extension Service. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the U.S. Department of Agriculture.

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ABOUT THE AUTHOR



Heidi Hill is currently the Aquaculture Research and Development Manager at Cargill Animal Nutrition. This study was completed as part of her dissertation research at Southern Illinois University.

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INNOVATION DISTINGUISHES BETWEEN A LEADER AND A FOLLOWER.

—Steve Jobs



Newly farmed aquatic species, changing raw material availabilities, and even controversial ecological issues have created serious needs for advancements in aquafeed processing. As a long-time leader in extrusion, Wenger is addressing these and other challenges with ground-breaking approaches. Consider these recent Wenger innovations: Oblique Tube Die and Diverging Cone Screw result in small diameter feeds at rates three to five times those of previous technology; Thermal Twin Screw Extruder permits high percentages of fish slurry, oil and high moisture ingredients; HIP preconditioner, with adjustable mixing intensity, addresses recipe challenges - especially those with varying content of starch, fiber and oils. And the list goes on.

Contact us now. With new concepts and fresh initiatives, we're ready to help you meet the ever-evolving requirements of the aquatic feed industry.

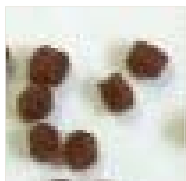
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BELGIUM TAIWAN BRASIL CHINA TURKEY INDIA



INVE Aquaculture: a pioneer looking towards the future

INVE Aquaculture, a Belgian pioneer in larval nutrition and health, is celebrating its 30th anniversary in 2013. Established in Ghent, Belgium in 1983, the company has brought numerous innovations to market that have revolutionized the aquaculture industry. Having emphasized the need for innovation since day 1, it is safe to say the company has (in)directly had an impact on every fish or shrimp hatchery across the globe; whether it's



through enriching live food with the SELCO products, hatching *Artemia* cysts with the SEP-Art Technology (now also used in the pet

industry) or finding the best balance between live food and formulation with their highly advanced dry diets.

Today, the company looks towards continuing to build aquaculture as the fastest growing food industry in the world. Its importance to the future development of our society is well-documented, and INVE Aquaculture further demonstrates this with a renewed vision: shaping aquaculture together. Most importantly of course with their customers, the farmers, but also with every other stakeholder: suppliers, governments, aquaculture organizations, etc...

INVE Aquaculture specializes in three main aquaculture segments: nutrition and health products for fish and shrimp hatcheries, as well as health products for farms. With Service Centers and experienced aquaculture specialists in all major aquaculture markets, they are able to not only understand the local needs of their customers, but also to update their product portfolio so the farmers are equipped to handle any obstacle they face during the production of fish and shrimp.

Nutrition and health for fish hatcheries

Long recognized as the true pioneer of industrial live food culturing and the ultimate supplier of superior quality *Artemia* cysts and other live food, the company wants to continue to put a bigger focus on their wide range of perfectly formulated, highly nutritional dry diets such as the **o.range** line. This master feeding line for fish hatcheries consists of four diets (START, WEAN, GROW and NURSE) that each meet the nutritional requirements of the larvae during every stage of the hatchery cycle. Specifically for the Asian markets they also market the **NRD** line, which can count on years of customer satisfaction. The formulated diet line is completed by the broodstock diets, such as the **Lansy Breed** range (now available in 8, 12 or 24 mm pellet sizes), for a complete integration from eggs to fry. The nutrition line is perfectly complemented by the new and improved health line specifically designed for fish larvae, including **Sanocare SURE** and **Sanocare ACE** for the best control of microbial flora during live food production. Meanwhile, **Sanolife MIC-F** and **Sanolife GWS** allow the easiest and most professional management of the larval rearing tanks.

Nutrition and health for shrimp hatcheries

Examples of industry standards for shrimp are the **FRIPPAK** & **LANSY** dry diets, with a variety of micro-encapsulated and flaked diets, both of which use all the essential nutrients and attractants for effective supplementation of live feed. Next to the actual live feed, we also carry a full range of culture & enrichment products. The latest innovation, **BREED-S FRESH**, are semi-moist pellets that replace up to 70% of the live feed in maturation regimes

of marine shrimp, including complete elimination of polychaetes. Additionally, health boosters from the **Sanoguard S-PAK** range improve the shrimp's resistance to stress and diseases while **Sanolife MIC** colonizes the shrimp's digestive tract with favorable bacteria that will compete with pathogenic and opportunistic bacteria and at the same time, improve the water quality.

Health products for fish and shrimp grow-out

INVE Aquaculture has developed a range of products specifically for on-growing shrimp and fish. These products fit in their holistic approach of increasing the farmer's profits through improved biosecurity, the management of the rearing conditions & strengthening the animal's health. The **Sanolife** range of probiotics has set industry standards by providing highly concentrated and consistent formulations of *Bacillus* specifically designed

for on-growing shrimp and fish. **Sanolife PRO-W**, for example, promotes the rapid decomposition of waste material and helps control pathogenic bacteria in ponds under both aerobic and anaerobic conditions. **Sano TOP-S** is a product that boosts the animals' immune system. It allows the most efficient and profitable plan of action during times of stress, such as the transfer from hatchery to nursery, and ultimately to the farm, or during disease outbreak.



Inve's aquaculture experts work with a customer (center) in Thailand, using a diet from our well-known FRIPPAK shrimp hatchery dry diet range.



HOW IS IT MADE?

A SUMMARY OF STARTER AQUATIC FEEDS

Will Henry discusses the three most common and cost-effective methods currently in use for the production of sub-millimeter aquatic feeds: pellet and crumble, direct extrusion, and spheronization.

This article is not intended to be an all-encompassing resource for starter aquatic feeds, as the author is aware that technology moves at an extremely fast past and producers are driven by the ever-demanding needs of a fluent market.

It is probably prudent to first discuss the requirements of typical micro-aquatic (sub-millimeter, less than 1 .0 mm in diameter) feeds. For this article, we will discuss the following product parameters that as an equip-

ment designer/manufacturer that our clients ask us to focus on: size & uniformity, homogeneity, shape, and economy.

Each method, regardless of limitations, has a specific niche to fulfill and performs well within

Size and uniformity

The importance of size and size uniformity, within the industry, are strict for obvious reasons (Wankowski, 1977; Wankowski & Thorpe, 1979). The foremost of these are yield cost at the time of harvest and feed costs. To put it simply, the cost of aquatic feed production is inversely proportional to the targeted product size. As size is decreased, the cost of manufacturing is increased. This is due to the various complexities that holds true regardless of the method of manufacturing. Figure 1 depicts a US minted dime for reference against 0.3mm, 0.5mm, and 1.0mm products to render a perspective of the size range.

Figure 1. Product Sample of Cold-Extrusion SAS



For discussion, let us assume we are targeting a feed cycle for 0.3 mm feed. As stated above, the cost to manufacture said feed is not inexpensive. As such, we want to ensure that the stock grow-out to the next stage where it will require a larger feed size in a timely and cost effective manner. If our feed size uniformity is poor, then feed is wasted (inability to consume over-sized pellets) and the grow-out time is lengthened (poor nutrition due to inability of consumption).

Pellet Homogeneity

Proper pellet homogeneity begins with formulation and grinding. The first consideration should be to the components of a required diet and the selection of ingredients that grind and mix well. Secondly, keeping the number of dry components to a minimum will help reduce the risk of heterogeneity (non-uniformity). For example, if we can keep the

HOW IS IT MADE?
A SUMMARY OF STARTER AQUATIC FEEDS

total dry ingredient count below 10 components, it will be easier to ensure that a uniform distribution occurs after mixing. In addition, component ratio (percentage of total batch size) is also important. Distributive mixing (measure of mixing intensity/efficiency) is greatly improved and more predictable if component ratios are greater than 5 - 7% of total batch size (J.M. Ottino, Kinematics of Mixing: Chaos and Transport, 1990).

The third consideration for pellet homogeneity is particle size. A general rule for homogeneous pellet production is that the mean particle size of the dry raw materials should be in the size range of 1/3 to 1/5 of the desired pellet size. For example, if the target pellet size is 1 mm, then the targeted mean particle size after grinding should be in the range of 300 to 500 microns. For reference comparing good particle size to poor particle size, and the effect of such on a final product, please reference Figures 2 and 3 below:

Figure 2. Direct Extrusion with poor grind



Figure 3. Direct Extrusion with good grind



For a more detailed comparison to consider an under-lying concern for starter feeds, please note the micro-graphs in Figures 4 and 5.

Figure 4 Pelleted and crumbled

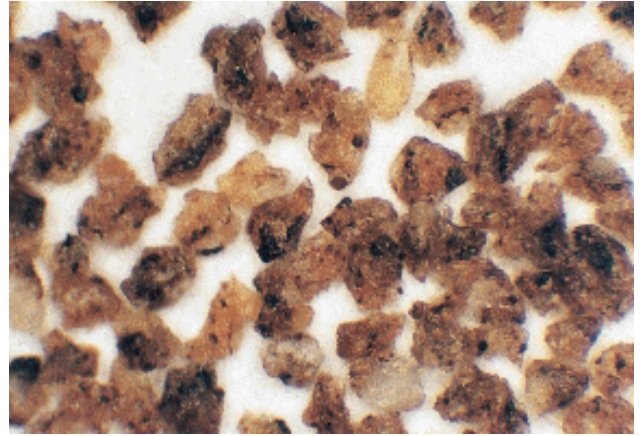


Figure 5. Extruded spheronization and agglomeration

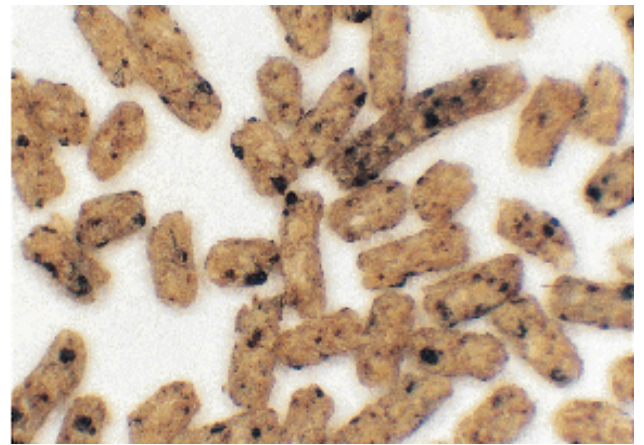


Figure 4 depicts a sample of 600 micron product (#1 Granule) that was produced via a pellet mill and then crumbled to final target size. The 'dark spots' are rendered from the extreme heat invoked on the process by the pellet mill, with the product being squeezed at high levels of mechanical energy through the small orifices in then die, and the sharp edges found on each pellet created by the crumbling process. The over-heated dark spots will reflect reduced feed functionality due to the destruction of vital vitamins and supplements, while the sharp edges will invariably effect mortality rates due to mouth injuries of the stock. Note the sample in Figure 5 shows a substantial reduction of both 'dark spots' and sharp edges.

HOW IS IT MADE?
A SUMMARY OF STARTER AQUATIC FEEDS

The primary limiting factor in obtaining a good grind, especially for finished pellet sizes below 1 mm, is the grinding equipment and operational cost. A simple alternative for operations that is 'close' to appropriate grinding levels would be to install a form of cost-effective particle classification prior to final processing. The two charts below reflect a 'Sieve Analysis' of two identical material samples. The analysis simply quantifies the effectiveness of the grinding system, and helps to determine the true mean particle size. Figure 4 sample was ground only, while Figure 5 sample was ground and then sifted to remove 'out-of-spec' particles. Note the improved consistency and precision of the mean particle size with 'Sample #1C2'. This benefit directly correlates to improved operational efficiencies (higher EOE's due to reduced incidents of die blockage) and FCRs (feed conversion ratio, improved on-spec production yield and higher feed availability to targeted growth stage).

Pellet Shape

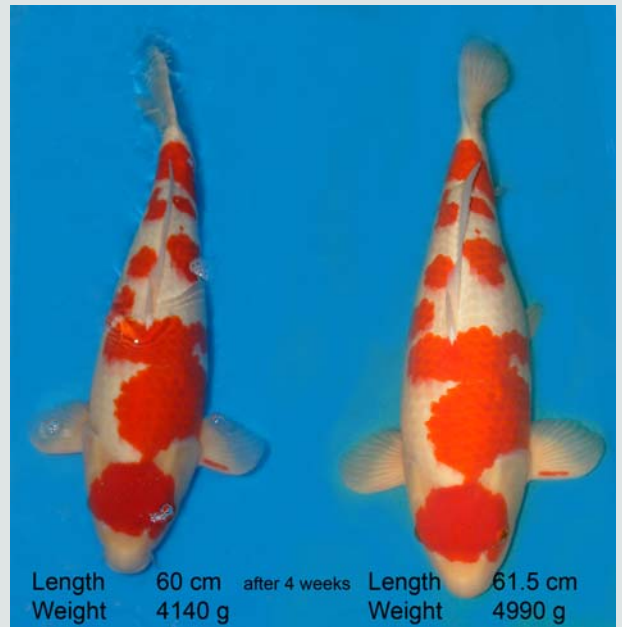
Figure 6: Sample #1B4	
Pulverized	
Micron Size	% Through
450	99.8%
350	99.2%
250	98.6%
149	97.8%
75	77.7%

Figure 7: Sample #1C2	
Pulverized & Sifted	
Micron Size	% Through
450	100.0%
350	100.0%
250	100.0%
149	99.8%
75	80.8%

In terms of shape, we will need to consider individual component shape as well as shape consistency. Individually, it is important to ensure that each pellet is round and smooth.

A feeding trial comparison used to reflect the benefit of a properly designed nutritional feeding regiment, considering both the quality and type of feed as well as feeding schedule.

- 2.5 % Increase in Length
- 10% Increase in Girth
- 20.5% Increase in Weight
- Appearance



Not to say that a perfect sphere is required, but a smooth spherical shape has proven to show marked improvement in mortality rates (specifically in non-bottom feeding applications) and yield uniformity. This would be due in part to the 'smooth' structure of a properly formed spherical pellet. Referring back to Fig. 4, you will note that sharp and jagged edges are prominent in most (if not all) of the 'pellets'. As a fingerling, the mouth of your stock is extremely sensitive to injury.

During consumption of said pellet, it is probable that some injury will be incurred causing the fish to refrain from feeding properly.

HOW IS IT
MADE?
A SUMMARY
OF STARTER
AQUATIC
FEEDS

PELLET & CRUMBLE	
<p>ADVANTAGES</p> <ul style="list-style-type: none"> High Capacity Levels Low Cost per Unit Simple Recipe Preparation 	<p>DISADVANTAGES</p> <ul style="list-style-type: none"> 40% Yield after Post Production Sifting Sinking Only Poor Final Appearance Poor Water Stability Sharp Pellet Edges (increased mortality) Nutritional Heterogeneity
DIRECT EXTRUSION	
<p>ADVANTAGES</p> <ul style="list-style-type: none"> Oil Added Internally Pasteurization 95% Yield after Post-Production Sifting Excellent Appearance Good Water Stability Floating or Sinking Good Durability 	<p>DISADVANTAGES</p> <ul style="list-style-type: none"> High Cost per Unit Low Production Rates Requires Dedicated Line Size Limitations Nutritional Heterogeneity
AGGLOMERATION & SPHERONIZATION	
<p>ADVANTAGES</p> <ul style="list-style-type: none"> Oil Added Internally Moderately Low Temperatures Pellet size to .150 mm 96% Yield after Post-Production Sifting Nutritional Homogeneity Excellent Appearance Medicate, Vitamins Improved Growth Rates, Uniformity and FCR 	<p>DISADVANTAGES</p> <ul style="list-style-type: none"> Sinking Only No Pasteurization Limited Production Rates Dedicated Line Recommended

Production Methodology

In summary, within the production industry, you will typically see three primary methods of producing starter aquatic feeds: pelletize and crumble, direct extrusion, agglomeration & spheronization. The pros and cons of each method can be easily compare, and are categorized in terms of production costs, yield, product characteristics, and targeted feed functions. Each method, regardless of limitations, has a specific niche to fulfill and performs well within. **ΩHF**

ABOUT THE AUTHOR

Will Henry joined Extru-Tech in 2006 after serving as senior project engineer with Bachelor Controls. He presents extensively on extrusion and food safety around the world. He holds a bachelor's of science in electrical



engineering from Kansas State University and is certified in HACCP, BSL-2 and SQF.

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Skretting Marine Hatchery Feeds (MHF)

Spectrum product portfolio

THE LIFE STAGES OF MARINE LARVAE such as sea bass and sea bream are extremely technical owing to the fact that these species are very primitive in physical form when they hatch. And because certain aspects of the life stages can vary immensely from one hatchery to the next and from one producing country to another, it is vital that each hatchery deploys the most appropriate feeding approach possible to optimise growth rates.

Established in 2006 with the express remit to deliver specific products and services to hatcheries of marine fish and shrimp species, Skretting's Marine Hatchery Feeds (MHF) team comprises dedicated staff with locally-focused market insight, knowledge and experience – all 100 percent focused on delivering top-quality marine- and shrimp-specific products and services.

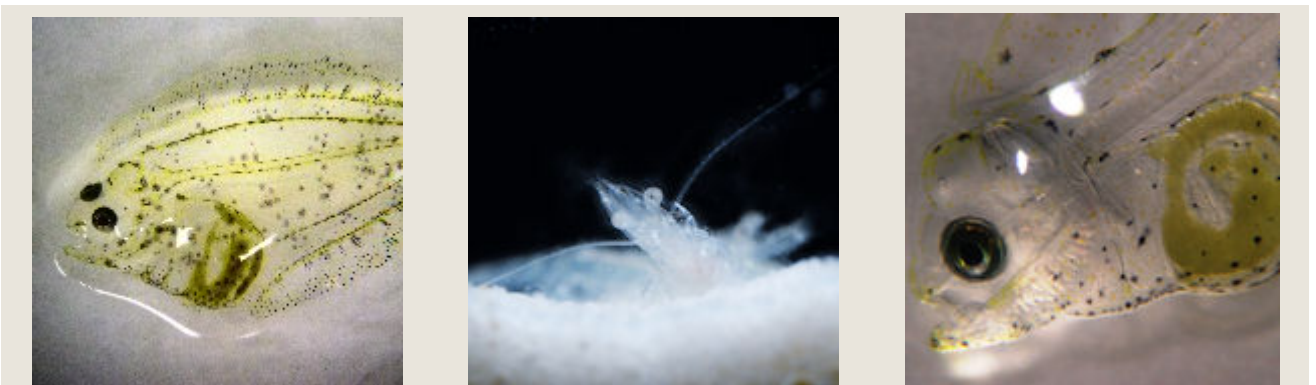


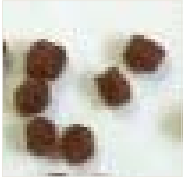
Through MHF's unique Spectrum product portfolio, every aspect of the animals' early life cycles are catered for, from devising broodstock feeds suited to the specific stages of conditioning, maturation, spawning and recovery of parent fish through to green water application products, live feed components, GEMMA Micro early weaning feeds, nursery feeds and pre-on-growing diets.

Furthermore, as part of its dedicated focus on hatcheries, MHF is constantly assessing what specific markets are doing and what they require. This enables the team to quickly deliver the exact products and services that hatcheries are asking for.

As well as locating dedicated team members in each of its main markets to deal specifically with marine and shrimp feeds, MHF has organised a senior, centrally-placed product team, led by product manager Eamonn O'Brien, which also includes a product development specialist and a technical support manager.

As a unit, the team proactively works across the entire MHF organisational matrix to exchange the unique experiences of different locations in order to build invaluable knowledge and expertise for the benefit of its customer base.





ADVANCES IN EXTRUDED FEED

Extruded diets with fresh raw material are now able to provide complete compounded nutritional requirements for broodstock and juvenile marine fish. Extrusion consultant, Peter Hutchinson explains ...

Manufacture of hatchery feeds is as much art as science. Understanding what the customer wants, what fish require and what is feasible in terms of manufacture can be a balancing act. At the end of the day we need to form some sort of pellet which will hold together as required, meet shelf life and biosecurity requirements, get eaten as well as meet nutritional requirements for growth and or egg quality.

It's actually difficult to write this type of article with "good science", as science is scrappy

In our earlier attempts with high end hatchery feeds (broodstock and juvenile), we threw everything in ...

for this side of the aquaculture industry and species are varied. Basics such as protein and lipid quality and high protein to energy

ratios are a given, however in a compounded diet for marine broodstock or juveniles our general understanding of these macronutrients needs to be expanded when compared with grow out diets, as in themselves balancing these nutrients won't generate quality results. Protein source is critical, however what we would generally understand as quality animal protein doesn't necessarily produce results.

From time to time specific ingredients may be required by a customer and formulations tailored to fit a species in question. Clearly

formulations are not so much cost driven (as would be the case with commercial grow-out diets) and an "all in" basis is often used as a starting point for ingredients. Sales are very much result driven and we rely on prompt feedback from customers. So if sales are growing, we figure we must be doing something right and we work closely with customers to see what we can learn from their results. Bearing in mind results will not generally be multiple replicate, peer reviewed studies, so intuition and experience play a significant roll. The costs of rigorous trials are prohibitive given the volumes of feed utilized by the hatchery industry and therefore prompt feedback is imperative. As is the case with many small businesses in the research industry, we don't have the luxury of big marketing budgets with gimmicky concepts either. There aren't many second chances out there in this market...!

In our earlier attempts with high end hatchery feeds (broodstock and juvenile), we threw everything in (much like everyone one else), including various MOS, pigments, soluble proteins, aminos, high DHA oil, ARA, high vits and mins, natural antioxidants, stimulants, attractants and so on. To be honest, the success rate wasn't as good as using wet fish diets. We then moved to semi-moist diets and while we had a small increase in palatability, not much else changed and customers were still using the diets primarily as "supplements" rather than as complete diets. We were using

ADVANCES IN
EXTRUDED
FEED

standard semi-moist stabilizing techniques at that time, including phosphoric acid as an acidulant, along with the other usual sugar syrups and prop glycol to reduce water activity.

It wasn't until we made a significant departure from these standard stabilizing methods and began using a blend of organic acids in conjunction with fresh wet fish/mussel/squid meat inclusion that we began to see real benefits. The greatly improved results from utilizing fresh ingredients are likely multifaceted in influence and as much as definitive conclusions are hard to draw, the majority of result probably relate to quality of protein (having not been rendered first), with a very slim possibility that some enzyme activity may survive the extrusion process. Also the organic acids may be directly influencing gut flora in terms of reducing pathogenic load and as an indirect consequence, helping to improve length of GIT microvilli. There are multiple theories surrounding use of organic acids including protection of proteins and other nutrients during processing, stimulation of enzyme secretion, nutrient release through acidification, increased utilization of fats and increased gastric retention. So take your pick as to the most significant role these ingredients are playing, however my intuition tells me that un-rendered wet raws and organic acids are mutually beneficial, as their combined inclusion has resulted in the most significant performance improvement we have seen to date.

The beauty of this approach is that it need not be restricted to the hatchery industry. Wenger Manufacturing have developed extrusion equipment that is capable of utilizing in excess of 50% wet raw material off the back of trends towards increasing wet meat inclusion in the pet food industry. In theory, by utilizing wet meat/fish by-products even standard salmon pellets could be produced economically, potentially with significant performance benefits.

While there are generic booster/supplement products on the market, which are designed to be fed in conjunction with wet fish diets and can supplement compounds lacking in the

wet feed, relying on these booster products as a sole source of feed has not worked well in our experience. Feeding of formulated "dough" alone from blended powders mixed with water will struggle to provide required results. Extruded diets with fresh raw material are now able to provide complete compounded nutritional requirements for broodstock and juvenile marine fish, with the added benefits of improved bio-security and convenience whilst still providing the high degree of palatability required. **ΩHF**

ABOUT THE AUTHOR



Peter Hutchinson is the Director of E.N. Hutchinson, Auckland, New Zealand

Peter studied aquaculture in Tasmania, Australia, in the early 'nineties before returning to New Zealand where he worked primarily in the finfish hatchery industry. In 1997 he joined the family business (EN Hutchinson Ltd.) and established a small extrusion plant, with a focus on aquaculture nutrition and general R&D. Over the last decade Peter has consulted widely in the field of aquatic nutrition and extrusion, for a diverse range of major private and public sector companies, including development of starch based bio-polymers, breakfast cereals, pet foods, agricultural and aquatic feeds.

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PRODUCTION OF MICRO FEEDS DIRECTLY FROM AN EXTRUSION COOKER

The previous article gave an overview of the different methods of producing hatchery feeds. Here, Joe Kearns focuses on single- and twin- screw extrusion.

Extrusion cooking of aquatic feeds is a proven process and is mainly used for production of grow out feeds in the field of aquaculture. Understanding the process and its limitations and critical design parameters allows for expansion into production of what is referred to as micro pellets or pellets suitable for use in starter or hatchery diets.

Hatchery diets are for juveniles and thus the diets are typically made from high quality ingredients resulting in a valuable product. This

is no different in human and or foods for pets as examples. Higher quality proteins, more digestible ingredients as well as increased

vitamin and mineral mixes are used. With the cost of raw materials being the major factor in aquatic feeds additional care in production of hatchery feeds is not that uncommon. It is also not unusual to understand that quality processing and equipment for production of these feeds is essential. There are a number of methods to make micro aquatic feeds via extrusion cooking. The major three categories would be:

also known as an agglomeration system, usually coupled with a sphere-izer. This article deals with direct extrusion and thus the first two options. It should be noted that the agglomeration system is capable of making feeds of much smaller diameters than directly off extruders, as described in the previous article. Diameters of 200 microns or 0.2mm are possible with a correctly designed agglomeration system. There are two production philosophies with regards to direct extrusion cooking of micro feeds, low capacity or high capacity. In either case the process begins with the raw material preparation. The use of floury raw materials and deboned fishmeal or animal protein meals are advantageous as they are either quite fine or will grind easier. It is critical that the ingredients be handled carefully due to their cost. Ingredients can be ground individually or after combination together. Fine grinding is essential due to the final extrusion die orifice opening sizes. The grinding is usually accomplished by micro pulverizing and sifting. It should be noted that all raw materials including process water, oil or other liquid ingredients such as possible steam injection be screened for large particle removal. The formula and liquids are then introduced into the equipment.

When using either a single or twin screw extruder the equipment is best utilized if it is a stand-alone system for micro feeds, in fact the best arrangement is if the entire line is

Selection of the extruder for production of micro feeds is a choice that depends partially on your pellet diameter requirements

is no different in human and or foods for pets as examples. Higher quality proteins, more digestible ingredients as well as increased vitamin and mineral mixes are used. With the cost of raw materials being the major factor in aquatic feeds additional care in production of hatchery feeds is not that uncommon. It is also not unusual to understand that quality processing and equipment for production of these feeds is essential. There are a number of methods to make micro aquatic feeds via extrusion cooking. The major three categories would be:

- Via singles screw extrusion
- Twin screw extrusion, multiple designs both parallel and non parallel
- Reduced heat forming extrusion or what is

**PRODUCTION
OF MICRO
FEEDS
DIRECTLY
FROM AN
EXTRUSION
COOKER**

solely used for producing micro feeds. The main reason is cleanliness. Any possible residual large particles from other extrusion products where extreme fineness of the raw material is not required can, in the end, result in die blockage causing a shutdown of the process. If this is not possible then attention to cleaning the system completely is advised. The system defined as delivery conveyors, hoppers, mixers, grinders, sifters and any other devices that would feed into the extrusion cooker.

Table 1: Effect of Pulverizing and sifting

Sample #1B4 Pulverized	
Micron Size	% Through
450	99.8%
350	99.2%
250	98.6%
149	97.8%
75	77.7%

Sample #1C2 Pulverized & Sifted	
Micron Size	% Through
450	100.0%
350	100.0%
250	100.0%
149	99.8%
75	80.8%

Table 1 shows the benefit of proper ingredient pulverizing and sifting. As seen, the pulverized only sample still had 0.2% particles above 450 micron and 1.4% above 250 microns. The pulverized and sifted sample was 100% through a 250 mesh screen which is quite acceptable for most micro feeds. This confirms the benefit of both pulverizing and sifting in combination for this process.

Single or twin?

Selection of the extruder for production of micro feeds is a choice that depends partially on

Figure 1. Extreme case of material blocking an extrusion die



your pellet diameter requirements. It is suggested that for diameters down to 1 mm a single screw extruder is a possible choice. For diameters down to 0.6 mm a twin screw extruder would be advised. Both single and twin screw extruders are relatively the same until the actual extruder barrel. Both are normally complete with preconditioners where steam and water and other possible liquid additions are incorporated into the dry raw materials. This would be a critical part of the process as it is hard to imagine you could force dry raw materials through such small die openings. Therefore typical moisture contents out of the preconditioner would be in the approximate 25 to 30 percent range. This would allow final inclusion of water and steam in the extruder barrel for final adjustments prior to flowing out of the die in the low 30% final moisture level. Accuracy of preconditioning in terms of evenness in moisture inclusion, steam injection etc. as well as the coefficient of variances in mixing would be important again so as to avoid any flow problems in the extrusion die.

This brings us to the major difference in the two styles of extruders, the extruder barrel. Single screw and twin screw extrusion are in this case trying to achieve the same result, pump the material through the die while im-

PRODUCTION
OF MICRO
FEEDS
DIRECTLY
FROM AN
EXTRUSION
COOKER

Figure 2. High capacity non parallel twin screw extruder for micro pellets



parting the required heat for the cooking process. In both cases controlled slippage of the raw materials is what increases friction between the raw materials themselves as well as the extruder parts creating heat for cooking. The actual extruder configuration can be adjusted to increase or decrease this phenomenon in singles and standard parallel single twin screw designs. The exception is the non parallel twin screw extruders referred to as Conical Co-Rotating Twin Screw Extruders. In this case the screw flighting does not allow for part changes but relies on the operation parameters of its design. Shaft speed control and open area related to the flow from a BPV, back pressure valve. **ΩHF**

ABOUT THE AUTHOR



Joseph P. Kearns is the Aquaculture Process Engineering Manager for Wenger Manufacturing, Inc. He has eight patents for Wenger all with regards to aquatic feeds and/or machinery associated with production of same.
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spectrum



The marine hatchery feed portfolio from Skretting



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SKRETTING 






MANUFACTURED FEEDS










SUPPLIER	PRODUCT NAME	SPECIES	LIFE STAGE	FORM	DESCRIPTION	MORE INFORMATION
Argent Chemical Laboratories	Cyclop-Eeze (Deep Frozen)	All	All	Whole organism	Whole frozen micro-crustacean, 3,000 ppm+ Astaxanthin.	WEBSITE
Argent Chemical Laboratories	Cyclop-Eeze (Freeze Dried)	All	All	Whole organism	Whole freeze dried micro-crustacean, 3,000 ppm+ Astaxanthin.	WEBSITE
Argent Chemical Laboratories	Hatchfry Encapsulon O - III	All	Larvae PL	Micro-Encapsulated	Complete diet, hydro-stable, all marine proteins Made in USA, Micron sizes: HF-0 (30-50) HF-1 (50-150) HF-2 (150-250) HF 3 (250-350).	WEBSITE
Argent Chemical Laboratories	Spirulina Microfine	All	All	Spray Dried Microfine	Finest purity made in USA.	WEBSITE
Argent Chemical Laboratories	Argentemia Platinum Grade 0	All	Larvae PL Fry	Artemia Cysts	High Ω3, High hatch rate Small nauplii.	WEBSITE
Aqua-In-Tech	Black Box Larval Diets	Fish Shrimp	Larval		Custom made to the clients specifications. Krill based protein diets with a proprietary bacterial products added for optimum stress resistance.	DATA SHEET
Aqua-In-Tech	Black Box Acclimation diets	Fish Shrimp	Nursery		Custom made to the clients specifications. Krill based protein diets with a proprietary bacterial products added for optimum stress resistance. Acclimation diet high in Vitamins and minerals, glucans, nucleotides and other materials that impact stress tolerance.	DATA SHEET
Aqua-In-Tech	MAT MIX	Shrimp	Broodstock	Powdered	Completely replaces most live feed ingredients (although recommended that you just use less). A powdered product that you mix up in the hatchery with some water and the ingredients provided. Proven to promote excellent productivity in broodstock.	DATA SHEET
Biomat	SPIROO microFEED PLUS	Fish Shrimp Bivalve	Larvae PL fry	Micro-packaged spirulina	Patent-pending micro packaging technology enables the production of a new and unique larvae and fry micro feed, based on 100% organic, contaminant-free, closed PBR, high-protein spirulina microalgae. SPIROO micro FEED PLUS features field tested neutral buoyancy, highly attractant, palatable and digestible proteins and nutrients with superior water stability. Room-temperature storage.	DATA SHEET


SUPPLIER	PRODUCT NAME	SPECIES	LIFE STAGE	FORM	DESCRIPTION	MORE INFORMATION
Bio-Oregon  Lifestage Diets for Fish®	BioVita Starter	Salmon Trout	First feeding fry	Extruded Crumbles	BioVita Starter is a premium - fish feed with high levels of - fish meal, and - fish oil. For use in -first feeding, it contains an enhanced vitamin pack and pigment to promote healthy - fish and natural coloration. Natural palatability enhancers ensure an active -first feeding response.	DATA SHEET WEBSITE CONTACT
Bio-Oregon  Lifestage Diets for Fish®	BioClark's Starter	Salmon Trout	First feeding fry	Extruded Crumbles	BioClark's Starter combines traditional dietary values with an increased level of alternative ingredients to reduce cost and to promote sustainability. For use in first feeding, it contains an enhanced vitamin pack and pigment to promote healthy fish and natural coloration. Natural palatability enhancers ensure an active first feeding response..	DATA SHEET WEBSITE CONTACT
Bio-Oregon  Lifestage Diets for Fish®	MicroVita	Salmon Trout	First feeding fry	Extruded Micro-Pellets	MicroVita micro-pellets are based on the premium BioVita Starter formulation. MicroVita micro-pellets are available in 0.6 & 0.9 mm sizes, and can be used as direct replacements for our #1 & #2 starter crumble sizes. Micro-pellets are clean, durable and uniform in shape.	DATA SHEET WEBSITE CONTACT
Bio-Oregon  Lifestage Diets for Fish®	BioFlake	Salmon Trout	First feeding fry	Flakes	BioFlake™ is a revolutionary flaked feed which is designed to stimulate fish appetite and encourage feeding. It is rich in Antarctic krill and provides all the conventional benefits of frozen krill without the need for refrigeration. BioFlake™ can be fed alone, or in combination with other feeds. When added to starter crumbles (BioVita or BioClark's) even the most - finicky -fish will be encouraged to start feeding.	DATASHEET WEBSITE CONTACT
Bio-Oregon  Lifestage Diets for Fish®	BioVita Fry	Salmon Trout	Parr	Extruded Pellets	BioVita Fry is a premium - fish feed with high levels of - fish meal, and - fish oil. It contains an enhanced vitamin pack and pigment to promote healthy -fish and natural coloration. Natural palatability enhancers ensure an active feed response.	DATA SHEET WEBSITE CONTACT
Bio-Oregon  Lifestage Diets for Fish®	Bio-Olympic Fry	Salmon Trout	Parr	Extruded Pellets	Bio-Olympic Fry is our most advanced fry diet and provides maximum growth rates and shortened production times. Bio-Olympic Fry has demonstrated growth improvements of up	DATA SHEET WEBSITE CONTACT
Bio-Oregon  Lifestage Diets for Fish®	BioClark's Fry	Salmon Trout	Parr	Extruded Pellets	BioClark's Fry is a mid-level energy fish feed for moderate or controlled growth. It includes an increased level of alternative ingredients to reduce cost and to promote sustainability. It contains an enhanced vitamin pack and pigment to promote healthy fish and natural coloration.	DATA SHEET WEBSITE CONTACT
Bio-Oregon  Lifestage Diets for Fish®	BioBrood	Salmon Trout	Broodstock	Extruded Pellets	BioBrood is designed to meet the needs of developing and maturing eggs and sperm. It contains premium -fishmeal and -fish oil, and extra vitamins & minerals for improved fecundity, sperm motility, brood health, egg quality, & fry survival. BioBrood should be fed for 6-12 months prior to spawning.	DATA SHEET WEBSITE CONTACT

SUPPLIER	PRODUCT NAME	SPECIES	LIFE STAGE	FORM	DESCRIPTION	MORE INFORMATION
Bio-Oregon 	BioPro	Salmon Trout	Parr	Extruded Pellets	BioPro is a health promoting diet specifically formulated for freshwater salmon & trout. BioPro is designed to be fed leading up to stressful situations, including periods of high disease risk or adverse environmental conditions such as elevated summer water temperatures, intense sunlight or low dissolved oxygen.	DATA SHEET WEBSITE CONTACT
Bio-Oregon 	BioSupreme	Salmon Trout	Smolt transfer	Extruded Pellets	BioSupreme is specifically formulated to prepare salmon for the transition from fresh to saltwater. Like BioTransfer, BioSupreme contains elevated levels of dietary salt and now includes newly identified ingredients that are essential for increasing feed intake and growth following transfer. BioSupreme should be fed for 6 weeks prior to release or transfer to saltwater.	DATA SHEET WEBSITE CONTACT
Bio-Oregon 	BioDry 1000LP	Salmon Trout	Parr	Extruded Pellets	BioDry 1000LP (Low Phosphorus) is an extruded, low-pollution fish feed which is formulated to reduce the amount of phosphorus discharged into the environment. This diet contains less than 1% dietary phosphorus.	DATA SHEET WEBSITE CONTACT
EN Hutchinson 	BroodMax	Marine Fish Shrimp	Broodstock	Pellet	A soft dry fully compounded steam extruded fish feed, designed for improvement of egg quality in broodstock. The texture improves palatability and also enables pellets to be molded together, for large species such as grouper. It contains high levels of soluble protein for palatability and digestibility as well as high levels of mixed carotenoids	DATA SHEET WEBSITE CONTACT
EWOS Canada	Micro (#0, #1, #2)	Salmonids	Hatchery Fry	Crumbles	A premium all fishmeal/oil freshwater diet. Results in excellent raceway hygiene and cost effective growth	See your sales rep for data sheets. WEBSITE
EWOS Canada	Micro 1.2 mm	Salmonids	Fingerlings	Extruded Pellets	A premium all fishmeal/oil freshwater diet. Results in excellent raceway hygiene and cost effective growth	See your sales rep for data sheets. WEBSITE
EWOS Canada	Transfer (1.5, 2.0 and 3.0 mm)	Salmon Trout	Fingerlings Smolts	Extruded pellets	Premium smolt feed used to prepare fish for transfer to salt water OR when combating stressors.	See your sales rep for data sheets. WEBSITE
EWOS Canada	Pacific (1.2, 1.5, 2 – 9 mm)	Salmon Trout Coho	Fry Fingerlings Grower	Extruded pellets	High protein and moderate fat diets. Blend of premium fish meals and select alternative proteins	See your sales rep for data sheets. WEBSITE
EWOS Canada	Vita (1.5, 2 – 9 mm)	Salmon Trout Bass Sturgeon	Fry Fingerlings Production	Extruded pellets	Moderate protein and low fat with fishmeal and highly digestible alternative ingredients	See your sales rep for data sheets. WEBSITE
EWOS Canada	Calform (2 – 9 mm)	Salmon Trout Bass	Fingerlings Production	Extruded pellets	Floating/slow sinking feed	See your sales rep for data sheets. WEBSITE

SUPPLIER	PRODUCT NAME	SPECIES	LIFE STAGE	FORM	DESCRIPTION	MORE INFORMATION
EWOS Canada	Calform (2 – 9 mm)	Salmon Trout Bass	Fingerlings Production	Extruded pellets	Floating/slow sinking feed.	See your sales rep for data sheets. WEBSITE
EWOS Canada	Natura (#0, #1, #2)	Pink chum	Hatchery Fry	Crumbles	High quality fish oil, low temp fish meals and select alternative ingredients.	See your sales rep for data sheets. WEBSITE
EWOS Canada	Brood (5, 7, 9 and 10.5 mm)	Salmon Trout	Feed 10 months prior to egg take	Extruded pellets	Nutritionally optimized fatty acids, fishmeal based diet.	See your sales rep for data sheets. WEBSITE
Gold Coin Biotechnologies	Gold Coin ENCAP	Shrimp	Larvae Feed	Micro- encapsulated feed	ENCAP products are microencapsulated with ingredients of the highest quality and di- gestibility. With our process being carried out at low temperature where minimum heat is involved, there is minimal nutrient loss. When used in hatcheries, the products also display the following advantages: simplicity to use, minimum water pollution, minimal feed wastage, controlled buoyancy, high attractability and faster growth to lar- vae.	WEBSITE
Gold Coin Biotechnologies	Gold Coin Microparticulated feed	Shrimp	Larvae Feed	Micro- particulated feed	Microparticulated feed is formulated based on the highly specialized feeding habits of the post-larvae. Highly digestible marine proteins are used to allow the young post- larvae's alimentary canal assimilate these important nutrients.	WEBSITE
Inve Aquaculture 	O.range	Fish	Larvae up to juveniles	Crumbled dry feed	The ultimate marine fish dry diet range. Consists of 4 diets that perfectly fit the fish's nutritional needs throughout the different hatchery stages. Optimal HUFA and DHA/ EPA profiles. Excellent stability and floata- bility. Formulated using only top quality raw ingredients.	WEBSITE CONTACT
Inve Aquaculture 	Fish Breed-M	Fish	Broodstock	Powdered	A consistent, high quality powdered concen- trate for moist broodstock feeds. Decreases or eliminates the use of fresh fish feed, thus reducing risk of infection. Optimizes produc- tivity while offering consistent spawning and fertilization rates.	WEBSITE CONTACT
Inve Aquaculture 	Lansy Breed	Fish	Broodstock	Pellets	Soft pellets that enhance the nutritional quality of the offspring and provide a more predictable output. Allows for better and increased egg production. Available in 8, 12 or 24 mm pellets.	WEBSITE CONTACT
Inve Aquaculture 	NRD	Fish	Larvae up to juveniles	Crumbled dry feed	Top performance dry diet range for marine fish. One diet line for the co-feeding, weaning, post-weaning, nursery and pre-ongrowing stages.	WEBSITE CONTACT

SUPPLIER	PRODUCT NAME	SPECIES	LIFE STAGE	FORM	DESCRIPTION	MORE INFORMATION
Inve Aquaculture 	BREED-S FRESH	Shrimp	Broodstock	Semi-moist pellets	Pioneering, soft shrimp maturation diet with fresh marine ingredients. Replaces up to 70% of the fresh feed. Offers full-biosecurity, a consistent nutritional quality and superior egg quality while boosting the spawning performance.	WEBSITE CONTACT
Inve Aquaculture 	EPAC	Shrimp	PL	Crumbled pellets	Post-larval shrimp feed range for low cost applications. NEW formula that includes more marine proteins and lipids, offers better water stability and increased palatability and attractiveness to the PLs. Maintains a clean and healthy rearing environment while allowing a reliable output of robust PLs.	WEBSITE CONTACT
Inve Aquaculture 	FRIPPAK FRESH	Shrimp	Larvae	Micro-encapsulated	A range of advanced larval shrimp feeds. Minimizes <i>Artemia</i> consumption, offering the best balance between live food and formulated diets. Contains high levels of fresh and natural ingredients. Offers higher survival rates and shorter production cycles. Now with NEW formulas for #2 CD and #3 CD.	WEBSITE CONTACT
Inve Aquaculture 	FRIPPAK PL FEEDS	Shrimp	PL	Crumbled	High quality diet range for post-larval shrimp. Complementary with our FRIPPAK FRESH range for the larval stages. Minimizes <i>Artemia</i> consumption and produces the best quality PLs. Increases survival rates.	WEBSITE CONTACT
Inve Aquaculture 	LANSY-Shrimp	Shrimp	Larvae PL	Micro-encapsulated, crumbled and flaked	A range of high quality dry diets covering all hatchery stages. Replaces at least 40% of the <i>Artemia</i> needs. Manufactured according to the highest sanitary standards, ensuring consistent survival and uniform growth. Excellent buoyancy and water stability.	WEBSITE CONTACT
Inve Aquaculture 	VANNA (China only)	Shrimp	Larvae PL	Micro-encapsulated, crumbled and flaked	A performing diet range for economic <i>vannamei</i> larviculture. Highly nutritional, well-balanced formulation. Largely reduces the use of live algae and <i>Artemia</i> . Produces strong, healthy PLs. Non-GMO.	WEBSITE CONTACT
Lucky Star	Initial	Fish	Larvae	Micro-encapsulated	Nutritionally balanced to satisfy the requirements of marine fish species. Slow sinking to maximize feed availability and avoid feed loss. High levels of digestible protein, utilizable lipids, cholesterol and vitamins. Effective co-feed with rotifer, artemia and micro algae.	WEBSITE
Lucky Star	MP Enhance	Fish	Larvae	Formulated particle	Extrusion micro-particulate granule which offers an economical choice. Effective co-feed with rotifer, microalgae and <i>artemia</i> .	WEBSITE
Lucky Star	Micro Elite	Shrimp	Larvae	Encapsulated	Micro Elite shrimp larval feed is processed by the most advanced encapsulated technology with the following characteristics: Excellent feed buoyancy in water column to maximize feed availability. Encapsulated granules extending water stability and minimize nutrition leaching. Balanced fatty acid profile.	WEBSITE
Lucky Star	Brine shrimp flake	Shrimp	Larvae	Flake	Lucky Star brine shrimp flake is delicately formulated to satisfy the nutritional requirements of quality shrimp larvae.	WEBSITE

SUPPLIER	PRODUCT NAME	SPECIES	LIFE STAGE	FORM	DESCRIPTION	MORE INFORMATION
Pacific Trading Aquaculture	Otohime	Fish	Larvae	Granulate	Otohime is made from highly selected raw materials with easily digested protein and high quality lipids to promote the vitality of fish larvae, sizes 75mu to 1400mu. Amazing cleanliness, excellent dispersibility on water surface and ideal sinking speed, this is considered the premium Japanese larval diet around the world.	DATA SHEET
Skretting 	Vitalis CAL	Fish	Broodstock	Extruded	Extruded diet which should be offered to brood fish from the onset of vitellogenesis and should be fed until 1 month after spawning to allow optimal development, sustenance and recovery through the whole spawning period.	WEBSITE CONTACT
Skretting 	Vitalis REPRO	Fish	Broodstock	Extruded	Extruded diet which should be offered outside the spawning window to maintain optimal condition of the spawning fish.	WEBSITE CONTACT
Skretting 	GEMMA Micro	Fish	Early weaning	Cold Extruded	Unique, patented diet, which is specifically formulated and produced to facilitate early weaning.	WEBSITE CONTACT
Skretting 	GEMMA Wean	Fish	Co-feed & weaning	Cold Extruded	Extruded diet which has been developed to co-feed and wean marine larvae during the larval rearing phases. Optimal diet to follow on from rotifers and co-feed with minimal <i>Artemia</i> .	WEBSITE CONTACT
Skretting 	GEMMA Diamond	Fish	Post-weaning	Cold Extruded	Extruded diet which has been designed to give juveniles the best start by assuring fast and efficient growth and low feed conversion under pre-growing conditions.	WEBSITE CONTACT
Skretting 	Perla MP	Fish	Transfer & pre-ongrowing	Extruded	Complete mini pellet starter diet which has been designed as a specific pre-ongrowing feed.	WEBSITE CONTACT
Skretting 	PL	Shrimp	Larval & post larval nutrition	Cold Extruded	Feeding programme which has been engineered to offer advanced nutrition to shrimp hatcheries. It can be utilized from zoea stages until pre-growing stages.	WEBSITE CONTACT
Skretting North America 	Starter Crumble	Trout	First feeding fry	Extruded Pellets	Starter Crumble, previously known as the Granulated Salmon/Trout Fry diet, is a nutrient rich crumbled starter feed suitable for Trout, Steelhead and a range of other cold and warm water species. Starter Crumble is produced from a highly digestible extruded pellet.	WEBSITE CONTACT
Skretting North America 	Classic Fry	Trout	Parr	Extruded Pellets	Classic Fry, previously called Extruded Steelhead, is a medium-energy extruded sinking or floating fry diet. Classic Fry is specifically formulated to achieve good growth and healthy fry.	WEBSITE CONTACT

SUPPLIER	PRODUCT NAME	SPECIES	LIFE STAGE	FORM	DESCRIPTION	MORE INFORMATION
Skretting North America 	Oncor Fry	Trout	Parr	Extruded Pellets	Oncor Fry is Skretting USA's best diet for Trout and Steelhead fry, formulated to ensure good water stability, excellent growth and low FCR. Oncor Fry has a higher level of digestible protein and higher energy content than Classic Fry to ensure that your fish get off to the best possible start.	WEBSITE CONTACT
Zeigler	EZ Artemia	Shrimp	Larvae PL	Micro-capsule	100% Artemia Replacement formulated as a complete balanced diet to mimic the color, taste, texture, and nutritional value of <i>Artemia nauplii</i>	DATA SHEET
Zeigler	EZ Larva	Shrimp	Larvae PL	Micro-capsule	Premium Liquid Larval Diet designed to produce high quality PLs and maintain excellent water quality. Contains algae, pigments, and high HUFA content.	DATA SHEET
Zeigler	Larva Z-Plus	Shrimp	Larvae PL	Micro-particle	Premium Dry Larval Diet scientifically and commercially proven to produce the highest quality PLs. Contains algae, pigments, and high HUFA content.	DATA SHEET
Zeigler	Larva Esencial	Shrimp	Larvae PL	Micro-particle	Dry Larval Diet designed to promote fast growth while maintaining water quality in larval rearing systems. Contains pigments and HUFA's from marine sources.	DATA SHEET
Zeigler	Larva AP-100	Shrimp Fish	Larvae PL	Micro-particle	Dry Larval Diet nutritionally balanced for marine larvae. Contains pigments and HUFA's from marine sources.	DATA SHEET
Zeigler	PL Raceway Plus	Shrimp	PL	Crumble	Complete, premium post-larval diet that promotes larger, healthier animals for stocking in ponds. Contains pigments and high levels of HUFA's from marine sources.	DATA SHEET
Zeigler	Brine Shrimp Flake – Red	Shrimp	PL	Flake	Highly digestible flake diet for coloration of the digestive track in <i>P. monodon</i> . Contains high quality brine shrimp.	DATA SHEET
Zeigler	Brine Shrimp Flake - Black	Shrimp	PL	Flake	Highly digestible flake diet for coloration of the digestive track in <i>P. vannamei</i> . Contains high quality brine shrimp.	DATA SHEET
Zeigler	EZ Black	Shrimp	PL	Micro-particle Flake	Micro-particle flake diet for coloration of the digestive track in <i>P. vannamei</i> . Contains high quality brine shrimp.	DATA SHEET

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Species Look up: Manufactured feeds

ALL

Argent Chemical Laboratories

Cyclop-Eeze (Deep Frozen)
 Cyclop-Eeze (Freeze Dried)
 Hatchfry Encapsulon O - III
 Spirulina Microfine
 Argentemia Platinum Grade 0

FISH

Aqua-In-Tech

Black Box Larval Diets
 Black Box Acclimation diets

Biomat

SPIROO microFEED PLUS

EN Hutchinson

BroodMax

Inve Aquaculture

O.range
 Fish Breed-M
 Lansy Breed
 NRD

Lucky Star

Initial
 MP Enhance

Pacific Trading Aquaculture

Otohime

Skretting

Vitalis CAL

Vitalis REPRO
 GEMMA Micro
 GEMMA Wean
 GEMMA Diamond
 Perla MP

Zeigler

Larva AP-100

SALMONIDS

EWOS Canada

Micro (#0, #1, #2)
 Micro 1.2 mm

Bio-Oregon

BioVita Starter
 BioClark's Starter
 MicroVita
 BioFlake
 BioVita Fry
 Bio-Olympic Fry
 BioClark's Fry
 BioBrood
 BioPro
 BioSupreme
 BioDry 1000LP

SALMON / TROUT

Brood (5, 7, 9 and 10.5 mm)

EWOS Canada

Transfer (1.5, 2.0 and 3.0 mm)
 Pacific (1.2, 1.5, 2 – 9 mm)
 Vita (1.5, 2 – 9 mm)
 Calform (2 – 9 mm)
 Calform (2 – 9 mm)

Skretting North America

Starter Crumble
 Classic Fry
 Oncor Fry

COHO

EWOS Canada

Pacific (1.2, 1.5, 2 – 9 mm)

BASS

EWOS Canada

Vita (1.5, 2 – 9 mm)
 Calform (2 – 9 mm)

STURGEON

EWOS Canada

Vita (1.5, 2 – 9 mm)

PINK CHUM

EWOS Canada

Natura (#0, #1, #2)

BIVALVE

Biomat

SPIROO microFEED PLUS

SHRIMP

Aqua-In-Tech

Black Box Larval Diets
 Black Box Acclimation diets
 MAT MIX

Biomat

SPIROO microFEED PLUS



Species Look up: Manufactured feeds

Gold Coin Biotechnologies

Gold Coin ENCAP

Gold Coin Microparticulated
feed

EN Hutchinson

BroodMax

Inve Aquaculture

BREED-S FRESH

EPAC

FRIPPAK FRESH

FRIPPAK PL FEEDS

LANSY-Shrimp

VANNA (China only)

Lucky Star

Micro Elite

Brine shrimp flake

Skretting

PL

Zeigler

EZ Artemia

EZ Larva

Larva Z-Plus

Larva Z-Plus

Larva Esencial

Larva AP-100

PL Raceway Plus

Brine Shrimp Flake – Red

Brine Shrimp Flake - Black

EZ Black

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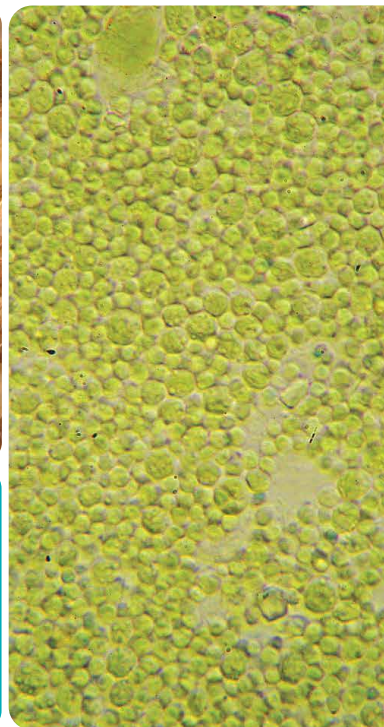
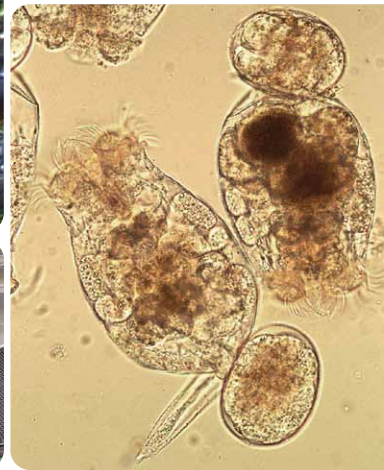
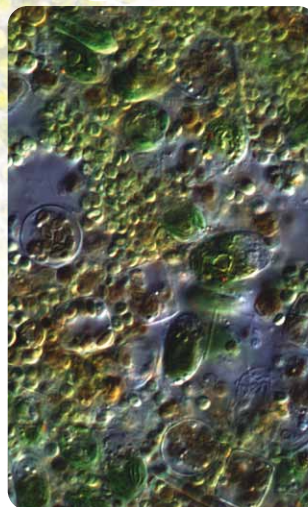
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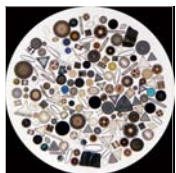
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ENRICHMENTS & SUPPLEMENTS


SUPPLIER	PRODUCT NAME	SPECIES	PRODUCT TYPE	FORM	DESCRIPTION	MORE INFORMATION
Aqua-In-Tech	PRO4000X	Fish, shrimp	Water conditioner probiotic for hatchery tanks and ponds	Tablets	Targeted delivery of large number of bacterial spores (>60 billion per tablet) to pond and hatchery tank bottoms. No activation required. Used for bio-augmentation and bioremediation. Bacteria. Stable field proven bacterial strains are the subject of a US patent for use in catfish ponds. Sludge degradation and ammonia reduction	DATA SHEET
Aqua-In-Tech	AQUAPRO-EZ	Fish, shrimp	Water conditioner probiotic for hatchery tanks and ponds	Bags	A mixture of selected bacterial strains and nutrients packaged in a biodegradable bag for direct addition to ponds and tanks. Sludge degradation and ammonia reduction	DATA SHEET
Aqua-In-Tech	MBX	Shrimp, Fish Broodstock; Shrimp Larvae, PL	Bacterial Extract		An extract from a non-pathogenic environmental bacterial species that is a source of nucleotides and nutrients shown to enhance PL stress tolerance and survivals in ponds	DATA SHEET
Inve Aquaculture 	S.presso	Fish	Live food enrichment	Liquid	Complete liquid enrichment for <i>Artemia</i> and rotifers. Innovative suspension/emulsion technology that performs in different conditions and densities.	WEBSITE CONTACT
Inve Aquaculture 	S.tream	Fish	Rotifer diet	Liquid	Semi-continuous rotifer culture diet with superior performance. Easy to adapt to any previous equipment, it is clean, easy and quick to use. Cost-effective, can be used from 2000 up to 8000 rotifers per ml.	WEBSITE CONTACT
Inve Aquaculture 	S.parkle	Fish	Rotifer diet	Liquid	Sparkling clean batch diet for a consistent, performing rotifer culture. Allows re-inoculation up to 50 consecutive generations. Cost-effective and easy to use as it is designed to reduce the workload providing short and highly productive runs.	WEBSITE CONTACT
Inve Aquaculture 	EASY SELCO	Fish	<i>Artemia</i> enrichment	Liquid	The original, easy to use liquid enrichment for <i>Artemia</i> . Easy preparation: no mixing required. Easy application: 1 single dose is possible. Easy storage: enhanced temperature stability	WEBSITE CONTACT
Inve Aquaculture 	A1 DHA SELCO	Fish	<i>Artemia</i> enrichment	Liquid	All-in-one liquid <i>Artemia</i> enrichment. Enriches up to 500 nauplii per ml. Optimal DHA inclusion and increased levels of natural marine phospholipids. Bacterial control during the enrichment cycle while ensuring increased survival rate of the fish larvae.	WEBSITE CONTACT
Inve Aquaculture 	DHA PROTEIN SELCO	Fish	Rotifer enrichment	Liquid	All-in-one powdered enrichment for rotifers with an optimal DHA/EPA ratio. Ensures a high nutritional value and allows continued rotifer growth during the enrichment process. Makes for increased survival rates of the fish larvae while reducing the number of deformities.	WEBSITE CONTACT

SUPPLIER	PRODUCT NAME	SPECIES	PRODUCT TYPE	FORM	DESCRIPTION	MORE INFORMATION
Inve Aquaculture 	Sanocare SURE	Fish		Liquid	Water conditioner for improved rotifer quality. Improves survival rate of the fish larvae, increases the coloration of the rotifers and thus also the attractability for the fish.	WEBSITE CONTACT
Inve Aquaculture 	Sanocare ACE	Fish		Liquid	Water conditioner for improved <i>Artemia</i> quality. Increases the quality and vitality of hatched, concentrated and stored <i>Artemia</i> nauplii. Stabilizes pH levels and avoids foaming off during hatching, enrichment or storage.	WEBSITE CONTACT
Inve Aquaculture 	Sanolife MIC-F	Fish			Microbial mixture for disease control, gut microflora colonization and water quality improvement in fish hatcheries. Inhibits a number of pathogenic bacteria. Produces enzymes and degrades waste. Colonizes the digestive tract and improves growth and survival rates.	WEBSITE CONTACT
Inve Aquaculture 	Sanolife GWS	Fish			Green water conditioner for larval fish rearing. Replaces up to 100% of the live algae while maintaining the rotifer quality inside the tank. Improves water quality and microbial flora. Diffuses light inside the tank, reducing the stress levels of the fish.	WEBSITE CONTACT
Inve Aquaculture 	Sanoguard S-PAK	Shrimp			Health booster for shrimp, for improved resistance to stress and diseases. Strengthens the immune system and health. Facilitates recovery after a period of stress. Improves survival and growth rates.	WEBSITE CONTACT
Inve Aquaculture 	Sanolife MIC	Shrimp			Microbial mixture for disease control and improved water quality in shrimp hatcheries. Inhibits <i>Vibrio</i> and other pathogenic bacteria. Produces enzymes and degrades waste. Colonizes the digestive tract. Produces strong PLs while improving survival and growth rates.	WEBSITE CONTACT
Lucky Star	Nutri - HUFA	Fish Shrimp	<i>Artemia</i> / Rotifer enrichment	Fluid	Lucky Star Nutri – HUFA is an <i>Artemia</i> /Rotifer enrichment product which consists of essential unsaturated fatty acids that are desirable by marine fish and shrimp larvae.	WEBSITE
Pacific Trading Aquaculture	Super Fresh Chlorella SV-12	Fish Rotifers	Rotifer diet Green-water technique	Fresh live chilled liquid	Super Fresh Chlorella SV12 has been developed in Japan especially for Rotifer cultivation. Each cell contains DHA, EPA and Vitamin B-12 ensuring optimal enrichment. Delivered live and fresh within 5 days of order and is considered a vital cornerstone of RELIABLE stable high and low density rotifer cultivation.	DATASHEET
Reed Mariculture 	Instant Algae Isochrysis 1800	Finfish – Zooplankton and <i>Artemia</i> enrichment, Bivalve Shell- fish, Shrimp	Single-species Microalgae, 8% dry weight	Refrigerated liquid concentrate; no blending required	Always available. Isochrysis 1800 can be used to replace live algae production, augment existing production during peak season, or to have available in case of a culture crash. <i>Isochrysis</i> is high in DHA and often used to enrich zooplankton such as rotifers or <i>Artemia</i> .	WEBSITE CONTACT

SUPPLIER	PRODUCT NAME	SPECIES	PRODUCT TYPE	FORM	DESCRIPTION	MORE INFORMATION
Reed Mariculture 	Instant Algae Nanno 3600	Finfish – as a rotifer feed or for greenwater	Single-species Microalgae, 18% dry weight	Frozen or Refrigerated liquid concentrate; no blending required	Nanno 3600 is our original high-yield rotifer feed. It is a single-species product (<i>Nannochloropsis</i>) and produces phospholipid-rich rotifers. It also provides a high Feed Conversion Rate with minimal organic waste, and gives an EPA and ARA pre-enrichment boost for use with high-DHA enrichment protocols. Store frozen for 3 years.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae Nanno 3600	Finfish – as a rotifer feed or for greenwater	Single-species Microalgae, 18% dry weight	Frozen or Refrigerated liquid concentrate; no blending required	Nanno 3600 is our original high-yield rotifer feed. It is a single-species product (<i>Nannochloropsis</i>) and produces phospholipid-rich rotifers. It also provides a high Feed Conversion Rate with minimal organic waste, and gives an EPA and ARA pre-enrichment boost for use with high-DHA enrichment protocols. Store frozen for 3 years.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae Pavlova 1800	Finfish – Zooplankton enrichment; Bivalve Shellfish; Shrimp	Single-species microalgae, 8% dry weight	Refrigerated Liquid concentrate; no blending required	<i>Pavlova</i> is a small golden/brown flagellate whose nutritional profile is very similar to <i>Isochrysis</i> . It is excellent for enriching rotifers and other zooplankton. Its sophisticated sterol composition makes it particularly popular in cold water fish hatcheries. <i>Pavlova</i> is very difficult to grow so it is not produced by many hatcheries.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae Tetraselmis 3600	Finfish -feed stimulant effect for zooplankton and Brine Shrimp; Bivalve Shellfish; Shrimp	Single-species microalgae, 18% dry weight	Frozen Liquid concentrate; no blending required	<i>Tetraselmis</i> is a large green flagellate with a very high lipid level. It contains natural amino acids that stimulate feeding in marine animals. <i>Tetraselmis</i> increases fecundity in zooplankton, is a standard feed for many Bivalves, and is excellent for increasing growth rates and fighting "Zoea Syndrome" in larval Shrimp.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae TW 1200	Finfish - Zooplankton; Bivalve Shellfish; Shrimp	Single-species microalgae; 6% dry weight	Refrigerated Liquid concentrate; no blending required	<i>Thalassiosira Weissflogii</i> is a large diatom used in Shrimp and Bivalve Shellfish larviculture. Considered by many to be the single best algae for larval Shrimp, the large cell size (5 – 15 micron) extends the algae feeding period until the end of the PL stage .	WEBSITE CONTACT
Reed Mariculture 	Instant Algae Shellfish Diet 1800	Bivalve Shellfish; Ascidians/ Tunicates; Sea Urchins;	Microalgal blend; 8% dry weight	Refrigerated Liquid concentrate; no blending required	Shellfish Diet 1800® is a mix of four marine microalgae that have all demonstrated success with a variety of Shellfish including Oysters, Clams, Mussels, and Scallops. Shellfish Diet can be used with pre-set larvae all the way up through broodstock as a complete live algae replacement.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae RotiGrow Plus	Finfish- Zooplankton feed	Microalgal blend; >14.8% dry weight	Frozen Liquid concentrate; no blending required	RotiGrow Plus is a clean, high yield rotifer feed that maximizes pre-enrichment levels of DHA, EPA and ARA. The essential first step in the RotiGrow System. Depending on the nutritional requirements of the fish larvae, it can be used as a stand-alone feed or in combination with one of our N-Rich enrichment products.	WEBSITE CONTACT

SUPPLIER	PRODUCT NAME	SPECIES	PRODUCT TYPE	FORM	DESCRIPTION	MORE INFORMATION
Reed Mariculture 	Instant Algae RotiGrow Nanno	Finfish - Zooplankton feed	Microalgal blend; >16.4% dry weight	Frozen Liquid concentrate; no blending required	RotiGrow Nanno is a clean, high yield single species rotifer feed that produces phospholipids-rich rotifers. Our highest yielding feed, it provides the highest biomass conversion rate of our products, with the least organic waste in the tank. Gives a high EPA and ARA pre-enrichment boost for use with high DHA-enrichment protocols.	WEBSITE CONTACT
Reed Mariculture Distributor to the Americas 	Chlorella Ltd. Chlorella V12	Finfish – Zooplankton feed	Live microalgae concentrate; 14% dry weight	Refrigerated algal concentrate – highly perishable	This Chlorella, grown in Japan, is a super fresh grow-out feed enriched with DHA using a patented methodology. It provides a moderate DHA, EPA and ARA enrichment (25mg/g HUFA pre-enrichment). It is naturally high in vitamin B-12, a nutrient necessary for larval health.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae N-Rich High PRO	Finfish-Zooplankton enrichment	Microalgal blend; 9% dry weight	Refrigerated Liquid concentrate; no blending required	N-Rich High PRO feeds ensure that the rotifer's soft tissue and gut contain the highest levels of proteins and lipids rich in phospholipid HUFAs, as well as a host of carotenoids, sterols, vitamins, enzymes, and other key nutrients. High PRO is especially protein-rich (>45%), keeping rotifers healthy and vibrant while they are being enriched.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae N-Rich PL Plus	Finfish-Zooplankton enrichment	Microalgal blend; 9% dry weight	Refrigerated Liquid concentrate; no blending required	N-Rich PL Plus provides a high phospholipid content (approximately 50%) plus other bioavailable polar and membrane lipids for rapid rotifer issue enrichment with minimal triglyceride storage. Rotifers emerge vibrant and swimming from the enrichment process. Near optimum enrichment in 1-2 hours when used with RotiGrow Plus.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae N-Rich Ultra PL	Finfish-Zooplankton enrichment	Microalgal blend; 9% dry weight	Refrigerated Liquid concentrate; no blending required	N-Rich Ultra PL provides a very high HUFA enrichment from bioavailable polar and membrane lipids for rapid rotifer issue enrichment with minimal triglyceride storage. Rotifers emerge vibrant and swimming from the enrichment process. Extreme DHA enrichment in as little as 2 hours when used with RotiGrow Plus.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae RotiGreen Omega	Finfish - Greenwater	Microalgal blend; 8% dry weight	Frozen Liquid concentrate; no blending required	RotiGreen Omega is effective Greenwater with Optimum DHA, EPA & ARA nutrition for fish larvae as well as enrichment maintenance for rotifers in the larval tank. Marine microalgae concentrates stay extremely clean with excellent suspension in the tank. *RotiGreen Omega may require special care for fish that are inflating air bladder.	WEBSITE CONTACT
Reed Mariculture 	Instant Algae Rotigreen Nanno	Finfish-Greenwater	Microalgal blend; 8% dry weight	Frozen Liquid concentrate; no blending required	RotiGreen Nanno balances DHA/EPA with ARA to optimally nourish fish and maintain the health of rotifers. Extremely clean, it offers excellent suspension in the water column. RotiGreen Nanno is as effective as live <i>Nannochloropsis</i> , and is replacing our Nanno 3600 for greenwater applications.	WEBSITE CONTACT

SUPPLIER	PRODUCT NAME	SPECIES	PRODUCT TYPE	FORM	DESCRIPTION	MORE INFORMATION
Reed Mariculture 	Instant Algae RotiGreen Iso	Finfish-Greenwater	Microalgal blend; 8% dry weight	Refrigerated Liquid concentrate; no blending required	RotiGreen Iso is a pure algae formulation that is as effective as live <i>Isochrysis</i> . A highly nutritious greenwater when swallowed or gill fed by larvae, it can maintain or further increase the DHA/EPA ratio in your rotifers and larval fish to meet their nutritional requirements. Naturally high in the carotenoids necessary for larval health.	WEBSITE CONTACT
Reed Mariculture 	Instant Zooplankton "Mini L 160" Live Rotifers	Finfish -Live Larval Feed	Live Zooplankton	A dense culture of Live Zooplankton packaged in 1 – 1.5 liters of salt water in breathable bags.	Reed Mariculture supplies pure cultures of a strain of <i>Brachionus plicatilis</i> (L-type) with a typical lorica length of about 160 µm. This species is euryhaline, capable of thriving in salinities of 5-40 ppt. It is available in quantities from 1 million to 1.5 billion, concentrated and packaged into "breathable" bags.	WEBSITE CONTACT
Reed Mariculture 	Instant Zooplankton <i>Parvocalanus crassirostris</i> Copepods	Finfish -Live Larval Feed	Live Zooplankton	A dense culture of Live Zooplankton packaged in 1 – 1.5 liters of salt water in breathable bags.	Copepods are the feed of choice for wild marine finfish. <i>Parvocalanus crassirostris</i> is a small, pelagic calanoid copepod. The nauplii (newly hatched larvae) are small measuring in the 40-100 µm range, making them a suitable feed for small-gape fish larvae. Adults are in the 200 to 400 µm range.	WEBSITE CONTACT
Reed Mariculture 	Otohime Larval Weaning Diets	Finfish - Larval Weaning Diet	High quality dry larval weaning diet	Pellets: Granular, Marumerized and Extruded	Otohime Larval Weaning Diets from Japan provide superior nutrition for juvenile and adult fish. They are amazingly clean with excellent particle integrity in water, provide optimal nutrition and stimulate a strong feeding response for improved growth and survival rates. A balanced diet suited for virtually all finfish.	WEBSITE CONTACT OTOHIME WEBSITE
Reed Mariculture 	APBreed RGcomplete	Finfish - Zooplankton Feed	Microalgal blend; 4.4% dry weight	Very stable refrigerated liquid concentrate; includes ammonia control; no blending required	RGcomplete is a super-concentrated microalgal-based premium quality feed for filter-feeding invertebrates. It has been sized especially for Breeders, Aquarists, and Propagators and includes both a pH buffer and ClorAmX® (ammonia neutralizer). It has a long refrigerated shelf life of at least 6 months. Suitable for a wide range of zooplankton with a balanced Omega profile.	WEBSITE CONTACT AP BREED WEBSITE
Reed Mariculture 	APBreed SDAquarist	Shellfish, Corals	Microalgal blend; 4.4% dry weight	Very stable refrigerated liquid concentrate; includes ammonia control; no blending required	A mixed diet of four marine microalgae (<i>Isochrysis</i> , <i>Pavlova</i> , <i>Tetraselmis</i> and <i>Thalassiosira weissflogii</i>) that provides superior nutrition for all types of shellfish, crustaceans and other filter feeding invertebrates. Increasing both growth rate and survival. Complete with ammonia control and buffered for a long refrigerated shelf life.	WEBSITE CONTACT AP BREED WEBSITE
Reed Mariculture 	APBreed TDO	Finfish - Pelletized Feed/ Weaning Diet	High quality dry diet	Pellets: Granular and Extruded	TDO is the top-selling hatchery larval finfish diet "top dressed" With <i>Haematococcus</i> (astaxanthin source), natural feed stimulants, a natural immune-stimulant, and more! Prime source of easily digested proteins and high quality lipids with an excellent HUFA and phospholipid profile. High in the carotenoid astaxanthin	WEBSITE CONTACT AP BREED WEBSITE

SUPPLIER	PRODUCT NAME	SPECIES	PRODUCT TYPE	FORM	DESCRIPTION	MORE INFORMATION
Skretting 	NEPTUNE	Fish	Water conditioner	Powder	Blend of selected micro algae and micro particles offering a convenient solution for replacing live algae in greenwater applications.	WEBSITE CONTACT
Skretting 	ORI-CULTURE	Fish	Rotifer culture	Powder	Diet which has been developed to offer excellent rotifer reproduction without compromising the culture environment and to increase the rotifers natural protein profile and fertility.	WEBSITE CONTACT
Skretting 	ORI-GREEN	Fish	Rotifer & <i>Artemia</i> enrichment	Powder	Diet which has been designed to ensure a very fast and efficient uptake by the live feed. The algae in the formulation also provide a natural pre-biotic effect and stimulate rotifer and <i>Artemia</i> condition.	WEBSITE CONTACT
Skretting 	ORI-GOLD	Fish	<i>Artemia</i> enrichment	Liquid suspension	Natural blend of encapsulated marine HUFAs, phospholipids, algae and proteins for enriching <i>Artemia</i> . It is boosted with specific proteins to offer a more balanced profile and increase gut retention in the <i>Artemia</i> .	WEBSITE CONTACT
Zeigler	EZ Bio	Shrimp	Larvae PL	Powder	A natural microbial treatment for <i>Vibrio sp.</i> and other pathogenic bacteria in hatchery systems.	DATASHEET
Zeigler	EZ Mate	Shrimp	Maturation	Form into Worm	Partial replacement for fresh maturation foods that promotes increased nauplii production; Completely biosecure and contains high levels of pigments, HUFA's, vitamins, and minerals.	DATASHEET
Zeigler	Maturation Supplement	Shrimp	Maturation	Pellet	Promotes rapid ovarian development in maturation systems.	DATASHEET
Zeigler	Shrimp Broodstock	Shrimp	Broodstock	Pellet	Uses premium ingredients to promote growth and reproductive development.	DATASHEET

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PRO4000X
AQUAPRO-EZ
MBX

Inve Aquaculture

S.presso
S.tream
S.parkle
EASY SELCO
A1 DHA SELCO
DHA PROTEIN SELCO
Sanocare SURE
Sanocare ACE
Sanolife MIC-F
Sanolife GWS

Lucky Star

Nutri - HUFA

Pacific Trading Aquaculture

Super Fresh Chlorella SV-12

Reed Mariculture

Instant Algae Isochrysis 1800
Instant Algae Nanno 3600
Instant Algae Nanno 3600
Instant Algae Pavlova 1800
Instant Algae Tetraselmis 3600
Instant Algae TW 1200
Instant Algae RotiGrow Plus
Instant Algae RotiGrow Nanno

Chlorella Ltd. Chlorella V12
Instant Algae N-Rich High PRO
Instant Algae N-Rich PL Plus
Instant Algae N-Rich Ultra PL
Instant Algae RotiGreen Omega
Instant Algae Rotigreen Nanno
Instant Algae RotiGreen Iso
Instant Zooplankton
"Mini L 160"
Live Rotifers
Instant Zooplankton Parvocalanus crassirostris Copepods
Otohime Larval Weaning Diets
APBreed RGcomplete
APBreed TDO

Skretting

NEPTUNE
ORI-CULTURE
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ORI-GOLD

SHELLFISH

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Instant Algae Shellfish Diet 1800
APBreed SDAquarist

SHRIMP

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