Influence of salinity and linoleic or α-linolenic acid based diets on ontogenetic development and metabolism of unsaturated fatty acids in pike perch larvae (Sander lucioperca)

Combinations of nutritional requirements and husbandry rearing conditions during early ontogeny are poorly studied in pikeperch (Sander lucioperca). The substitution of marine oils with vegetable oils has reduced stress tolerance and caused neurophysiological changes in pike perch larvae, but effects of environmental cues are limited. Saline water influences on a range of physiological functions during early fish larval ontogeny and may affect FA metabolism, - elongation and desaturation - activity when given diets limited in LC PUFAs, but rich in shorter chain n-3 or n-6 PUFAs. Consequently, live Artemia differing in 18:2n-6 (LA) and 18:3n-3 (ALA) content by enrichment with sunflower oil (SFO) or linseed oil (LO) were fed to 10 days post hatch (DPH) larvae and reared up to isosmotic salinities (0, 5, 10 ppt) until 30 DPH. Larval tissue FA composition was examined at 15, 25 and 30 DPH. Besides, an in vivo assay was performed on 20 DPH larvae with 14C labelled FA including LA; ALA; 20:4n-6 (ARA); 20:5n-3 (EPA) or 22:6n-3 (DHA) to establish FA incorporation and metabolism. At 30 DPH, performance, digestive enzymatic activity, eicosanoid activity, skeletal anomalies and stress sensitivity were further evaluated. Results on larval FA profiles suggest a low desaturation and elongation capability over LA and ALA, with no significant effects of salinity or larval age on modulation of unsaturated fatty acid metabolism. In vivo assays revealed that regardless of salinity or diet, pikeperch possess a marked specificity to incorporate ARA and EPA compared to a poorer incorporation of DHA. Larvae exposed to a confinement stress test caused high acute mortality in all experimental groups except for a control group fed with Artemia enriched by a commercial DHA Selco emulsion. Growth performance was not significantly affected by salinity or dietary enrichment with SFO or LO, but influenced on larval enzymatic activity of pepsin, aminopeptidase, trypsin and alkaline phosphatase, while lipase activity was not significantly affected. Increased saline conditions significantly decreased hormonal prostaglandin eicosanoid PGE2, PGE3 activity with the highest activity at 0 ppt. The prevalence of severe skeletal anomalies was generally high, affecting over 75% of the larval population with negative effects by increase in salinity. The incidence of anomalies was higher on endochondral bones, namely maxillary, ranging from 58-83% of the population. These results agree well with those from expression of sox 9 and twist2 genes; involved in chondrocyte ossification and differentiation.

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Effect of different dietary N-3 long-chain polyunsaturated fatty acids levels on stress response of meagre (Argyrosomus regius, Asso 1801) juveniles

General information
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Organisations: National Institute of Aquatic Resources, Section for Aquaculture, University of Las Palmas de Gran Canaria
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Effects of dietary digestible protein and energy levels on growth performance, feed utilization, and body composition of juvenile permit, Trachinotus falcatus (Linnaeus, 1758)
A 9-wk study was conducted to evaluate the effect of dietary protein and energy on growth performance of juvenile permit, Trachinotus falcatus, growing from approximately 30 to 150g. Nine experimental diets were formulated to contain three levels of crude protein (400, 450, and 500g/kg dry matter [DM]); and three levels of crude lipid (100, 200, and 300g/kg DM) in a 3 x 3 factorial design. Growth rate and feed efficiency were significantly improved with increasing dietary protein levels from 400 to 500g/kg and with dietary lipid levels from 100 to 200g/kg. Fish body protein content was positively correlated with dietary ratio of digestible protein (DP) to digestible energy (DE) (P<0.01, R²=0.83), while body lipid was negatively correlated with dietary DP/DE (R²=0.55, P<0.05) but positively correlated with dietary DE levels (R²=0.66, P<0.01). Results showed a protein-sparing effect, as protein retention was significantly increased by increasing dietary lipid level. In conclusion, the diet containing DP of 392.7g/kg and DE of 18.8 MJ/kg (DM), corresponding to a DP/DE of 20.9g/MJ, is suggested as an optimal feed for growth and feed efficiency in juvenile permit.

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BFI (2019): BFI-level 1
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BFI (2018): BFI-level 1
The importance of phospholipids combined with long-chain PUFA in formulated diets for pikeperch (Sander lucioperca) larvae

Dietary phosphoglycerides and n-3 long-chain PUFA (LC-PUFA) play important functions in the development of pikeperch (Sander lucioperca) larvae. This study aimed to determine optimal dietary levels of soyabean lecithin (SBL)-derived phospholipids (PL) in starter feeds for pikeperch larvae 10–30 d post-hatch (DPH) and examine performance and ontogeny by additional supplementation of n-3 LC-PUFA in the form of Algatrium DHA 70 (glyceride product; 660–700 mg/g DHA; EPA 60–75 mg/g). In total, six isoproteic and isoenergetic extruded diets were formulated with increasing levels of PL (3.7, 8.3 or 14.5 % wet weight (w.w.), respectively); however, three of the diets were supplemented with three levels of Algatrium DHA 70 (0.6, 2.0 or 3.4 %, respectively). Liver proteomic analyses of larvae at 30 DPH were included for effects of PL and primarily DHA on performance, physiological expression and interactions in larval proteins. In addition, bone anomalies, digestive enzymatic activity, candidate gene expression and skeleton morphogenesis were examined. Results confirmed the importance of dietary PL levels of at least 8.2 % w.w., and an additional beneficiary effect of supplementation with DHA plus EPA. Thus, combined supplementation of SBL (up to 14.51 % w.w. PL) and n-3 LC-PUFA (1.004 % DM DHA and 0.169 % DM EPA) in the form of TAG resulted in highest growth and lowest incidence of anomalies, improved digestive enzyme activity and had differential effect on liver proteomics. The results denote that essential fatty acids can be supplemented as TAG to have beneficial effects in pikeperch larvae development.
Crosstalk between innate immunity and circadian rhythm: Do fish immune defences have a sense of time?

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Organisations: National Institute of Aquatic Resources, Section for Aquaculture, Nanyang Technological University
Contributors: Lazado, C. C., Lund, I., Skov, P. V., Jokumsen, A., Gesto, M., Huy, N. Q., Pedersen, P. B.
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Rhythmicity and plasticity of digestive physiology in a euryhaline teleost fish, permit (Trachinotus falcatus)

Digestive physiology is considered to be under circadian control, but there is little evidence in teleost fish. The present study explored the rhythmicity and plasticity to feeding schedules of enzymatic digestion in a candidate aquaculture fish, the permit (Trachinotus falcatus). The first experiment identified the rhythms of digestive factors throughout the light-dark (LD) cycle. Gastric luminal pH and pepsin activity showed significant daily variation albeit not rhythmic. These dynamic changes were likewise observed in several digestive enzymes, in which the activities of intestinal protease, chymotrypsin and lipase exhibited significant daily rhythms. In the second experiment, the existence of feed anticipatory activity in the digestive factors was investigated by subjecting the fish to either periodic or random feeding. Anticipatory gastric acidification prior to feeding was identified in periodically fed fish. However, pepsin activity did not exhibit such anticipation but a substantial postprandial increase was observed. Intestinal protease, leucine aminopeptidase and lipase anticipated periodic mealtime with elevated enzymatic activities. Plasma melatonin and cortisol demonstrated robust daily rhythms but feeding time manipulations revealed no significant impact. Plasma ghrelin level remained constant during the LD cycle and appeared to be unaffected by differing feeding regimes as well. Taken together, the digestive factors of permit were highly dynamic during the LD cycle. Periodic feeding entrained digestive physiology and mediated anticipatory gastric acidification and intestinal enzymatic activities. This knowledge will be essential in developing feeding protocols and husbandry-related welfare strategies that will further advance this candidate finfish as an aquaculture species.

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Web of Science (2017): Impact factor 2.258
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Web of Science (2016): Impact factor 1.812
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 2.01 SJR 0.943 SNIP 0.944
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.18 SJR 0.999 SNIP 0.951
Web of Science (2014): Impact factor 1.966
Web of Science (2014): Indexed yes
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Scopus rating (2013): CiteScore 2.36 SJR 0.974 SNIP 1.043
Web of Science (2013): Impact factor 2.371
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Long-term tryptophan supplementation decreased the welfare and innate immune status of pikeperch juveniles

It has been demonstrated that short-term supplementation of L-tryptophan (TRP) can mitigate the primary neuroendocrine response to stress in some fish species, but such stress reduction was reported to be both dose- and context-dependent (Basic et al., 2013; Machado et al., 2015). So, the TRP responses may be species related or depend on the stress levels experienced by the fish. Since percid fish were reported to be more stress responsiveness than common aquaculture species such as rainbow trout (Jentoft et al., 2005), this study aimed (1) to determine to what extent a long-term dietary TRP mitigate the physiological response of pikeperch (Sander lucioperca) to emersion stress, and (2) to characterize the related immune status. Pikeperch juveniles of 10 g received four experimental diets: (CT) = control groups without any stress and any feed TRP supplement, (CTs) = control groups submitted to emersion stress but without any feed TRP supplement, 3TRPs = groups receiving 3-time TRP diet and submitted to emersion stress, 6TRPs = groups receiving 6-time TRP diet and submitted to emersion stress. Various organs were sampled on D7, D37 and D91 of TRP supplementation for evaluation of physiological and innate immune responses; samplings were done one hour after the emersion challenge stress. Specific growth rate (SGR) as well as food conversion rate (FCR) were also checked. Emersion stress induced a significant increase in plasma cortisol both after a single stress or repeated stress challenges. Dietary TRP significantly decreased cortisol in a dose related manner both after a single or repeated stress; but plasma glucose level was only affected after a single stress but not after long-term feeding. The two stress indicators measured showed that pikeperch displayed higher stress responsiveness as already demonstrated for European perch in comparison to salmonids (Jentoft et al., 2005). The reduction in physiological stress status by dietary TRP was associated to a significant decrease in plasma lysosomal activity, especially on D91; indicating negative interaction with the innate immune pathways. Growth rate was slowed by the long-term dietary TRP in association to an increase in FCR values. The
available results indicate that long-term TRP supplementation has negative impact on the overall welfare status of pikeperch. Other analyses are ongoing and more results concerning key brain neurotransmitters such as serotonin, dopamine and their metabolites concentrations as well as on the expressions of key-immune genes (C3-1, TNF-α, IL-1β, etc) will be discussed.

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Organisations: National Institute of Aquatic Resources, Section for Aquaculture, University of Namur
Contributors: Mandiki, S. N. M., Redivo, B., Baekelandt, S., Douxfils, J., Lund, I., Höglund, E., Kestemont, P.
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BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.11 SJR 0.997 SNIP 1.138
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Scopus rating (2011): CiteScore 3.52 SJR 1.209 SNIP 1.262
Web of Science (2011): Impact factor 3.322
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.143 SNIP 1.06
Web of Science (2010): Impact factor 3.044
Web of Science (2010): Indexed yes
Anaerobic digestion of solid waste in RAS: Effect of reactor type on the biochemical acidogenic potential (BAP) and assessment of the biochemical methane potential (BMP) by a batch assay

Anaerobic digestion is a way to utilize the potential energy contained in solid waste produced in recirculating aquaculture systems (RASs), either by providing acidogenic products for driving heterotrophic denitrification on site or by directly producing combustive methane. In this study the biochemical acidogenic potential of solid waste from juvenile rainbow trout was evaluated by measuring the yield of volatile fatty acids (VFA) during anaerobic digestion by batch or fed-batch reactor operation at hydrolysis time (HT) / hydraulic retention time (HRT) of 1, 5, or 10 days (and for batch additional 14 and 20 days) in continuously stirred tank reactors. Generally, the VFA yield increased with time and no effect of the reactor type used was found within the time frame of the experiment. At 10 days HT or 10 days HRT the VFA yield reached 222.3 ± 30.5 and 203.4 ± 11.2 mg VFA g-1 TVS0 (total volatile solids at day 0) in batch and fed-batch reactor, respectively. For the fedbatch reactor, increasing HRT from 5 to 10 days gained no significant additional VFA yield. Prolonging the batch reactor experiment to 20 days increased VFA production further (273.9 ± 1.6 mg VFA g-1 TVS0, n=2). After 10 days HT / HRT, 16.8 - 23.5 % of total Kjeldahl N was found as TAN and 44.3 - 53.0 % of total P was found as ortho-phosphate. A significant difference between reactor types was detected for the phosphorous dissolution at 5 days HT / HRT as a relatively steep increase (of a factor 2-3) in ortho-P content occurred in fed-batch reactors but similar steep increase was only notable after 10 days HT for batch reactors. No differences between reactor types at the other HT / HRT were recorded for P as well as (for all HT / HRT for) N. Based on this study a HRT of approximately 5 days would be recommended for the design of an acidogenic continuously stirred reactor tank in a RAS single-sludge denitrification set-up. The biochemical methane potential of the sludge was estimated to 318 ± 29 g CH4 g-1 TVS0 by a batch assay and represented a higher utility of the solid waste when comparing the methane yield with the VFA yield (in COD units). This points towards a technological challenge of ultimately increase the acidogenic output to match the methane yield as both products are formed from the same reference point

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Humoral and mucosal defense molecules rhythmically oscillate during a light–dark cycle in permit, Trachinotus falcatus

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Web of Science (2014): Impact factor 2.674
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BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 3.11 SJR 0.997 SNIP 1.138
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No evidence for a bioenergetic advantage from forced swimming in rainbow trout under a restrictive feeding regime

Sustained swimming at moderate speeds is considered beneficial in terms of the productive performance of salmonids, but the causative mechanisms have yet to be unequivocally established. In the present study, the effects of moderate exercise on the bioenergetics of rainbow trout were assessed during a 15 week growth experiment, in which fish were reared at three different current speeds: 1 BL s\(^{-1}\), 0.5 BL s\(^{-1}\) and still water (approximate to 0 BL s\(^{-1}\)). Randomly selected groups of 100 fish were distributed among twelve 600 L tanks and maintained on a restricted diet regime. Specific growth rate (SGR) and feed conversion ratio (FCR) were calculated from weight and length measurements every 3 weeks. Routine metabolic rate (RMR) was measured every hour as rate of oxygen consumption in the tanks, and was positively correlated with swimming speed. Total ammonia nitrogen (TAN) excretion rates showed a tendency to decrease with increasing swimming speeds, yet neither they nor the resulting nitrogen quotients (NQ) indicated that swimming significantly reduced the fraction of dietary protein used to fuel metabolism. Energetic budgets revealed a positive correlation between energy expenditure and the current speed at which fish were reared, fish that were forced to swim and were fed restrictively consequentially had poorer growth and feed utilization. The results show that for rainbow trout, water current can negatively affect growth despite promoting minor positive changes in substrate utilization. We hypothesize that this may be the result of either a limited dietary energy supply from diet restriction being insufficient for both covering the extra costs of swimming and supporting enhanced growth.
Dietary LC-PUFA deficiency early in ontogeny induces behavioural changes in pike perch (Sander lucioperca) larvae and fry

This study examined whether dietary supply of DHA and phospholipids during early ontogeny affected the outcome of behavioural challenges in pike perch larvae and fry, and whether the history of lipid nutrition carried over in long-term effects on learning ability. Pike perch larvae were fed Artemia enriched with either refined olive oil high in oleic acid (A);
refined olive oil supplemented with a low (B) or a high (C) level of DHA; or refined olive oil acid supplemented with fish oil with a high content of phospholipids (PL) and DHA (D). The enriched live diets were provided until 28 days post hatch (dph), at which time larval behavioural responses to visual and mechano-sensory stimuli were assessed. All dietary groups were subsequently fed an identical enriched live feed (diet D) and gradually weaned to an extruded dry feed, on which they were maintained for 112 days. At the end of this period, assessment of fry avoidance behaviour was repeated and individuals were tested for spatial learning ability in a maze. At the larval stage, individuals maintained on Artemia rich in DHA showed a 5–8 fold increase in swimming speed when subjected to a visually simulated predator test, a response that was not observed for larvae on diets low in DHA content. Independent of the predator simulation, larvae deficient or low in DHA exhibited significantly more time swimming along the edge of a test arena and had overall higher locomotor activities compared to larvae fed a diet with a high DHA content. Larvae on DHA rich diets showed an ability to achieve significantly higher peak acceleration rates during the escape response, which was maintained at 112 dph. Time spent locating the exit of a maze decreased with repetitious training sessions, although fish fed diets low in DHA spent longer time in the maze, caused by extended periods of inactivity or “freezing” behaviour (time lag) prior to the onset of active searching behaviour. The consistency of behavioural responses to mechano-sensory stimuli in larvae and fry suggests long-term effects on the neuromuscular pathway involved in escape responses. A longer period of freezing in the learning test may reflect a more anxious and fragile behaviour profile in fish fed low levels of DHA. Further studies should aim at verifying whether this affects performance related traits, such as immune competence and robustness.

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SciVal rating (2017): CiteScore 3.05 SJR 1.152 SNIP 1.58
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BFI (2016): BFI-level 2
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SciVal rating (2016): CiteScore 2.75 SJR 1.122 SNIP 1.51
Web of Science (2015): Impact factor 2.57
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
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SciVal rating (2015): CiteScore 2.12 SJR 1.107 SNIP 1.256
Web of Science (2014): Impact factor 1.893
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Web of Science (2014): Indexed yes
SciVal rating (2014): CiteScore 2.16 SJR 1.01 SNIP 1.33
Web of Science (2014): Impact factor 1.878
Web of Science (2015): Indexed yes
BFI (2013): BFI-level 1
Web of Science (2013): Indexed yes
SciVal rating (2013): CiteScore 2.18 SJR 1.151 SNIP 1.293
Web of Science (2013): Impact factor 1.828
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Web of Science (2012): Indexed yes
SciVal rating (2012): CiteScore 2.32 SJR 1.222 SNIP 1.485
Web of Science (2012): Impact factor 2.009
Influence of dietary lipid and protein sources on the sensory quality of organic rainbow trout (Oncorhynchus mykiss) after ice storage

The influence of dietary protein and lipid sources on the quality of organic rainbow trout (Oncorhynchus mykiss) was studied. The protein and oil sources were fishmeal, fish oil, and organic vegetable protein and oils. Sensory profiling was performed during 3 to 14 days of ice storage along with lipid analyses of the fillet. Overall, the results showed that the sensory characteristics of the trout were affected in different ways during ice storage. The source of lipid seemed to affect the sensory quality at the beginning of the storage period, while the protein source seemed to have a more pronounced impact at the end of the storage period.
Robustfish: New possibilities for growth and robustness in organic aquaculture

General information
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Effects of organic plant oils and role of oxidation on nutrient utilization in juvenile rainbow trout (Oncorhynchus mykiss)
Producing organic fish diets requires that the use of both fishmeal and fish oil (FO) be minimized and replaced by sustainable, organic sources. The purpose of the present study was to replace FO with organic oils and evaluate the effects on feed intake, feed conversion ratio (FCR), daily specific growth rate (SGR) and nutrient digestibility in diets in which fishmeal protein was partly substituted by organic plant protein concentrates. It is prohibited to add antioxidants to organic oils, and therefore the effects of force-oxidizing the oils (including FO) on feed intake and nutrient digestibility was furthermore examined. Four organic oils with either a relatively high or low content of polyunsaturated fatty acids were considered: linseed oil, rapeseed oil, sunflower oil and grapeseed oil. Substituting FO with organic oils did not affect feed intake (P>0.05), FCR or SGR (P>0.05) despite very different dietary fatty acid profiles. All organic plant oils had a positive effect on apparent lipid digestibility compared with the FO diet (P<0.05), whereas there were no effects on the apparent digestibility of other macronutrients when compared with the FO diet (P>0.05). Organic vegetable oils did not undergo auto-oxidation as opposed to the FO, and the FO diet consequently had a significantly negative effect on the apparent lipid digestibility. Feed intake was not affected by oxidation of any oils. In conclusion, the study demonstrated that it is possible to fully substitute FO with plant-based organic oils without negatively affecting nutrient digestibility and growth performance. Furthermore, plant-based organic oils are less likely to oxidize than FOs, prolonging the shelf life of such organic diets

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Farming different species in RAS in Nordic countries: Current status and future perspectives

Recirculating aquaculture systems (RAS) have gained increasing interest in recent years as a means to intensify fish production while at the same time minimize the environmental impact. Considerable hands-on experience has accumulated within the Nordic countries over the last 20-30 years in designing, building, and operating intensive land-based RAS for different species. This study compiles and assesses published literature along with un-published hands-on experiences with rearing different species in RAS in the Nordic countries, including Atlantic salmon (Salmo salar), rainbow trout (Oncorhynchus mykiss), European eel (Anguilla anguilla), pike perch (Stizostedion lucioperca), Arctic char (Salvelinus alpinus), sturgeon (order Acipenseriformes), Nile tilapia (Oreochromis niloticus), and European lobster (Homarus gammarus). High capital costs are one of the biggest challenges to sustainable RAS calling for large scale
intensive productions to reduce investment -and operation costs. Consistent with this, production of Atlantic salmon smolts in indoor RAS and rainbow trout in outdoor Model-Trout-Farms (MTFs) have been the commercially most successful productions so far. Aside from end-of-pipe treatment including sludge handling and efficient nitrogen removal, much of the RAS technology applied is well known and is, as such, more or less ready to apply for culturing a variety of species. Successful production of “new” species in RAS therefore largely comes down to identifying the biological requirements of that specific species, and designing the RAS to fulfill and support the specific requirements. Well established brood-stocks and continuous supply of offspring is furthermore a prerequisite for successful RAS production of most species. Successful operations of less intensive RAS such as aquaponic systems appear to be feasible primarily when culturing more exotic species targeted for selected customers

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Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.01 SJR 0.705 SNIP 1.233
Web of Science (2017): Impact factor 1.49
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.09 SJR 0.824 SNIP 1.525
Web of Science (2016): Impact factor 1.559
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.63 SJR 0.748 SNIP 1.114
Web of Science (2015): Impact factor 1.381
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.61 SJR 0.723 SNIP 1.404
Web of Science (2014): Impact factor 1.181
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.8 SJR 0.672 SNIP 1.524
Web of Science (2013): Impact factor 1.232
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.72 SJR 0.948 SNIP 1.374
Web of Science (2012): Impact factor 1.406
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.54 SJR 0.705 SNIP 1.389
Web of Science (2011): Impact factor 1.421
ISI indexed (2011): ISI indexed yes
Feed intake as explanation for density related growth differences of common sole Solea solea

Growth of common sole Solea solea is negatively correlated to density, which affects productivity in culture and hence commercial success. Studies of individual feed intake were performed to examine growth and population dynamics at different densities. Three initial stocking densities: 1.0, 2.1 and 3.9 kg m$^{-2}$ of individually tagged sole, referred to as low density (LD), medium density and high density (HD), were examined during 145 days. Despite that tank productivity (g m$^{-2}$ day$^{-1}$) was highest for the HD group, the specific growth rate (SGR) decreased significantly with increase in stocking density. Individual size variation was similar between densities, indicating that growth was not associated with hierarchy and dominant behaviour. Individual data indicated that increased density reduced the growth potential of all individuals in a population. Individual feed intake was positively correlated to both fish size and individual SGR. Feed conversion ratio was likewise positively correlated to feed intake. The relative feed intake (g feed g fish$^{-1}$) was not correlated to fish size at any density tested, but was significantly highest for the LD population. This explains a substantial part of the better growth in the LD group supported by indications of better utilization of the ingested feed.
Organic plant ingredients in the diet of Rainbow trout (Oncorhynchus mykiss): Impact on fish muscle composition and oxidative stability

Rainbow trout were fed diets containing either fish meal and fish oil (FM-FO) (control) or diets in which 40% of the fishmeal was substituted with a mixture of ingredients grown organically including plant protein concentrate (PP) in combination with either fish oil (FO) as lipid source, or one of the following organic plant oils; rapeseed (RO), linseed/flaxseed (LO), grape seed (GO), or sunflower (SO). The impact of these substitutions was investigated by measuring fish muscle fatty acid profile as well as oxidative and color stability of the fillet during 14 days ice storage. The inclusion of plant protein concentrate did not affect the fatty acid profile significantly but resulted in a slightly improved oxidative stability of the fish fillets as compared to the control diet. The fatty acid profile of the oil used was in general well reflected in the fish muscle fatty acid profile. Fish fed PP-RO were the most oxidatively stable during ice storage but the omega-3 fatty acid content was reduced by 40% compared to fish fed the FM-FO control diet. Replacing FO by LO was not suitable as it induced oxidation and the fillet contained 40–50% less of long chain omega-3 fatty acids.

General information
State: Published
Organisations: National Food Institute, Division of Industrial Food Research, National Institute of Aquatic Resources, Section for Aquaculture
Pages: 1367-1377
Publication date: 2013
Peer-reviewed: Yes

Publication information
Journal: European Journal of Lipid Science and Technology
Volume: 115
Issue number: 12
ISSN (Print): 1438-7697
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2.22 SJR 0.776 SNIP 1.05
Web of Science (2017): Impact factor 2.2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.06 SJR 0.712 SNIP 1.042
Web of Science (2016): Impact factor 2.145
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.85 SJR 0.643 SNIP 0.878
Web of Science (2015): Impact factor 1.953
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.98 SJR 0.742 SNIP 1.052
Web of Science (2014): Impact factor 1.812
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.16 SJR 0.863 SNIP 1.122
Web of Science (2013): Impact factor 2.033
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.06 SJR 0.864 SNIP 1.221
Dietary supplementation of essential fatty acids in larval pikeperch (Sander lucioperca); short and long term effects on stress tolerance and metabolic physiology

The present study examined the effects of feeding pike perch larvae Artemia, enriched with either docosahexanoic acid (DHA), arachidonic acid (ARA), oleic acid (OA), olive oil (OO) or a commercial enrichment DHA Selco (DS) on tissue lipid deposition, stress tolerance, growth and development, and metabolic rate. There was higher tissue retention of ARA than DHA at comparable inclusion levels. No differences were observed between diets on the percentage contribution of ARA or DHA to the fatty acid profile of tissues (head and trunk). Total fatty acid content (mgg⁻¹) was significantly higher in the head, reflecting its high content of neural tissue. Observations on larval erratic behaviour and mortality following exposure to salinity stress suggested that high inclusions levels of DHA had an alleviating effect, while ARA did not. Particularly larval groups reared for 16 days on diets enriched with OO and OA had mortality rates approaching 100% within two hours. Interestingly, this tendency, although not as pronounced, was also apparent in juvenile fish after 120 days of rearing on a common diet. Standard metabolic rate in larvae on an OO enriched diet was significantly elevated, but otherwise no groups had significant changes to their respiratory physiology. In addition to increased stress challenge sensitivity, early feeding with OA had long term impact on pike perch neural development indicated by a smaller brain size in juvenile fish.

In conclusion, lack of DHA in the diet of pikeperch larvae suggests that this long chain polyunsaturated fatty acid is involved in processes that increase stress tolerance and that lack of dietary DHA in early larval stage caused increased stress sensitivity and long-term impaired neural development, while it does not appear to affect metabolic rate at rest.
The effect of protein and lipid source in organic feed for (organic) rainbow trout on sensory quality

General information
State: Published
Organisations: National Food Institute, Division of Industrial Food Research, National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Green-Petersen, D., Hyldig, G., Jacobsen, C., Baron, C. P., Jokumsen, A., Lund, I., Nielsen, H. H.
Number of pages: 1
Publication date: 2012
Peer-reviewed: No
Event: Poster session presented at EuroSense 2012 Fifth European Conference on Sensory and Consumer research, Berne, Switzerland.
Electronic versions:
The effect of protein and lipid source in organic feed for (organic) rainbow trout on sensory quality.pdf
Source: dtu
Source-ID: u::5996
Research output: Research › Poster – Annual report year: 2012

Is batch variability in hatching time related to size heterogeneity and cannibalism in pikeperch (Sander lucioperca)?

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Steenfeldt, S. J., Lund, I., Höglund, E.
Pages: 727-732
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Aquaculture Research
Volume: 42
Issue number: 5
ISSN (Print): 1355-557X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 1.47 SJR 0.586 SNIP 0.981
Web of Science (2017): Impact factor 1.475
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.23 SJR 0.556 SNIP 0.917
Web of Science (2016): Impact factor 1.461
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.37 SJR 0.789 SNIP 1.074
Web of Science (2015): Impact factor 1.606
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.23 SJR 0.669 SNIP 0.918
Web of Science (2014): Impact factor 1.376
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 1.43 SJR 0.827 SNIP 0.985
Web of Science (2013): Impact factor 1.32
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.29 SJR 0.78 SNIP 0.96
Web of Science (2012): Impact factor 1.422
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 1.37 SJR 0.733 SNIP 0.976
Web of Science (2011): Impact factor 1.203
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.653 SNIP 0.937
Web of Science (2010): Impact factor 1.186
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.648 SNIP 0.909
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.649 SNIP 0.787
Scopus rating (2007): SJR 0.668 SNIP 0.899
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.656 SNIP 0.992
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.544 SNIP 0.802
Scopus rating (2004): SJR 0.634 SNIP 0.898
Scopus rating (2003): SJR 0.717 SNIP 0.99
Scopus rating (2002): SJR 0.614 SNIP 0.786
Scopus rating (2001): SJR 0.568 SNIP 0.753
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.528 SNIP 0.634
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 0.543 SNIP 0.686
Original language: English
DOI:
10.1111/j.1365-2109.2010.02681.x
Source: orbit
Source-ID: 266010
Replacement of fish meal with a matrix of organic plant proteins in organic trout (Oncorhynchus mykiss) feed, and the effects on nutrient utilization and fish performance

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Lund, I., Dalsgaard, A. J. T., Rasmussen, H. T., Holm, J., Jokumsen, A.
Pages: 259-266
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Aquaculture
Volume: 321
Issue number: 3-4
ISSN (Print): 0044-8486
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.05 SJR 1.152 SNIP 1.58
Web of Science (2017): Impact factor 2.71
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.75 SJR 1.122 SNIP 1.51
Web of Science (2016): Impact factor 2.57
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.12 SJR 1.107 SNIP 1.256
Web of Science (2015): Impact factor 1.893
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 2.16 SJR 1.01 SNIP 1.33
Web of Science (2014): Impact factor 1.878
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.18 SJR 1.151 SNIP 1.293
Web of Science (2013): Impact factor 1.828
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.32 SJR 1.222 SNIP 1.485
Web of Science (2012): Impact factor 2.009
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.39 SJR 1.281 SNIP 1.536
Web of Science (2011): Impact factor 2.041
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.161 SNIP 1.39
The effect of protein and lipid source in organic feed for (organic) rainbow trout on sensory quality

The aim of this work was to study which effects protein and lipid source in feed for organic rainbow trout (Oncohynchus mykiss) may have on the sensory quality of the final product after up to 14 days of storage in ice. The protein sources used in the experiment were fishmeal and a mixture of vegetable protein. While the lipid sources were fish, linseed, sunflower, rapeseed and grape seed oil. After slaughtering all fish were frozen (-40°C) until the sensory experiment was performed, for which the trout were thawed and stored for 3, 5, 7 and 14 days in ice respectively. The sensory experiment included objective sensory profiling, of samples which were heat treated in a convention oven at 100°C until the core temperature was 70°C. The sensory panel consisted of 11 assessors which all were tested and trained. The sensory analysis included descriptors related to the odour, appearance, flavour and texture. After 3 days of storage in ice an impact of lipid source is seen. Inclusion of linseed oil resulted in a sensory profile comparable to the use of fish oil in the feed. While some of the other vegetable oils, especially grape seed oil results in a sensory profile rather different from the trout that had fish oil. However, this difference observed after 3 days of storage did not appear after a longer storage time, and consequently no differences in the sensory characteristics is observed after the 5 days of storage in ice. Nevertheless after 7 days in ice some differences are appearing again. Here the trout which have had rapeseed and grape seed oil in the feed has a more neutral flavour and odour compared to the other ones. After 14 days of storage the protein source had an effect, and the trout which received fishmeal in the feed were more tainted. Therefore, it is seen that the shelf-life is increased by feeding the fish with vegetable protein compared to fish meal. The conclusion of the experiment therefore was that both dietary vegetable protein and lipid sources can influence on sensory characteristics of trout stored in ice.

General information
State: Published
Organisations: Division of Industrial Food Research, National Food Institute, Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Hyldig, G., Green-Petersen, D., Jacobsen, C., Baron, C. P., Jokumsen, A., Lund, I., Nielsen, H. H.
Number of pages: 119
Publication date: 2011
The effects of dietary long-chain essential fatty acids on growth and stress tolerance in pikeperch larvae (Sander lucioperca L.)

The nutritional requirements of pikeperch larvae have been sparsely examined. Dietary polyunsaturated fatty acids, arachidonic acid (ARA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) may affect growth and physiological stress response in marine fish larvae, but these mechanisms have not received as much attention in freshwater fish. Pikeperch larvae were reared on Artemia from day 3 until 21 days posthatch. Artemia were enriched with six formulated emulsions, with inclusion of either fish oil, pure olive oil (POO) or olive oil supplemented with various combinations of ARA, EPA and DHA. Larval tissue FA was significantly related to the content in the diets, but larval growth was similar for all treatments. When exposed to stress by confinement in small tanks with culture tank water or saline water (15 g L\(^{-1}\)), mortality in larvae treated with POO was significantly higher than in the remaining treatments while tissue cortisol contents in these fish seemed lower. The findings of a lower stress response in larvae fed POO may be related to the lower tissue content in these larvae of essential fatty acids especially DHA but also EPA and ARA.

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Lund, I., Steenfeldt, S. J.
Pages: 191-199
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Aquaculture Nutrition
Volume: 17
Issue number: 2
ISSN (Print): 1365-2095
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2 SJR 0.846 SNIP 1.008
Web of Science (2017): Impact factor 2.078
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.96 SJR 0.946 SNIP 1.442
Web of Science (2016): Impact factor 1.665
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.86 SJR 1.021 SNIP 1.196
Web of Science (2015): Impact factor 1.511
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.8 SJR 1.179 SNIP 1.28
Web of Science (2014): Impact factor 1.395
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.16 SJR 1.232 SNIP 1.195
Web of Science (2013): Impact factor 1.665
European eel and aquaculture

General information
State: Published
Organisations: Institute Management, National Institute of Aquatic Resources, Section for Freshwater Fisheries Ecology, Section for Public Sector Consultancy, Section for Aquaculture, Section for Population Ecology and Genetics
Number of pages: 19
Publication date: 2010

Publication information
Place of publication: Charlottenlund
Publisher: DTU Aqua. Institut for Akvatiske Ressourcer
ISBN (Print): 978-87-7481-127-5
Original language: English
(DTU Aqua-rapport; No. 229-2010).
Electronic versions:
229-2010_European-Eel-and-Aquaculture.pdf
URLs:
Influence of dietary arachidonic acid combined with light intensity and tank colour on pigmentation of common sole (Solea solea L.) larvae

Supplementation of dietary arachidonic acid (ARA) is known to cause hypopigmentation in common sole larvae (Solea solea L.). This study examined a possible link between dietary ARA supplementation - light intensity and tank colour on pigment defects in common sole larvae. Larval tissue ARA and prostaglandin PGE(2) content increased significantly when fed Artemia enriched by a fish oil emulsion supplemented with 24% dietary ARA during premetamorphosis (until 11 days post hatch, dph) as compared to larvae fed on Artemia enriched by a fish oil based emulsion. More than 90% of all larvae in groups treated with the ARA supplemented emulsion during premetamorphosis showed partly or complete dorsal hypopigmentation. There were no significant effects of light intensity or tank background colour in combination with ARA on malpigmentation. Larval hypopigmentation was below 10% in the groups not treated with ARA supplemented diets. In these groups, however, the proportion of hypopigmented larvae increased significantly by a combination of a high visual light intensity (4000 lx) and transparent tanks. A high light intensity of 4000 lx increased growth as compared to low intensity of 100 lx, suggested to be related to a higher feed intake. Early pigment cell (chromatophor) development until 11 dph (i.e. start of metamorphosis) was not significantly related to dietary treatment, but during metamorphosis (from 16 dph) total chromatophore concentration (cells larvae (-1)) was significantly lower for larvae treated with ARA and a possible lack of pigment cell differentiation or degeneration/cytolysis continued for this group during post metamorphosis.

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Lund, I., Steenfeldt, S. J., Hansen, B.
Pages: 159-165
Publication date: 2010
Peer-reviewed: Yes

Publication information
Journal: Aquaculture
Volume: 308
Issue number: 3-4
ISSN (Print): 0044-8486
Ratings:
  BFI (2019): BFI-level 2
  Web of Science (2019): Indexed yes
  BFI (2018): BFI-level 2
  Web of Science (2018): Indexed yes
  BFI (2017): BFI-level 2
  Scopus rating (2017): CiteScore 3.05 SJR 1.152 SNIP 1.58
  Web of Science (2017): Impact factor 2.71
  Web of Science (2017): Indexed yes
  BFI (2016): BFI-level 2
  Scopus rating (2016): CiteScore 2.75 SJR 1.122 SNIP 1.51
  Web of Science (2016): Impact factor 2.57
  Web of Science (2016): Indexed yes
  BFI (2015): BFI-level 2
  Scopus rating (2015): CiteScore 2.12 SJR 1.107 SNIP 1.256
  Web of Science (2015): Impact factor 1.893
  Web of Science (2015): Indexed yes
  BFI (2014): BFI-level 2
  Scopus rating (2014): CiteScore 2.16 SJR 1.01 SNIP 1.33
  Web of Science (2014): Impact factor 1.878
  Web of Science (2014): Indexed yes
  BFI (2013): BFI-level 1
  Scopus rating (2013): CiteScore 2.18 SJR 1.151 SNIP 1.293
  Web of Science (2013): Impact factor 1.828
Organic vegetable proteins and oil in feed for organic rainbow trout (Oncorhynchus mykiss)
The demand for organic trout is increasing, stressing the need for organic, vegetable feed ingredients as replacement for fish meal, as the principles of organic aquaculture encourage the development of feed that do not deplete global fish stocks. In addition, the organic code of practice does not allow addition of artificial amino acids to the feed, and optimization of the amino acid profile of organically based diets must therefore derive from the protein sources alone. The aim of this study was to evaluate the digestibility and growth performance of organic vegetable dietary ingredients as replacement for fish meal and fish oil in feed for organic rainbow trout (Oncorhynchus mykiss). Six iso-energetic and iso-nitrogenous diets were prepared, comprising a fish meal and fish oil based control diet and three diets in which the inclusion of fish meal was gradually reduced from 59 to 35 % and replaced by a matrix of organic horse bean, pea and rape in the proportion of 1:1:0.7. In the last two diets, the inclusion of fish oil was reduced by 50 and 100 %, respectively and replaced by flax seed oil high in omega-3 fatty acids. Digestibility was measured directly using a modified, flow-
through Guelph System consisting of 18 tanks, and feeding each diet in triplicate. Growth performance was measured using a recirculation system consisting of 12 square formed fibre glass tanks. The fish were reared in duplicate for 9 weeks, from an initial individual weight of about 60 g to a final weight of about 200 g. The fish showed good growth performance with a specific growth rate (SGR) of 1.8 % d⁻¹, and a feed conversion ratio (FCR) of 0.75, and there were no significant differences between the groups. Likewise, there were no significant differences in nutrient digestibility between the diets. The results indicate that a matrix of organic horse bean, pea and rape may partially replace fish meal, and flax seed oil may replace fish oil in feed for organic rainbow trout without compromising growth performance and feed utilization.

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Lund, I., Dalsgaard, A. J. T., Jokumsen, A., Larsen, B. K.
Publication date: 2010
Peer-reviewed: No
Event: Poster session presented at 14th International Symposium on Fish Nutrition & Feeding, Qingdao, China.
URLs:
http://www.isfn2010.com
Source: orbit
Source-ID: 263962
Research output: Research › Poster – Annual report year: 2010

Videreudvikling af intensivt opdræt af sandart i Danmark

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Publication date: 2010

Publication information
Place of publication: Charlottenlund
Publisher: DTU Aqua, Institut for Akvatiske Ressourcer
ISBN (Print): 978-87-7481-125-1
Original language: Danish
(DTU Aqua-rapport; No. 228-2010).
Electronic versions:
228-2010_Videreudvikling-af-intensivt-opdraet-af-sandart-i-Danmark.pdf
URLs:
http://www.aqua.dtu.dk/Publikationer/Forskningsrapporter/Forskningsrapporter_siden_2008
Source: orbit
Source-ID: 269205
Research output: Research › Report – Annual report year: 2010

Danish model trout farms – Technology and environmental impact

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Publication date: 2009
Peer-reviewed: No
Source: orbit
Source-ID: 252713
Research output: Research › Conference abstract for conference – Annual report year: 2009

Influence of dietary arachidonic acid combined with light intensity and tank background colour on pigmentation of common sole (Solea solea)

General information
Influence of hatching time on time of first feeding and subsequent growth and cannibalism in pikeperch (Sander lucioperca)

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Steenfeldt, S. J., Lund, I.
Publication date: 2009
Peer-reviewed: No
Event: Poster session presented at 5th Fish and Shellfish Larviculture Symposium, Ghent, Belgium.

Bibliographical note
Published in: Special publication / European Aquaculture Society, no. 38
Source: orbit
Source-ID: 252731
Research output: Research › Poster – Annual report year: 2009

New methods in trout farming to reduce the farm effluents - Case study in Denmark

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources, Section for Aquatic Process and Product Technology
Contributors: Jokumsen, A., Pedersen, P. B., Dalsgaard, A. J. T., Lund, I., Paulsen, H., Rasmussen, R. S., Hyløg, G.
Number of pages: 111
Pages: 58-70
Publication date: 2009

Host publication information
Title of host publication: A handbook for sustainable aquaculture - Integrated approach for a sustainable and healthy aquaculture
Volume: 8
Publisher: SustainAqua Collective Research
Editors: Bardoz, V. L., Oberdieck, A.
URLs:
http://www.haki.hu/tartalom/SUSTAIN0906/SustainAqua%20handbook_EN.pdf
Source: orbit
Source-ID: 252725
Research output: Research - peer-review › Book chapter – Annual report year: 2009

Proteinafgrøder til økologiske regnbueørreder (Oncorhynchus mykiss)

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources, Section for Fish Diseases, Section for Aquatic Protein Biochemistry
Publication date: 2009
Peer-reviewed: No
Event: Poster session presented at Økologi-kongres, Odense, Denmark.
A comparison of fatty acid composition and quality aspects of eggs and larvae from cultured and wild broodstock of common sole (Solea solea L.)

Eggs from a F-1 cultured broodstock of sole were compared with eggs from wild-caught breeders throughout one spawning season, to evaluate if egg quality may be affected by culture-related conditions. Fourteen batches of eggs from cultured broodstock and 17 batches from wild-caught sole were compared with respect to fatty acid (FA) composition, egg size, fertilization rate and hatching rate. Based on a multivariate analysis of the FA profiles, it was possible to discriminate between culture and wild inheritance. Eggs from cultured broodstock had high levels of C20:1(n-9), C18:2(n-6) and C18:3(n-3), whereas eggs from wild fish had high levels of C16:1(n-7), C20:4(n-6) and C20:5(n-3). Differences in FA profiles were most likely related to dietary differences. Fertilization and hatching rates were generally low and lowest in eggs from cultured broodstock, but not related to FA composition. Larval growth of one batch from each group was compared. Larval growth was not correlated to broodstock origin, FA composition or egg or larval size. However, larval survival was significantly lower for larvae from cultured broodstock.

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Lund, I., Steenfeldt, S. J., Suhr, K., Hansen, B.
Pages: 544-555
Publication date: 2008
Peer-reviewed: Yes

Publication information
Journal: Aquaculture Nutrition
Volume: 14
Issue number: 6
ISSN (Print): 1353-5773
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 2 SJR 0.846 SNIP 1.008
Web of Science (2017): Impact factor 2.078
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 1.96 SJR 0.946 SNIP 1.442
Web of Science (2016): Impact factor 1.665
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 1.86 SJR 1.021 SNIP 1.196
Web of Science (2015): Impact factor 1.511
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 1.8 SJR 1.179 SNIP 1.28
Web of Science (2014): Impact factor 1.395
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.16 SJR 1.232 SNIP 1.195
Web of Science (2013): Impact factor 1.665
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 1.9 SJR 1.343 SNIP 1.145
Web of Science (2012): Impact factor 1.688
Essential fatty acids influence metabolic rate and tolerance of hypoxia in Dover sole (Solea solea) larvae and juveniles

Dover sole (Solea solea, Linnaeus 1758) were raised from first feeding on brine shrimp (Artemia sp.) with different contents and compositions of the essential fatty acids (EFA) arachidonic acid (ARA, 20:4n - 6); eicosapentaenoic acid (EPA, 20:5n - 3), and docosahexaenoic acid (DHA, 22:6n - 3), and their metabolic rate and tolerance to hypoxia measured prior to and following metamorphosis and settlement. Four dietary Artemia preparations were compared: (1) un-enriched; (2) enriched with a commercial EFA mixture (Easy DHA SELCO Emulsion); (3) enriched with a marine fish oil combination (VEVODAR and Incromega DHA) to provide a high ratio of ARA to DHA, and (4) enriched with these fish oils to provide a low ratio of ARA to DHA. Sole fed un-enriched Artemia were significantly less tolerant to hypoxia than the other dietary groups. Larvae from this group had significantly higher routine metabolic rate (RMR) in normoxia, and significantly higher O-2 partial pressure (PO2) thresholds in progressive hypoxia for their regulation of RMR (P-crit) and for the onset of agitation, respiratory distress and loss of equilibrium. Metamorphosis was associated with an overall decline in RMR and increase in P-crit, but juveniles fed on un-enriched Artemia still exhibited higher P-crit and agitation thresholds than the other groups. Sole fed un-enriched Artemia had significantly lower contents of EFA in their tissues, both before and after settlement. Thus, enriching live feeds with EFA has significant effects on the respiratory physiology of sole early life stages and improves their in vivo tolerance to hypoxia. We found no evidence, however, for any effect of the ratio of ARA to DHA.
The effects of dietary long chain essential fatty acids on growth and stress tolerance in pike perch larvae (Stizostedion lucioperca L.)

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Steenfeldt, S. J., Lund, I.
Publication date: 2008
Peer-reviewed: No
Event: Poster session presented at Percid Fish Culture, From Research to Production, Namur, Belgium.
Source: orbit
Source-ID: 229165
Research output: Research › Poster – Annual report year: 2008

The influence of dietary concentrations of arachidonic acid and eicosapentaenoic acid at various stages of larval ontogeny on eye migration, pigmentation and prostaglandin content of common sole larvae (Solea solea L.)

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Pedersen, P. B., Lun, I., Steenfeldt, S. J., Overton, J. L., Nunn, M.
Publication date: 2008
Number of pages: 55
Publication information
Place of publication: Hirtshals
Publisher: DTU Aqua. Institut for Akvatiske Ressourcer
ISBN (Print): 87-74-81091-x
Original language: Danish
(DTU Aqua-rapport; No. 200-08).
Electronic versions:
200-08_elektronisk_samlet.pdf
URLs:
http://www.aqua.dtu.dk/Publikationer/Forskningsrapporter/Forskningsrapporter_siden_2008

Bibliographical note
Projekt finansieret af Den Europæiske Unions Fiskerisektorprogram FIUF og Fødevareministeriet
Source: orbit
Source-ID: 231195
Research output: Research › Report – Annual report year: 2008

Opdræt af tunge (Solea solea) - undersøgelse af mulighederne for kommercialisering

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Pedersen, P. B., Lund, I., Steenfeldt, S. J., Overton, J. L., Nunn, M.
Number of pages: 55
Publication date: 2008
Publication information
Place of publication: Hirtshals
Publisher: DTU Aqua. Institut for Akvatiske Ressourcer
ISBN (Print): 87-74-81091-x
Original language: Danish
(DTU Aqua-rapport; No. 200-08).
Electronic versions:
200-08_elektronisk_samlet.pdf
URLs:
http://www.aqua.dtu.dk/Publikationer/Forskningsrapporter/Forskningsrapporter_siden_2008

Bibliographical note
Projekt finansieret af Den Europæiske Unions Fiskerisektorprogram FIUF og Fødevareministeriet
Source: orbit
Source-ID: 231195
Research output: Research › Report – Annual report year: 2008
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.917 SNIP 1.165
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.033 SNIP 1.315
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.021 SNIP 1.695
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.937 SNIP 1.238
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.072 SNIP 1.626
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.151 SNIP 1.909
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.969 SNIP 1.458
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.062 SNIP 1.319
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.981 SNIP 1.114
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.073 SNIP 1.24
Original language: English
DOIs:
10.1016/j.aquaculture.2008.01.004
Source: orbit
Source-ID: 226476
Research output: Research - peer-review › Journal article – Annual report year: 2008

Udvikling af produktionsmetoder til intensivt opdræt af sandartyngel: Projektrapport

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Steenfeldt, S. J., Lund, I.
Number of pages: 35
Publication date: 2008

Publication information
Publisher: DTU Aqua. Institut for Akvatiske Ressourcer
ISBN (Print): 87-74-81089-6
Original language: Danish
(DTU Aqua-rapport; No. 199-08).
Electronic versions:
199_08_elektronisk_samlet.pdf
URLs:
http://www.aqua.dtu.dk/Publikationer/Forskningsrapporter/Forskningsrapporter_siden_2008

Bibliographical note
Finansieret af Den Europæiske Unions Fiskerisektorprogram FIUF og Fødevareministeriet
Source: orbit
Source-ID: 229083
Research output: Research › Report – Annual report year: 2008

Effect of dietary arachidonic acid, eicosapentaenoic acid and docosahexaenoic acid on survival, growth and pigmentation in larvae of common sole (Solea solea L.)
Evidence confirms that polyunsaturated fatty acids (PUFAs), arachidonic acid (ARA), eicosapentaenoic acid (EPA) and docosahexaenoic acid, DHA are involved in growth as well in pigmentation of marine fish larvae. In the present study we examined the performance of common sole larvae reared on Artemia enriched with 10 formulated emulsions, differing in inclusions of ARA, EPA, and DHA. The specific growth rate of the sole larvae until late metamorphosis, 21 days after hatching (dah) was 20 to 27% d(−1). Even though the relative tissue essential fatty acid (EFA) concentrations significantly reflected dietary composition, neither standard growth nor larval survival were significantly related to the absolute
concentrations of ARA, EPA and DHA or their ratios. This suggests low requirements for essential polyunsaturated fatty acids (PUFAs) in common sole. Malpigmentation was significantly related to increased dietary ARA content. However, pigmentation was not affected by inclusion levels of EPA or DHA when ARA was high. This, and no relation between DHA: EPA or ARA: EPA ratios and pigmentation and only a weak relation to ARA: DHA ratio, advocate for that it is the absolute concentration of ARA in larval tissues, that is responsible for malpigmentation rather than the relative concentration to other PUFAs. Within malpigmentation, the trait “albinism” was characterised by an abnormal incomplete eye migration, but this trait is suggested not to be related to dietary ARA. Furthermore, albinism resulted in a lower growth rate, which suggests that visual aberrations affected prey capture. (C) 2007 Elsevier B.V. All rights reserved.
The impact of dietary fatty acids in common sole larval (Solea solea, L.) nutrition

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Lund, I.
Number of pages: 190
Publication date: 2007

Publication information
Publisher: Roskilde University and Danish Institute for Fisheries Research
Original language: English
Electronic versions:
PhD_Lund.pdf
Source: orbit
Source-ID: 226475
Research output: Research › Ph.D. thesis – Annual report year: 2007

Avisprogram for regnbueørred i Danmark

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources, Section for Software and GIS development
Selective breeding provides an approach to increase resistance of rainbow trout (Onchorhynchus mykiss) to the diseases, enteric redmouth disease, rainbow trout fry syndrome, and viral haemorrhagic septicemia

In this study, we reasoned that if we challenged rainbow trout with the causative agents of enteric redmouth disease (ERM), rainbow trout fry syndrome (RTFS), and viral haemorrhagic septicemia (VHS), we would: 1) detect additive genetic variation for resistance to ERM, RTFS, and VHS; and 2) find that resistance of the trout to ERM and RTFS are favourably correlated genetically, while resistance to VHS is unfavourably correlated with resistance to ERM and RTFS.

We tested these premises by challenging 63 full-sib families of rainbow trout (50 sires, 38 dams) with Yersinia ruckeri, Flavobacterium psychrophilum, and VHS virus, the causative agents of ERM, RTFS, and VHS. Resistance to each disease was assessed as both a binary trait (i.e., died/survived) and a longitudinal trait (i.e., time until death following challenge). Additive genetic variation and genetic correlations for resistance to ERM, RTFS, and VHS were estimated by fitting a threshold liability model to resistance assessed as a binary trait. As a longitudinal trait, additive genetic variation and genetic correlations were estimated by fitting a Weibull frailty model to the times until death. Our findings support the first of our premises as we detected additive genetic variation for resistance to ERM, RTFS, and VHS. The heritability for resistance to ERM, RTFS, and VHS ranged between 0.42 and 0.57 on the underlying liability scale when resistance was assessed as a binary trait. As a longitudinal trait, the heritabilities ranged between 0.07 and 0.21 for time until death on the logarithmic-time scale. We were, however, unable to support our second premise as we found that resistance to each of the diseases tended to be weakly correlated genetically. The genetic correlations between the resistances ranged between -0.11 and 0.15 when resistance was assessed as a binary trait, and between -0.23 and 0.16 when resistance was assessed as a longitudinal trait. These findings are encouraging for commercial trout production. The additive genetic variation detected for resistance demonstrates that selectively breeding trout for resistance to ERM, RTFS, and VHS will be successful, providing a complementary approach to control these diseases. The weak genetic correlations suggest that it should be relatively easy to improve resistance to each of the diseases simultaneously.
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.917 SNIP 1.165
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.033 SNIP 1.315
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.021 SNIP 1.695
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.937 SNIP 1.238
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.072 SNIP 1.626
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.151 SNIP 1.909
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.969 SNIP 1.458
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.062 SNIP 1.319
Web of Science (2001): Indexed yes
Scopus rating (2000): SJR 0.981 SNIP 1.114
Web of Science (2000): Indexed yes
Scopus rating (1999): SJR 1.073 SNIP 1.24
Original language: English
Keywords: disease resistance, genetic variation, genetic correlation, Onchorhynchus mykiss, rainbow trout
DOIs:
10.1016/j.aquaculture.2004.12.022
Source: orbit
Source-ID: 225730
Research output: Research - peer-review › Journal article – Annual report year: 2005

Avlsarbejde kan øge sygdomsresistens hos regnbueørred

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Pages: 126-127
Publication date: 2003
Peer-reviewed: No

Publication information
Journal: Ferskvandsfiskeribladet
Volume: 101
Issue number: 6
ISSN (Print): 0015-0223
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
Source-ID: 225728
Research output: Research › Journal article – Annual report year: 2003

Ørreder med 6% højere tilvækst på avlsstationen

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A., Lund, I., Berg, P., Henryon, M.
Pages: 100-102
Genetic variation for growth rate, feed conversion efficiency, and disease resistance exists within a farmed population of rainbow trout

The objective of this study was to test that additive genetic (co)variation for survival, growth rate, feed conversion efficiency, and resistance to viral haemorrhagic septicaemia (VHS) exists within a farmed population of rainbow trout. Thirty sires and 30 dams were mated by a partly factorial mating design. Each sire was mated to two dams, and each dam was mated to two sires, producing 50 viable full-sib families (29 sires, 25 dams). The fish from these families were reared for a 215-day growout period, and were assessed for survival between days 52 and 215, growth rate (i.e., body weight on days 52, 76, 96, 123, 157, 185, and 215, and body length on days 52 and 215); feed conversion efficiency between days 52-215, 52-76, 77-96, 97-123, 124-157, 158-185, and 186-215, and VHS resistance. REML estimates of additive genetic variation for the body weights, body lengths, and feed conversion efficiencies were obtained by fitting univariate linear (reduced) animal models. Additive genetic variation for VHS resistance was estimated by fitting a Weibull, sire-dam frailty model to time until death of fish challenged with VHS. Genetic correlations were estimated among the body weights, body length, and feed conversion efficiencies that expressed additive genetic variation, while genetic correlations between VHS resistance and the body weights, body length, and feed conversion efficiencies were approximated as product-moment correlations among predicted breeding values of the sires and dams. Additive genetic variation was found to be very low for survival, body weight on days 52 and 76, body length on day 52, and feed conversion efficiency between days 185 and 215. However, additive genetic variation was detected for body weight on days 96, 123, 157, 185, and 215 (coefficient of additive genetic variation (CV)=8.4-28.4%, heritability (h2)=0.35 for body weight on day 215), body length on day 215 (CV=6.9%, h2=0.53), feed conversion efficiency between days 52-215, 52-76, 77-96, 97-123, 124-157, and 158-185 (CV=4.0-13.9%), and VHS resistance (additive genetic variance for log-frailty=0.24, h2 on the logarithmic-time scale=0.13). Genetic correlations among the body weights, body length, and feed conversion efficiencies that expressed additive genetic variation were generally favourable and moderate-to-very strong (0.55-0.99), though there were unfavourable correlations (-0.01 to -0.33) between the predicted breeding values for VHS resistance and the predicted breeding values for the body weights, body length, and feed conversion efficiencies. These results demonstrate that additive genetic (co)variation for growth rate, feed conversion efficiency, and VHS resistance does exist within the farmed population of rainbow trout, and indicates that selective breeding for these traits can be successful.
Web of Science (2017): Impact factor 2.71
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 2.75 SJR 1.122 SNIP 1.51
Web of Science (2016): Impact factor 2.57
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): CiteScore 2.12 SJR 1.107 SNIP 1.256
Web of Science (2015): Impact factor 1.893
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): CiteScore 2.16 SJR 1.01 SNIP 1.33
Web of Science (2014): Impact factor 1.878
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.18 SJR 1.151 SNIP 1.293
Web of Science (2013): Impact factor 1.828
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): CiteScore 2.32 SJR 1.222 SNIP 1.485
Web of Science (2012): Impact factor 2.009
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 2.39 SJR 1.281 SNIP 1.536
Web of Science (2011): Impact factor 2.041
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.161 SNIP 1.39
Web of Science (2010): Impact factor 2.044
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.949 SNIP 1.27
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 0.917 SNIP 1.165
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.033 SNIP 1.315
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.021 SNIP 1.695
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.937 SNIP 1.238
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.072 SNIP 1.626
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.151 SNIP 1.909
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.969 SNIP 1.458
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.062 SNIP 1.319
Web of Science (2001): Indexed yes
Optimal ratio between digestible protein and digestible energy in feed for European sea bass (Dicentrarchus labrax)

General information
State: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Pedersen, P. B., Lund, I., Holm, J., Boisen, S., Hjermitslev, N., Autin, M., Jokumsen, A.
Publication date: 2000

Host publication information
Title of host publication: Book of Abstracts
Source: orbit
Source-ID: 260318
Research output: Research › Conference abstract in proceedings – Annual report year: 2000

Projects:

The role of lipid source, stress and exercise on lipid uptake and metabolism in salmonids
Pfalzgraff, T., PhD Student, National Institute of Aquatic Resources
Skov, P. V., Main Supervisor, National Institute of Aquatic Resources
Lund, I., Supervisor, National Institute of Aquatic Resources
Olsen, R. E., Supervisor
01/12/2018 → 30/11/2021
Project: PhD

Uptake, assimilation and utilization of nutrients by European lobster (Homarus gammarus) larvae and post-larvae
Goncalves, R., PhD Student, National Institute of Aquatic Resources
Lund, I., Main Supervisor, National Institute of Aquatic Resources
Gesto, M., Supervisor, National Institute of Aquatic Resources
01/09/2018 → 31/08/2021
Project: PhD

Restocking of lobster at stone reefs in the sea at North West Jutland (39555)
The overall idea is to capture mature female lobsters, hatch the eggs and grow larvae to juveniles for restocking in coastal waters around Hirtshals to Løkken. Partners are NSC, Hirtshals/Løkken Fisheries Associations, fishermen and restaurants. DTU Aqua is involved in optimizing knowledge about nutritional requirements of lobster larvae and juveniles to ensure a high survival and growth. The project is coordinated by the North Sea Centre and is funded by "ENV"-Fonden and FLAG (Local Actions Groups within Fisheries).
Lund, I., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Goncalves, R., PhD Student, National Institute of Aquatic Resources
01/07/2018 → 30/06/2020
Keywords: Research area: Aquaculture
Collaborators: Villa Vest (restaurant), North Sea Centre, Hirtshals Fisheries Association, Løkken Fisheries Association, Lilleheden (restaurant)
Project: Research

Sustainable fish feed development in Ghana (Susfeed) (39158)
The overall objective of the project is to enable Kwame Nkrumah University of Science and Technology (KNUST) to serve as a centre of excellence for sustainable development of aquaculture and to take a scientific approach to the continued improvement of fish feed formulation using local raw materials, through controlled experiments and in collaboration with the private sector in Ghana. The immediate objectives of the project are to formulate cost effective tilapia feeds assessed for digestibility, nutritional value and amino acid profiles based on local feed ingredients; to facilitate the growth of the tilapia aquaculture industry in Ghana through promoting the production and application of locally developed high quality feeds; to achieve a zero change in nutrient discharge to the environment through the application of balanced feed and efficient feeding strategies; and to improve the methodological and scientific capacity at KNUST to provide a platform of excellence in research and teaching. The project is funded by DANIDA, Ministry of Foreign Affairs of Denmark.
Skov, P. V., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
**Amino acid uptake patterns in fish fed plant based protein and the effects on protein utilization.**

Rolland, M., PhD Student, National Institute of Aquatic Resources
Skov, P. V., Main Supervisor, National Institute of Aquatic Resources
Dalsgaard, A. J. T., Supervisor, National Institute of Aquatic Resources
Holm, J., Supervisor
Lund, I., Examiner, National Institute of Aquatic Resources
Espe, M., Examiner
Skiba-Cassey, S., Examiner

**Award relations:** Amino acid uptake patterns in fish fed plant based protein and the effects on protein utilization.

**Project:** PhD

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**Optimized sludge hydrolysis and improved nitrogen removal through denitrification**

Letelier-Gordo, C. O., PhD Student, National Institute of Aquatic Resources
Pedersen, P. B., Main Supervisor, National Institute of Aquatic Resources
Dalsgaard, A. J. T., Supervisor, National Institute of Aquatic Resources
Lund, I., Examiner, National Institute of Aquatic Resources
van Rijn, J., Examiner
van Rijn, J., Examiner
Mizyoyan, N., Examiner

**Award relations:** Optimized sludge hydrolysis and improved nitrogen removal through denitrification

**Project:** PhD

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**Eel hatchery technology for a sustainable aquaculture (EEL-HATCH) (39181)**

Hatchery and rearing technology for commercial production of glass eels is fundamental to sustainable and profitable eel aquaculture. The vision is to enhance existing technology to rear European eel larvae to the glass eel stage, thereby closing the lifecycle in captivity. Pioneering research of the consortium has raised eel breeding from a state of reproductive failure to stable production of viable larvae. Objectives include: Design "state of the art" hatchery facilities, optimize broodstock feeds, enhance assisted reproductive technology, and develop larval culture systems and diets. The main success criterion is achievement of large scale culture of larvae throughout the larval stage, leading to glass eel production. The establishment of sustainable aquaculture of this endangered species, presently relying on captive glass eel will rebuild the highly profitable market for eel aquaculture and suppliers as well as assist in conservation and stock management plans. Results obtained during the half of the project period include the design and establishment of a dedicated research facility in relation to DTU Aqua in Hirtshals, involving several partners. The facility applies recirculation aquaculture systems with emphasis on matured water technology and microbial control. Scientific highlights include successful production of recombinant European eel gonadotropic hormones; enhanced reproduction, fertilization and incubation procedures; and optimized larval culture conditions, including e.g. temperature, salinity, and light regime. Larval diets have been developed and tested in first feeding and behavioral experiments, leading to the first published work on larval feeding for this species. Experiments on improved diets and optimized rearing tanks for larval growth are ongoing. This project is coordinated by DTU Aqua. The project is funded by Innovation Fund Denmark.

**Keywords:** Research areas: Fish Biology & Aquaculture & Coastal Ecology

**Collaborators:** BioMar A/S, STMI, Bioneer A/S, Billund Aquaculture Service Aps, North Sea Science Park, Danish Aquaculture Association

**Project Coordinator:** DTU Aqua

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Lund, I., Project Participant, National Institute of Aquatic Resources
Larsen, B. K., Project Participant, National Institute of Aquatic Resources

01/04/2014 → 31/03/2017

**Keywords:** Research area: Aquaculture

**Collaborators:** Kwame Nkrumah University of Science and Technology

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**Project:** Research
**Landbased aquaculture of European lobster (39156)**

The aim of the project is to solve remaining biological and technical challenges concerning commercial farming of European lobster. These include optimizing reproduction and broodstock production, improving larval survival and examining nutritional requirements and metabolism in the first life stages. Furthermore, the technical system set-up will be improved. The work during the first two years have been focusing on survival and growth tests, comparison of diets, respiration tests and novel cage design for European Lobster farming. Furthermore, active collaboration and exchange of knowledge have taken part in the established European Lobster Centre of Excellence (ELCE) group that now includes partners from seven countries (Norway, Denmark, Iceland, Sweden, United Kingdom, Italy and Spain). The project is coordinated by Svinna-verkfrædi ehf, Iceland. The project is funded by Nordforsk, Nordic Council of Ministers.

Lund, I., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
01/03/2014 → 28/02/2017

**Development of filtering technologies for microalgae and sustainable high quality feed for fry (FIMAFY) (39115)**

There is an urgent need for alternative resources to fishmeal and fish oil for the production of fish feed to the aquaculture industry. The resource problem is due to a combination of the rapid growth of the aquaculture, and the fact that catches of fish for the feed industry is stagnating. The idea to use microalgae as fish feed originated from an on-going EU-project, which aims at demonstrating that algae can be grown on process water from the industry. The partners in the project will develop, test and demonstrate new technologies for harvesting and refining microalgae. The project will develop a technology to open the cell walls of the microalgae in order to make it possible to extract micro- and macronutrients for use as an alternative resource to fish oil and fishmeal in the production of fish feed for the aquaculture industry. The project is coordinated by the National Food Institute, Technical University of Denmark. The project is funded by the Danish Ministry of Food, Agriculture and Fisheries through the Green Development and Demonstration Program (GUDP).

Lund, I., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Höglund, E., Project Participant, National Institute of Aquatic Resources
01/10/2013 → 31/03/2017

**Enhancing the European aquaculture production by removing production bottlenecks of emerging species, producing new products and accessing new markets (DIVERSIFY) (39132)**

Following the objectives of this Call, DIVERSIFY identified a number of new/emerging, large and/or fast growing finfish species, which are believed to be excellent candidates for the expansion of the aquaculture industry of Europe. The emphasis is on the Mediterranean or warm-water cage culture industry, but also addressed is pond/extensive culture, fresh water recirculation systems and cold-water species. These new/emerging species are marketed at a large size and can be processed easily into a range of products to provide the consumer with a greater diversity of fish species and new processed products. In collaboration with a number of SMEs, DIVERSIFY will build on recent/current national initiatives for species diversification in aquaculture, in order to overcome the documented bottlenecks in the aquaculture production of these selected species. DIVERSIFY will provide knowledge where needed to solve bottlenecks in juvenile reproduction, grow-out, nutrition and feeding husbandry, new product development and marketing. The programme will also provide tools for genetic improvement and disease control. This will provide improved efficiency in production and reduced costs, and identify markets for the new products. The expertise in the consortium and lessons learned, could provide in a 5 year period what took the Atlantic salmon industry 20 years of development. DIVERSIFY focuses on meagre (Argyrosomus regius) and greater amberjack (Seriola dumerili) for marine warm-water cage culture, wreckfish (Polyprion americanus) for warm- and cool-water marine cage culture, Atlantic halibut (Hippoglossus hippoglossus) for marine cold-water culture, grey mullet (Mugil cephalus) for euryhaline herbivore for warm-water pond, extensive and integrated culture, and pikeperch (Sander lucioperca) for freshwater intensive culture using Recirculation Aquaculture Systems (RAS). The project is coordinated by the Hellenic Center for Marine Research. 31 research institutions etc. are involved in the project. The project is funded by EU, Framework Programme 7.

Lund, I., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
Skov, P. V., Project Participant, National Institute of Aquatic Resources
Gesto, M., Project Participant, National Institute of Aquatic Resources
01/01/2014 → 01/01/2018

**Pre-feasibility study regarding establishment of hatchery facility for production of juvenile lobsters (Homarus Gammarus) (39035)**
Pre-feasibility study to obtain “state of the art” knowledge and to determine the biological as well as physical requirements and economic costs for establishing a lobster hatchery at the North Sea Research Centre for restocking purposes and for public communication. The project was coordinated by the North Sea Science Park. The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

Lund, I., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Støttrup, J. G., Project Participant, National Institute of Aquatic Resources
01/12/2012 → 01/04/2013
Keywords: Research areas: Aquaculture & Coastal Ecology
Collaborators: Danish Shellfish Centre, North Sea Science Park
Project: Research

Better use of nutrition resources for sustaining aquaculture production in Central Vietnam under climate change condition (SANSIV) (38975)
The main objective of the project is to contribute to the sustainable development of coastal aquaculture in Central Vietnam under climate change condition through better use of available nutrition resources. ARSINC (Aquaculture Research Sub-Institute for North Central (ARSINC), under Research Institute for Aquaculture) No.1(RIA1) in Vietnam is the applicant and main responsible while DTU Aqua is the Danish partner. The immediate objectives of this project are: - Better use of nutrition resources by developing cost-effective formulated feeds for permit (Trachinotus falcatus) and by application of non-feed based and improved integrated aquaculture models as adaptive practices in coping with the impacts of climate change in Central Vietnam. - Propose and disseminate adapted aquaculture options to farmers, authorities and other stakeholders in response to climate change conditions. The project management and coordination have so far been in good status. Overall the project made appropriate progress toward achievement of the project’s objectives. Reports on analysis of aquaculture system in Central region including Coastal farmer’s livelihood and vulnerability to climate change were finalized. The reviews on known environmental effects of traditional diets for fish farming are on their final stage. Workshop on adaptive aquaculture techniques and models in response to climate change condition and proposed recommend policy was organized. These are served for proposing both adaptive aquaculture techniques/models and policies for local authorities. Through training course and study tour adaptive aquaculture techniques/models have been introduced to local farmers and extension workers. Regarding to development of cost-effective grow-out pellet feed for the selected commercial carnivorous fish species - pompano (Trachinotus falcatus) as case study to replace trash fish in response to global limitation of fish meal and fish oil, all original planned experiments have completed. Additional experiments required for PhD student’s study will be carried out and finished within 2016. Experiments/trials on farming techniques for non-feed based species (hard shell clam Meretrix lyrata, macro alage Kappaphycus alvarezii) and integrated multi-trophic (shrimp and seaweed) have completed. There have been 5 published articles, of which one article was published in an international peer review journal as the result of joint contribution between Vietnamese and Danish scientists. All 3 MSC students from Aquaculture Research Sub-Institute for North Central (ARSINC-responsible institute) have finished their education through participation in project experiments by the end of 2015. These MSc students will contribute to the building of research capacity and sustainability for ARSINC. Additionally, one MSc student from Department of Science and Technology, Nghe An Province, was also educated through participation in project experiments. This project was coordinated by Aquaculture Research Sub-Institute for North Central, Research Institute for Aquaculture, Vietnam. The project was funded by EU, Framework Programme 7.
Lund, I., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Steenfeldt, S. J., Project Participant, National Institute of Aquatic Resources
Pedersen, P. B., Project Participant, National Institute of Aquatic Resources
01/10/2012 → 01/10/2015
Keywords: Research area: Aquaculture
Collaborators: Aquaculture Research Sub-Institute for North Central, Aalborg University
Project: Research

Activities:

The effect of dietary fatty acid content on rainbow trout fry robustness towards Flavobacterium psychrophilum
Period: 4 Sep 2017
Nikolaj Reducha Andersen (Guest lecturer)
Ivar Lund (Guest lecturer)
Alfred Jokumsen (Guest lecturer)
Lone Madsen (Guest lecturer)
National Veterinary Institute
Fish Diseases
National Institute of Aquatic Resources
Section for Aquaculture
Degree of recognition: International

Related event

18th International Conference on Diseases of Fish and Shellfish: 18th International Conference on Diseases of Fish and Shellfish
04/09/2017 → 08/09/2017
Belfast, United Kingdom
Activity: Talks and presentations › Conference presentations