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Organisations

Senior Adviser, National Institute of Aquatic Resources
25/01/2007 → present
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25/02/2012 → present
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Research outputs:

Aquaculture production systems and environmental interactions

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources, University of Haifa, COISPA, Stazione Sperimentale per lo Studio delle Risorse del Mare
Contributors: Angel, D., Jokumsen, A., Lembo, G.
Pages: 103-118
Publication date: 2019

Host publication information
Title of host publication: Organic Aquaculture
Publisher: Springer
Editors: Lembo, G., Mente, E.
ISBN (Print): 978-3-030-05602-5
DOIs:
doi.org/10.1007/978-3-030-05603-2_6
Research output: Chapter in Book/Report/Conference proceeding → Book chapter – Annual report year: 2019 → Research → peer-review

Boldness in early emerging rainbow trout: A metabolic cost with no return?

General information
Publication status: Accepted/In press
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Corresponding author: Skov, P. V.
Contributors: Skov, P. V., de Jesus Gregersen, J., Gesto, M., Jokumsen, A.
Publication date: 2019
Peer-reviewed: Yes

Publication information
Journal: Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology
ISSN (Print): 1095-6433
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
Original language: English
DOIs:
10.1016/j.cbpa.2019.01.016
Research output: Contribution to journal → Journal article – Annual report year: 2019 → Research → peer-review

Nordic Centre of Excellence Network in Fishmeal and Fish oil
The main objective of this work was to summarise current knowledge on fishmeal and fish oil as well as identify the research needs and create a roadmap for future industry-driven research. The main conclusion was that the quality of raw material, fishmeal and - oil are not yet well defined. The real focus by the industry has mainly been limited to nutrients, such as proteins and fats and other components that makeup fishmeal. There has been less focus on the health benefits
of dietary contents of fishmeal and –oil and the relationship between processing methods and the nutritional and technical properties of fishmeal. In addition, to proactively strengthen the market position and competitiveness, it is crucial for the industry to achieve a common understanding of the needs of their customers in line with a clear profile of the benefits of their products. A communication strategy as well as a research strategy is needed. Finally, the identity of the industry needs to be clear and transparent to promote a story about the industry to provide a clear and positive image of the industry to be communicated to the society. This means, that a communication strategy as well as a research strategy must be established, as there is a lack of communication along the value chain from the industry to the consumers. There is still a lack of understanding by the consumers of why fishmeal is produced, the reasons must be communicated in such a way that it reaches the average consumer.

The industry members are interested in moving forward to sustain the future growth of the industry. Fishmeal and fish oil production has been prosperous for a very long time, but to
Emergence time was not correlated with any differences in standard or maximum metabolic rates, but was however, correlated with higher routine metabolic rates, as demonstrated by significantly bigger weight losses during fasting in the early emerging group. Growth rates and feed conversion efficiencies were not significantly different when fish were co-habitated under a restrictive feeding regime, suggesting that early emerging fish are not able to monopolise food resources. The intermediate emerging group, which makes up the bulk of a population and is often ignored, appears to possess the best growth performance traits, possibly because they do not expend excessive energy on dominance behaviour such as the early emerging group, while they are also not overly timid or stress prone such as the late emerging group.

**General information**
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Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Corresponding author: Skov, P. V.
Contributors: Skov, P. V., de Jesus Gregersen, K. J., Gesto, M., Jokumsen, A.
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**Publication information**
Journal: Comparative Biochemistry and Physiology - Part A: Molecular & Integrative Physiology
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ISSN (Print): 1095-6433
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
Original language: English
DOI:
10.1016/j.cbpa.2019.01.016
Research output: Contribution to journal › Journal article – Annual report year: 2019 › Research › peer-review

Assessing stakeholder’s experience and sensitivity on key issues for the economic growth of organic aquaculture production
Participatory management is widely recognised as a working method of paramount importance, based on the principles of knowledge sharing, accountability and legitimacy. Hence, it is broadly considered suitable for addressing issues related to the sustainable development of the seafood industry, and specifically, of the aquaculture system. A survey focused on the current EU regulatory framework was carried out to elicit stakeholders’ preferences, knowledge and experience on key issues for the development of organic aquaculture, supported by science-based regulations. The survey was completed by 65 stakeholders belonging to several categories, and it was supported by the implementation of the Analytic Hierarchy Process method. Stakeholders’ preferences were elicited on organic production methods and control systems, the quality of the environment and organic products, fish health and welfare. The views expressed by the participants revealed both competence and awareness, despite the complexity of the subject. Several ideas and useful suggestions emerged regarding unresolved technical issues. In addition, the need for a targeted communication strategy on the quality of organic aquaculture products and the necessity of fostering European/national programs to support the production and marketing of organic aquaculture products were highlighted.

**General information**
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, COISPA, Stazione Sperimentale per lo Studio delle Risorse del Mare
Corresponding author: Lembo, G.
Contributors: Lembo, G., Jokumsen, A., Spedicato, M. T., Facchini, M. T., Bitetto, I.
Pages: 84-93
Publication date: 2018
Peer-reviewed: Yes

**Publication information**
Journal: Marine Policy
Volume: 87
ISSN (Print): 0308-597X
Ratings:
BFI (2018): BFI-level 2
Scopus rating (2018): CiteScore 3.08 SJR 1.242 SNIP 1.316
Web of Science (2018): Impact factor 2.865
Web of Science (2018): Indexed yes
Confirmation that pulse and continuous peracetic acid administration does not disrupt the acute stress response in rainbow trout

Peracetic acid (PAA) is considered an eco-friendly alternative to other antimicrobial agents of common use in aquaculture. The literature suggests that fish can habituate to PAA exposure based on a reduction of the fish corticosteroid response to PAA administration after repeated exposures. If that is true, PAA would also be a good option from the point of view of fish physiology. However, stronger evidence is needed to confirm that the use of PAA is welfare-friendly to fish. Besides habituation, other hypothetical factors such as desensitization, physiological exhaustion or PAA-mediated endocrine disruption could potentially explain the reduction in the corticosteroid response after repeated/prolonged PAA exposure. In this study, rainbow trout that had been exposed to PAA for several weeks were challenged with a secondary chasing stressor: fish were pursued with a dipnet for 1 min and their acute response was evaluated by measuring plasma cortisol, plasma glucose, plasma lactate and brain serotonergic activity. All fish were equally able to mount a normal physiological stress response to the secondary stressor independent of previous exposure to PAA. This suggests that the decrease in the cortisol response after repeated exposure to PAA, as seen in previous studies, is a true habituation to PAA administration, which supports the use of PAA as a welfare-friendly antimicrobial agent in aquaculture.

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, Leibniz-Institute of Freshwater Ecology and Inland Fisheries, U.S. Arid Land Agricultural Research Center
Corresponding author: Gesto, M.
Pages: 190-194
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Aquaculture
Volume: 492
ISSN (Print): 0044-8486
Ratings:
BFI (2018): BFI-level 2
Scopus rating (2018): CiteScore 3.42 SJR 1.154 SNIP 1.553
Web of Science (2018): Impact factor 3.022
Web of Science (2018): Indexed yes
Original language: English
Electronic versions:
Postprint. Embargo ended: 11/04/2019
DOIs:
Research output: Contribution to journal › Journal article – Annual report year: 2018 › Research › peer-review

Interplay between daily rhythmic serum-mediated bacterial killing activity and immune defence factors in rainbow trout (Oncorhynchus mykiss)
Circadian rhythm is emerging as an important regulator of immune functions. However, there is a paucity of information on the influence of this biological phenomenon in the antimicrobial factors in teleost fish. This study investigated the dynamics and interplay of serum-mediated bacterial killing activity and immune defence factors throughout the light:dark (LD) cycle in rainbow trout (Oncorhynchus mykiss). The juvenile fish came from two different emergence time fractions (i.e., late and early) that were believed to exhibit behavioural and physiological differences. Serum collected during the day from fish (mean ± SD: 39.8 ± 6.3 g) reared under 14L:10D photoperiod demonstrated bactericidal activity against Flavobacterium psychrophilum, Yersinia ruckeri and Aeromonas salmonicida subsp. salmonicida of varying magnitude, but no significant differences between the emergence fractions were observed. A day-night comparison in the same batch of fish revealed time-of-day dependence in the bactericidal activity against F. psychrophilum and Y. ruckeri amongst emergence fractions. A group of fish (63.3 ± 4.7 g) from each fraction was entrained to 12L:12D photoperiod for 21 days to investigate whether serum bactericidal activity exhibit daily rhythm. Serum-mediated bacterial killing activity against F. psychrophilum and Y. ruckeri displayed significant daily rhythm in both emergence fractions, where the peak of activity was identified during the light phase. Moreover, several serum defence factors manifested variations during the LD cycle, where anti-protease
(ANTI) and myeloperoxidase (MPO) activities exhibited significant daily oscillation. However, there were no remarkable differences in the daily changes of serum factors amongst emergence fractions. Acrophase analysis revealed that the peaks of activity of alkaline phosphatase (only in late fraction), ANTI, lysozyme (only in early fraction) and MPO were identified during the light phase and corresponded with the period when serum-mediated bacterial killing activity was also at its highest. The daily dynamics of bactericidal activity and immune defence factors displayed positive correlation, particularly between MPO and, the two pathogens (i.e., F. psychrophilum and Y. ruckeri). Taken together, the study revealed that serum-mediated bacterial killing activity and immune defence factors remarkably varied during the LD cycle in rainbow trout. In addition, the two emergence fractions displayed nearly comparable immunological profiles.

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, National Veterinary Institute, Fish Diseases
Corresponding author: Lazado, C. C.
Contributors: Lazado, C. C., Gesto, M., Madsen, L., Jokumsen, A.
Pages: 418-425
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: Fish and Shellfish Immunology
Volume: 72
ISSN (Print): 1050-4648
Ratings:
BFI (2018): BFI-level 1
Scopus rating (2018): CiteScore 3.62 SJR 1.04 SNIP 1.099
Web of Science (2018): Impact factor 3.298
Web of Science (2018): Indexed yes
Original language: English
Keywords: Aquaculture, Circadian rhythm, Fish, Immunity, Stress-coping style
Electronic versions:
Postprint.pdf. Embargo ended: 14/11/2018
DOIs:
10.1016/j.fsi.2017.11.025
Source: FindIt
Source-ID: 2393019017
Research output: Contribution to journal › Journal article – Annual report year: 2018 › Research › peer-review

Stress and disease resilience differences related to emergence time for first feeding in farmed rainbow trout (Oncorhynchus mykiss)
Salmonid individuals show a relatively high variability in the time required to abandon the gravel nest where they hatch, the so-called "emergence time". Different behavioral and physiological traits have been shown to be associated to that emergence time in wild salmonids. In general, early- and late-emerging fish have traits resembling those of proactive and reactive stress coping styles, respectively. Proactive fish are considered to be more resilient to stress and probably to disease, so it was hypothesized that fish with different emergence time have different ability to resist repeated episodes of stress without suffering deleterious effects on their welfare or health status. In this study, rainbow trout eyed eggs were hatched and larvae were fractionated according to their emergence time (Early fraction: first 20 % of fish to emerge; Intermediate fraction: mid 20 %; Late fraction: last 20 %). When the fish were four months old, part of the fish were exposed to a daily repeated stress protocol for 15 days. The next day, both naïve and repeatedly-stressed fish were exposed to an acute stress challenge. Different plasma (cortisol, glucose, lactate) as well as CNS (serotonergic activity) stress markers were assessed to evaluate the stress resilience of the different fractions. Furthermore, an intraperitoneal infection challenge with Flavobacterium psychrophilum was carried out to assess the disease resilience of the different emergence fractions. Altogether, the results showed that fish from different fractions displayed different activation of the hypothalamus-pituitary-interrenal axis, pointing to a higher stress resilience in the fish with shorter emergence times. However, those differences were not reflected in the ability of the different fractions to grow and perform well in terms of growth, or in the ability to overcome the infection with the bacteria, which was similar for all the emergence fractions. This suggests that discriminating fish according to emergence time would probably have little effect in improving the performance and the welfare of farmed fish.

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, National Veterinary Institute, Fish Diseases
Corresponding author: Gesto, M.
Crosstalk between innate immunity and circadian rhythm: Do fish immune defences have a sense of time?

General information
Publication status: Published
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.
Publication date: 2017
Peer-reviewed: No
Event: Poster session presented at Aquaculture Europe 2017, Dubrovnik, Croatia.

Bibliographical note
Poster in International Conference: Aquaculture Europe 17, October 17-20, 2017, Dubrovnik, Croatia
Source: PublicationPreSubmission
Source-ID: 139938289
Research output: Contribution to conference › Poster – Annual report year: 2017 › Research

Emergence time and skin melanin spot patterns do not correlate with growth performance, social competitive ability or stress response in farmed rainbow trout

In wild salmonid fish, specific individual behavioral traits have been correlated with the timing of fry emergence from their gravel spawning nests; Early emerging fish display more aggressive behavior and have a higher probability of becoming socially dominant, compared to fish that emerge at a later stage. Apart from aggression and dominance, other behavioral and metabolic traits, such as boldness, metabolic rate, or growth, have also been linked to emergence time. Altogether, the traits of early- and late-emerging fish resemble those of the proactive and reactive stress-coping style, respectively. As proactive fish are considered more resilient to stress, it may be desirable to select these for aquaculture production. However, it is currently unclear to what extent the link between emergence time and stress-coping styles is maintained in the selective breeding of farmed fish. In the present study, eyed eggs from a commercial supplier were hatched, and larvae fractionated according to their emergence time. Later on, juvenile fish from different emergence fractions were subjected to a stress challenge and also tested to evaluate their competitive ability for food. Beyond some slight dissimilarities in the acute stress responses, emergence fraction displayed no correlation with growth rates, or the ability to compete for feed. Within the whole group of fish utilized in the experiments, no relationship between skin melanin spot pattern and growth performance, stress response intensity, or competitive ability was found. Altogether, the differences in physiological traits related to emergence time were not as strong as those found in earlier studies. It is hypothesized, that the origin and degree of domestication of the fish might be partly responsible for this. The predictive value of skin spots or emergence time to infer the fish stress coping style in farmed fish is also discussed.

General information
A holistic approach to provide recommendations for potential updates of the EU organic aquaculture regulation

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Publication date: 2016
Peer-reviewed: No
Event: Poster session presented at Aquaculture Europe 2016, Edinburgh, United Kingdom.
Research output: Contribution to conference › Poster – Annual report year: 2016 › Research

Denmark – European champion in organic rainbow trout

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Section for Aquaculture
Contributors: Larsen, E., Nielsen, M., Larsen, V. J., Jokumsen, A.
Publication date: 2016
Peer-reviewed: No

Feed requirements in organic aquaculture

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A., Lembo, G.
Publication date: 2016
Peer-reviewed: No
Event: Abstract from Aquaculture Europe 2016, Edinburgh, United Kingdom.
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2016 › Research

Final Report on Aquaculture (Part C)

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Lembo, G., Sossidou, E., Estevez, A., Mente, E., Jokumsen, A., Sorgeloos, P.
Number of pages: 13
Publication date: 2016

Publication information
Publisher: European Commission
Original language: English
Research output: Book/Report › Report – Annual report year: 2016 › Research

Organic extractive aquaculture state of the art and challenges

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: d’Orbcastel, R., Abbink, W., Jokumsen, A., Przybyla, C., Callier, M., Delélé, S., Blancheton, J.
Publication date: 2016
Peer-reviewed: No
Event: Abstract from Aquaculture Europe 2016, Edinburgh, United Kingdom.
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2016 › Research
Stress-resilience differences related to emergence time in rainbow trout

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Gesto, M., Jokumsen, A.
Publication date: 2016
Peer-reviewed: No
Event: Abstract from 8th International Symposium on Fish Endocrinology, Gothenburg, Sweden.
Research output: Contribution to conference » Conference abstract for conference – Annual report year: 2016 » Research

The relation between EU regulation on organic aquaculture and scientific knowledge on production systems

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Abbink, W., Lembo, G., Jokumsen, A., Sæther, B., Noble, C., Nielsen, H., Adámek, Z.
Publication date: 2016
Peer-reviewed: No
Event: Abstract from Aquaculture Europe 2016, Edinburgh, United Kingdom.
Research output: Contribution to conference » Conference abstract for conference – Annual report year: 2016 » Research

Boom for økologiske linemuslinger

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A.
Publication date: 2015

Publication information
Media of output: OrganicToday
Year: 2015
Original language: Danish
Research output: Other contribution » Net publication - Internet publication – Annual report year: 2016 » Communication

Boom in production of organic line mussels in Denmark

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A.
Pages: 3
Publication date: 2015
Peer-reviewed: No

Publication information
Boosting the quality of organic trout fry

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A.
Publication date: 2015
Peer-reviewed: No

Publication information
Journal: Hatchery International
ISSN (Print): 1498-136X
Original language: English
Electronic versions:
Publishers_version
Research output: Contribution to journal › Journal article – Annual report year: 2015 › Research

Challenges in sourcing of feed ingredients for organic production of carnivorous Fish

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Berge, G., Jokumsen, A., Lembo, G., Spedicato, M.
Publication date: 2015
Peer-reviewed: No
Event: Abstract from Aquaculture Europe 2015, Rotterdam, Netherlands.
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2016 › Research

Consumer perception and scientific knowledge of stocking density in organic aquaculture

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Publication date: 2015
Peer-reviewed: No
Event: Abstract from Aquaculture Europe 2015, Rotterdam, Netherlands.
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2016 › Research

Costs and benefits of farming fish with selected behavioural and physiological traits

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, Danish Shellfish Centre
Contributors: Skov, P. V., de Jesus Gregersen, J., Jokumsen, A.
Publication date: 2015
Peer-reviewed: No
Event: Abstract from Aquaculture 2015, Montpellier, France.

Bibliographical note
B11.5
Source: PublicationPreSubmission
Source-ID: 116457839
Research output: Contribution to conference › Conference abstract for conference – Annual report year: 2015 › Research
Danish focus on organic fry

**General information**
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A.
Publication date: 2015

**Publication information**
Media of output: Organic e-prints
Year: 2015
Original language: English
URLs:
http://orgprints.org/28260/
Research output: Other contribution › Net publication - Internet publication – Annual report year: 2015 › Research

Danish organic mussel production boom

**General information**
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A.
Pages: 63
Publication date: 2015
Peer-reviewed: No

**Publication information**
Journal: World Fishing & Aquaculture
Issue number: April
ISSN (Print): 2044-1908
Original language: English
Research output: Contribution to journal › Journal article – Annual report year: 2015 › Research

Fiskedød på Sig Fiskeri 2011-2012: Redegørelse til brug ved Sig Fiskeris retslige søgsmål mod Naturstyrelsen

**General information**
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, Aarhus University
Contributors: Wiberg-Larsen, P., Jokumsen, A., Jensen, P. N.
Publication date: 2015

**Publication information**
Publisher: Aarhus Universitet, DCE – Nationalt Center for Miljø og Energi
Original language: Danish
Source: FindIt
Source-ID: 2290449287
Research output: Book/Report › Report – Annual report year: 2015 › Research › peer-review

Organic Trout Ova/Fry is already available from Danish Hatcheries

**General information**
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A.
Pages: 1
Publication date: 2015
Peer-reviewed: No

**Publication information**
Journal: ICROFS news
Original language: English
Electronic versions:
28721.pdf
Organic Trout Ova/Fry is already available from Danish Hatcheries

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A.
Pages: 27-36
Publication date: 2015
Peer-reviewed: No

Publication information
Journal: Aquaculture Europe Magazine
Volume: 40
Issue number: 1
ISSN (Print): 1018-9661
Original language: English
Electronic versions:
28721.pdf
URLs:
http://orgprints.org/28721/

Peracetic acid products expand sanitizing, organic water treatment options

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, Danish Aquaculture Association
Contributors: Pedersen, L., Jokumsen, A., Larsen, V. J., Henriksen, N. H.
Pages: 66-67
Publication date: 2015
Peer-reviewed: No

Publication information
Journal: Global Aquaculture Advocate
ISSN (Print): 1540-8906
Original language: English
Electronic versions:
Publishers_version
Research output: Contribution to journal › Journal article – Annual report year: 2015 › Research

Robust fiskeyngel en nødvendighed

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A.
Publication date: 2015

Publication information
Media of output: www.okologi.dk
Year: 2015
Original language: Danish
URLs:

The relation between EU regulations on organic aquaculture and scientific knowledge of different welfare issues
Udvikling af dansk økologisk yngelopdræt

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, Danish Aquaculture Association
Contributors: Larsen, V. J., Henriksen, N. H., Pedersen, L., Jokumsen, A.
Number of pages: 53
Publication date: 2015
Publication information
Publisher: Dansk Akvakultur
ISBN (Print): 978-87-997876-2-3
Original language: Danish
(Faglig rapport fra Dansk Akvakultur; No. 2015-3).
Electronic versions:
Publishers version
URLs:
http://www.danskakvakultur.dk/media/12669/Projekt-%C3%98KO-yngel-projektrapport-230215-ENDELIG-VJL.pdf
Research output: Book/Report › Report – Annual report year: 2015 › Research

Certificering af ål og andre mindre arter

General information
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Organisations: National Institute of Aquatic Resources, Section for Aquaculture, Jupiter Ål A/S, Danish Aquaculture Association, Dansk Åleproducentforening
Contributors: Jokumsen, A., Larsen, V. J., Graver, C., Lauritzen, M.
Number of pages: 121
Publication date: 2014
Publication information
Place of publication: Charlottenlund
Publisher: DTU Aqua. Institut for Akvatiske Ressourcer
ISBN (Print): 978-87-7481-184-8
ISBN (Electronic): 978-87-7481-183-1
Original language: Danish
(DTU Aqua-rapport; No. 277-2014).
Electronic versions:
Publishers version
URLs:
http://www.aqua.dtu.dk/Publikationer/Forskningsrapporter/Forskningsrapporter_siden_2008
Research output: Book/Report › Report – Annual report year: 2014 › Research

European Commission: Final report on aquaculture (part A)

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Lembo, G., Mente, E., Garcia, A. E., Jokumsen, A.
Number of pages: 35
Publication date: 2014
Publication information
European Commission: Final report on aquaculture (part B)

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Lembo, G., Speiser, B., Casey, J., Garcia, A. E., Jokumsen, A., Papandroulakis, N., Sorgeloos, P.
Number of pages: 35
Publication date: 2014

Feasibility case study in Belarus on the feasibility of Danish recirculation technology

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Nielsen, P., Martti, N., Roze, A., Barulin, N., Jokumsen, A.
Number of pages: 39
Publication date: 2014

Feasibility study guidelines to implement innovative land-based farm concepts

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Nielsen, P., Järvisalo, O., Jokumsen, A.
Number of pages: 13
Publication date: 2014
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.

General information
Publication status: 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., Lund, I., Nielsen, H. H., Jokumsen, A.
Pages: 333-346
Publication date: 2014
Peer-reviewed: Yes

Publication information
Journal: Journal of Aquatic Food Product Technology
Volume: 23
Issue number: 4
ISSN (Print): 1049-8850
Ratings:
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Web of Science (2014): Impact factor 0.688
Web of Science (2014): Indexed yes
Original language: English
DOIs: 10.1080/10498850.2012.718047
Research output: Contribution to journal > Journal article – Annual report year: 2012 > Research > peer-review


General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture
Contributors: Jokumsen, A., Pedersen, L.
Number of pages: 37
Publication date: 2014

Publication information
ISBN (Print): 978-952-303-092-3
Original language: English
Electronic versions:
Publishers version
URLs:

Robustfish: New possibilities for growth and robustness in organic aquaculture

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Aquaculture, National Veterinary Institute, Section for Bacteriology, Pathology and Parasitology, Section for Ecosystem based Marine Management, University of Copenhagen, Danish Aquaculture Association
Publication date: 2014
Background paper on aquaculture research

The Board of MISTRA established in 2012 a Working Group (WG) on Aquaculture to provide the Board with background information for its upcoming decision on whether it should invest in aquaculture research. The WG included Senior Advisor Axel Wenblad, Sweden (Chairman), Professor Ole Torrissen, Norway, Senior Advisory Scientist Unto Eskelinen, Finland and Senior Advisory Scientist Alfred Jokumsen, Denmark. The WG performed an investigation of the Swedish aquaculture sector including interviews with a range of stakeholders within aquaculture research, farming organisations, authorities, NGOs and the Ministry of Rural Affairs. The WG was asked to develop a research program for strategic and efficient development of Swedish Aquaculture.

Swedish aquaculture production currently includes about 11,000 tonnes rainbow trout in FW and SW, 1,100 tonnes arctic char (FW), 90 tonnes eel (FW), 1,500 tonnes mussels (SW) and a few tonnes of crayfish altogether corresponding to a total value of SEK 328 million in 2011. Further about 1,000 tonnes of fish and crustaceans were produced for restocking as well as about 3 million fry of salmon and trout were released into rivers. Swedish aquaculture research was overall assessed to be of very high quality and highly acknowledged at international level. However, integration of the research issues with the main stakeholders in the aquaculture sector needs focus; i.e. integration of the political frameworks, regional administrations, the aquaculture producers and the research groups on aquaculture. A closer connection and dialogue between the stakeholders may be facilitated through the regional aquaculture research centers established by the National Competence Centre for Aquaculture, and the National Aquaculture Council being established. These structures may create a common and focused platform for cooperation on research and education, exchange and transfer of knowledge from research to aquaculture practice.

Further, integration of biological and technological research combined with education and training of skilled professionals as well as authority staff dealing with aquaculture is strongly called upon. Hence, a strong integration of the stakeholders within the aquaculture sector is assessed to be an important platform for a trans-disciplinary research and development program for strategic and efficient development of Swedish Aquaculture. Sweden has large potentials for aquaculture due to the availability of vast water resources of good quality (both marine and fresh water), a high veterinary status and generally well developed public infrastructure. Swedish aquaculture has the potential to develop into a green business producing environmentally sustainable healthy food with low ecosystem and climate impact. Swedish import of aquaculture products may be reduced by increased domestic production. Further Swedish aquaculture may be a driving force in the development of employment, infrastructures and improvement of economic and social conditions in rural areas. Swedish 4 • mistra aquaculture has the potential to contribute significantly to food security. It is therefore important that aquaculture becomes an integrated part of the food production system, i.e. being accepted as an equal food producing sector in line with the agricultural sector. Innovative development of Swedish aquaculture requires production systems with minimal environmental impact, e.g. recirculation technology, efficient feeds and waste management. Although the nutrient-poor hydropower dams in northern Sweden may tolerate nutrient load the strategy for the required development of Swedish aquaculture has to include technologies and strategies to minimize the environmental impact, in particular to the Baltic Sea. Swedish aquaculture may develop to be an environmental service, which may be exported. The governmental policy on aquaculture should reflect the conclusions of the official report Det växande vattenbruk and the strategy Svenskt vattenbruk – en grön näring på blå åkrar, Strategi 2012–2020. Implementing the strategy will require a real management of aquaculture that secures the balance between responsibility for the environment and development of aquaculture production. For a significant and powerful Swedish aquaculture to develop, strong and committing policy instruments should be coordinated and managed. This means that the strategy for aquaculture needs to be followed by a long term focused research policy on aquaculture and responsibility for putting it into force as well as availability of adequate funding from national and international sources (e.g. EMFF, research councils, EU, Nordic and BONUS). Finally, the financial sector should be made more confident with aquaculture to facilitate investments in aquaculture. The integration of environmental, economic and social sustainability is essential for the development of a dynamic Swedish aquaculture industry. Research should include basic and applied aquaculture research integrated with resilience science and take a food systems approach considering relevant aspects of the food chain between farm and fork (e.g. producers, food industry, retail and consumers). Aiming to enable a progressive change of the Swedish aquaculture sector the Working Group recommends that MISTRA establishes a research program on aquaculture including: 1. Global ecosystem aspects of aquaculture production including diversification, production systems, species, products, etc. 2. Environmental efficient production with trapping of solid waste and balanced nutrient management (recirculation technology, waste heat/green energy/integrated production systems). 3. Policy instruments: legislation, economic incentives, socioeconomic...
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.
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.

Effects of stocking density and sustained aerobic exercise on growth, energetics and welfare of rainbow trout

Two stocking densities, "low" (L, between ~19 and ~25 kg m⁻³) and "high" (H, between ~75 and ~100 kg m⁻³) were compared for effects on specific growth rate (SGR), feed conversion, energetics and welfare of rainbow trout reared at 14 °C either in static water (S) or swimming in a gentle current of ~0.9 bodylengths s⁻¹ (C). Trout (initial mass ~110 g) were reared for 9 weeks in circular tanks (volume 0.6 m³), in triplicate of four conditions (LS, LC, HS, HC). Fish were fed ad libitum daily; waste pellets were swirl-collected at the outflow to calculate feed intake. SGR was measured each three weeks for the last six weeks of the trial. The tanks functioned as intermittent-stopped flow respirometers, to permit metabolic rate to be measured as instantaneous oxygen uptake once per hour. Mean (±SD) SGR was significantly lower at H than L (1.51±0.03 vs 1.44±0.04% day⁻¹, respectively, n=6) and lowest in HC. When compared over a similar interval of mass gain, H groups had approximately 25% higher metabolic rates than L, with the highest rates in the HC condition. As a result, fish in the H groups dissipated a greater amount of feed energy as metabolism and, across all groups, there was a direct negative relationship between the quantity of energy dissipated and their SGR. There was no evidence of a neuroendocrine stress response, plasma cortisol was around 1 ng ml⁻¹ in all conditions. An acute crowding stress increased plasma cortisol to above 120 ng ml⁻¹ in all groups, but C groups recovered to control levels within 8 h whereas S groups required 20 h. Respirometry on individuals revealed that H fish had approximately 14% higher metabolic rates than L fish, indicating that increased metabolic rate in rearing tanks was in part physiological. The H groups had approximately 15% lower critical swimming speeds than the L groups which, together with their raised metabolic rate, indicated a physiological impairment. Thus, high density...
reduced SGR by raising energy dissipation, at least partially as a physiological response by the fish, although there was no evidence of an endocrine stress response. The only beneficial effect of C was in recovery from acute stress.

Global certificering. Implementering af global certificering (Aquaculture Stewardship Council – ASC) for regnbueørred samt vurdering af bæredygtig certificering af andre arter

The effect of protein and lipid source in organic feed for (organic) rainbow trout on sensory quality
The effects of stocking density and low level sustained exercise on the energetic efficiency of rainbow trout (Oncorhynchus mykiss) reared at 19°C

A 9 week growth trial was performed at two rearing densities; low (~25 kg m−3) and high (~100 kg m−3), in combination with either static water or a water current corresponding to 0.9 body lengths s−1, to investigate the effects of density and exercise on the bioenergetics of rainbow trout reared at 19 °C, particularly routine metabolic rate (RMR), specific growth rate (SGR), and feed conversion ratio (FCR). The growth trial showed that high rearing density resulted in significantly lower SGR and increased FCR, with no significant alleviating effects of awater current, although slight improvement in both parameters were observed at low density. A significant linear relationship between SGR and FCR suggested that increased energy expenditure was the primary cause of reduced growth. Hourly measurements of instantaneous oxygen uptake, during a period of similar growth (200–350 g), revealed clear effects of the experimental conditions. Energetic budgets were calculated from feed intake and routine metabolic rate (RMR) and revealed that whilst feed intake was similar for all groups, a higher RMR in the high density groups resulted in a higher daily rate of energy utilization for routine activity, leading to slower growth. However, a lower RMR in fish subjected to a current resulted in a greater proportion of energy being retained, leading to significantly higher SGR for the selected period, at both low and high density. Furthermore, the presence of a water current was observed to induce schooling behaviour, which is known to reduce aggression and stress. It is thereby likely that the presence of a current had a positive effect on welfare in addition to its effect on energy metabolism. We conclude that the presence of a water current to some extent could alleviate the negative effects of high density at 19 °C, a relatively high temperature experienced in farming of rainbow trout during hot seasons.

Time-dependent changes in protein expression in rainbow trout muscle following hypoxia

Adaptation to hypoxia is a complex process, and individual proteins will be up- or down-regulated in order to address the main challenges at any given time. To investigate the dynamics of the adaptation, rainbow trout (Oncorhynchus mykiss) was exposed to 30% of normal oxygen tension for 1, 2, 5 and 24h respectively, after which muscle samples were taken. The successful investigation of numerous proteins in a single study was achieved by selectively separating the sarcoplasmic proteins using 2-DE. In total 46 protein spots were identified as changing in abundance in response to hypoxia using one-way ANOVA and multivariate data analysis. Proteins of interest were subsequently identified by MS/MS following tryptic digestion. The observed regulation following hypoxia in skeletal muscle was determined to be time specific, as only a limited number of proteins were regulated in response to more than one time point. The cellular response to hypoxia included regulation of proteins involved in maintaining iron homeostasis, energy levels and muscle structure. In conclusion, this proteome-based study presents a comprehensive investigation of the expression profiles of numerous proteins at four different time points. This increases our understanding of timed changes in protein expression in rainbow trout muscle following hypoxia.
Effects of rearing density and water current on the respiratory physiology and haematology in rainbow trout, *Oncorhynchus mykiss* at high temperature

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**Moderate exercise of rainbow trout induces only minor differences in fatty acid profile, texture, white muscle fibres and proximate chemical composition of fillets**

These experiments studied how moderate water velocities (0.9 body length second−1 (bl s−1)) may influence different quality characteristics of rainbow trout when compared to fish kept in standing water (b0.1 bl s−1). Fish fed at 1.3% of their body weight per day were slaughtered at a weight of 350 g after nine weeks of experiment at 15.0 °C. The fatty acid composition in fillets differed only marginally between exercised fish (excF) and control fish (ctrlF) kept in standing water. ExcF fillets had a significantly lower content of fatty acids 16:0 (P < 0.05) and 18:1 (n−7) (P < 0.01) and a higher content of 20:2 (n−6) (P < 0.05) compared to ctrlF fish, but all differences were small (b7%). The percentage of n−3 fatty acids was not significantly affected by the applied training regime and neither was the n−3 · n−6−1 ratio. The percentage of n−3 fatty acids, however, decreased linearly in both groups when the lipid content in the fillet increased (R2≥0.85, Pb1·10−6). Fillet texture measured instrumentally as shear force (g) after 72 h of ice storage did not differ between the two experimental groups, and neither did the content of lipid, protein or dry matter in the fillet. Muscle fibre sizes have a possible role in textural characteristics and were determined by histological analyses of white, glycolytic muscle tissue. These data
showed that although differences in average fibre diameters were small (excF: 75.04 (s.d.=48.96)μm; ctrlF: 74.50 (46.21)μm) the general fibre size distribution differed significantly among the two groups (Pb0.01). Moreover, moderate exercise induced small but significant changes in fibre circularity (excF: circ.=0.724; ctrlF:=0.720, Pb0.05) but neither muscle fibre diameter nor circularity was significantly related to fillet texture. Altogether, the results suggest that moderate water velocities have limited impact on quality of pan-sized rainbow trout but subtle changes in the fillets indicate that other training strategies may induce stronger responses.
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.
Horse bean-, pea- and rape protein and flax seed oil in feed for organic trout

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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.

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Contributors: Lund, I., Dalsgaard, A. J. T., Jokumsen, A., Larsen, B. K.
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A scientific perspective on key impacts in different production systems

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Contributors: Jokumsen, A.
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Can increased water velocities improve quality of farmed rainbow trout

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Organisations: Section for Aquaculture, National Institute of Aquatic Resources, Section for Aquatic Lipids and Oxidation, Section for Aquatic Process and Product Technology
Contributors: Rasmussen, R. S., Timm Heinrich, M., Hyldig, G., Jacobsen, C., Jokumsen, A.
Digestibility in selected rainbow trout families and relation to growth and feed utilisation

Experiments have been carried out aimed at clarifying variations in the digestibility of dietary nutrients in rainbow trout families and studying how differences in digestibility may be related to growth and feed utilisation at various growth rates. The digestibility of protein, lipid, carbohydrates (nitrogen-free extracts, NFE) and dry matter was analysed in two experiments involving eight rainbow trout families \([\text{Ab, Ba, Cd, Dc (first study); V, X, Y, Z (second study)}]\). In the first experiment rainbow trout were reared for 128 days at 13.0°C, and in the second experiment, they were reared for 84 days at 16.8°C. In both experiments, the fish were fed ad libitum and reared from an initial weight of 70-100 g to a final weight of 500-700 g. When the fish reached a weight of approximately 200 g, some individuals were moved to another experimental system in which the digestibility of protein, lipid, nitrogen-free extracts and dry matter was measured. Taken as a whole, our results indicate that selective breeding still offers a large potential for improved growth and feed utilisation in rainbow trout strains. In the first study, family Dc showed a higher specific growth rate (SGR) than the other three families \((P < 0.05)\), and family Ba showed a lower feed conversion ratio (FCR) than family Ab \((P < 0.05)\); there were no observed differences in digestibility despite some differences in growth. In the second study, family Y grew faster than all of the other families \((P < 0.05)\), and family Z grew faster than families V and X \((P < 0.01)\). A comparable pattern was seen for FCR, with family Y utilising feed better than family V \((P < 0.05)\), and families V, Y and Z performing better than family X \((P < 0.001)\). Protein digestibility was higher in the two fastest growing families \((Y and Z)\) than in the slower growing family X \((P < 0.05)\), while lipid digestion was higher in family Y than in family V \((P < 0.05)\). A comparison of the results from both experiments revealed that protein digestibility in particular was closely related to the SGR and the FCR at high growth rates. However, despite the advantageous protein digestibility on fish growth, analysis of the protein retention efficiency (PRE) showed that when protein was ingested in relatively large amounts, as in the fastest growing families, the “excess” nitrogen was excreted and therefore did not contribute to protein deposition in the fish body. Hence, the potential weight gain offered by improved protein digestibility does not materialise when the protein intake is above a certain level. Other factors must therefore explain the positive relation between fast growth and high protein digestibility.
Effects of stocking density on the energetics and welfare of rainbow trout

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Multivariate data analysis of 2 DE data: Time dependent changes in protein expression in rainbow trout following hypoxia
In the last decade there has been a growing understanding of the health benefits of fish consumption. This has lead to an increased interest in studies examining which parameters will affect eating quality of fish grown in fish farms. Especially increased softening of fish muscle is a major problem since it significantly reduces the quality of the major edible part of the fish. One important stressor affecting quality is hypoxia which will occur in fish farms, when the trout is collected for transport before slaughter. In order to explore the biochemical mechanisms responsible for the changes seen in trout muscle following hypoxia, a proteome study was conducted. This will greatly aid the aquaculture industry when evaluating the type of stressors mostly affecting food quality, allowing the industry to optimise handling of the rainbow trout accordingly. In the present study a number of rainbow trout were kept in tanks where hypoxia, (30% of normal oxygen) when introduced, was the only stressor. The fish were sacrificed at different time points (1, 2, 5 and 24 hours) after the onset of hypoxia and muscle samples were taken from each individual fish. Protein expression profiles of the samples were achieved by 2-DE. Protein spots, which individually or in combination with other spots varied according to hypoxia were found by multivariate data analysis (partial least squares regression) on group scaled data (normalised spot volumes) followed by selection of significant spots by jack-knifing. Tandem mass spectrometry was used to identify protein spots of interest.

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

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Proteinafgrøder til økologiske fisk

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Proteinafgrøder til økologiske regnbueørreder (Oncorhynchus mykiss)

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Flere økologiske fisk

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Contributors: Jokumsen, A.
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Improved digestibility and growth in selected families of rainbow trout (Oncorhynchus mykiss)

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Proteinfoder til økologiske ørreder

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Aspects of respiratory physiology and energetics in rainbow trout (Oncorhynchus mykiss) families with different size-at-age and condition factor

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Gennembrud for økologiske fisk

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Økologisk fiskeopdræt: Rapport fra en vidensyntese om udviklingsmuligheder inden for økologisk fiskeopdræt i Danmark

General information
Selective breeding provides an approach to increase resistance of rainbow trout (Oncorhynchus mykiss) to the diseases, enteric redmouth disease, rainbow trout fry syndrome, and viral haemorrhagic septicaemia.

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 septicaemia (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.

Selective breeding provides an approach to increase resistance of rainbow trout (Oncorhynchus mykiss) to the diseases, enteric redmouth disease, rainbow trout fry syndrome, and viral haemorrhagic septicaemia.

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 septicaemia (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.
Ny struktur for Dansk Ørredavl

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A., Thomsen, B.
Pages: 126-127
Publication date: 2004
Peer-reviewed: Unknown

Sustainable aquaculture production in Denmark

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A.
Pages: 10-12
Publication date: 2004
Peer-reviewed: No

Avlsarbejde kan øge sygdomsresistens hos regnbueørred

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
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 52, 76, 96, 123, 157, 185, and 215 (coefficient of additive genetic variation \( CV = 8.4-28.4\% \), heritability \( h^2 = 0.35 \) for body weight on day 215), body length on day 215 \( CV = 6.9\% \), \( h^2 = 0.53 \), 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, \( h^2 \) 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.
Nyt fra avlsstationen - Salg af øjenæg

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A.
Pages: 41
Publication date: 2002
Peer-reviewed: No

Publication information
Journal: Ferskvandsfiskeribladet
Volume: 100
Issue number: 2
ISSN (Print): 0015-0223
Original language: Danish
Source: orbit
Source-ID: 226065
Research output: Contribution to journal › Journal article – Annual report year: 2002 › Research

Udredning vedrørende vandforbrug ved produktion af regnbueørreder i danske dambrug

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A.
Number of pages: 63
Publication date: 2002

Publication information
Place of publication: Hirtshals
Publisher: Danmarks Fiskeriregnskaber
ISBN (Print): 87-90968-25-5
Original language: Danish
(DFU-rapport; No. 106-02).
Electronic versions:
106-02_vandforbrug_ved_produktion_af_regnbueørreder.pdf
URLs:
Source: orbit
Source-ID: 226074
Research output: Book/Report › Report – Annual report year: 2002 › Research

Aqua flow - til glæde for opdrættere : Formidling af forskningsresultater

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A.
Pages: 200-201
Publication date: 2001
Peer-reviewed: No

Publication information
Journal: Ferskvandsfiskeribladet
Volume: 99
Issue number: 9
Original language: Danish
Source: orbit
Source-ID: 226052
Research output: Contribution to journal › Journal article – Annual report year: 2001 › Research
Avisarbejde på regnbueørred i Danmark

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A., Berg, P., Lund, I.
Pages: 18-27
Publication date: 2001
Peer-reviewed: No

Publication information
Journal: Fisk og hav
Volume: 53
ISSN (Print): 0105-9211
Original language: Danish
URLs:
Source: orbit
Source-ID: 226053
Research output: Contribution to journal › Journal article – Annual report year: 2001 › Research

Information fra Dansk Ørredavl

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A., Lund, I.
Pages: 257-261
Publication date: 2001
Peer-reviewed: Unknown

Publication information
Journal: Ferskvandsfiskeribladet
Volume: 99
Issue number: 11
ISSN (Print): 0015-0223
Original language: Danish
Source: orbit
Source-ID: 226060
Research output: Contribution to journal › Journal article – Annual report year: 2001 › Communication

Resultater fra akvakulturforskning og teknologisk udvikling under EU-støttede forskningsprogrammer : Aquaflow II

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A.
Number of pages: 50
Publication date: 2001

Publication information
Place of publication: Hirtshals
Publisher: Danmarks Fiskeriundersøgelser
Original language: Danish
(Concerted Action - Project; No. Q5CA-2000-30105).
Source: orbit
Source-ID: 226072
Research output: Book/Report › Report – Annual report year: 2001 › Research

Første spadestik til avlsstationen

General information
Optimal ratio between digestible protein and digestible energy in feed for European sea bass (Dicentrarchus labrax)

Resultater fra akvakulturforskning og teknologisk udvikling under EU-støttede forskningsprogrammer

Avisstation ved Nordsøcentret
Effect of replacement of fish meal by potato protein concentrate in the diet for rainbow trout on feeding rate, digestibility and growth

Six isonitrogenous and isoenergetic diets were composed to investigate the effects of incorporation of potato protein concentrate (PPC) and supplementation of methionine in the diet for rainbow trout (Oncorhynchus mykiss) on feeding rate, digestion, growth, feed utilization and body composition. The control diet contained all Danish L T-fish meal as protein sources. The other experimental diets contained 2.2, 5.6, 8.9 and 11.1% PPC respectively. Diet 6 contained 5.6% PPC and 1.7% methionine. A 4-week trial was conducted at about 12°C. The results showed that feeding rate decreased with increased incorporation levels of PPC. Apparent digestibility of dry matter, crude protein and ash increased with increased proportion of dietary PPC, while there was no significant effect on the apparent digestibility of crude fat. The incorporation of 5.6% PPC decreased growth rate and 8.9% PPC decreased both growth and feed efficiency. Supplementation of 1.7% methionine decreased both feeding rate and growth.
Resultater fra akvakulturforskning og teknologisk udvikling under EU-støttede forskningsprogrammer

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources
Contributors: Jokumsen, A.
Number of pages: 56
Publication date: 1999

Publication information
Place of publication: Hirtshals
Publisher: Danmarks Fiskeriundersøgelser
Original language: Danish

Bibliographical note
Concerted Action - Project - FAIR - CT97-3837
Source: orbit
Source-ID: 226066
Research output: Contribution to journal › Journal article – Annual report year: 1999 › Communication

Effects of dietary incorporation of potato protein concentrate and supplementation of methionine on growth and feed utilization of rainbow trout

Four diets (1, 2, 3 and 4) were formulated to contain different potato protein concentrate (PPC) levels (0, 22, 56, and 111 g kg⁻¹). Diet 5 contained 56 g kg⁻¹ PPC and 17 g kg⁻¹ methionine. A growth trial was conducted to investigate the effect on growth and feed utilization of incorporation of PPC and supplementation of methionine in the diet of rainbow trout. When the proportion of PPC exceeded 56 g kg⁻¹ the growth of fish decreased while both growth and feed utilization decreased when the dietary PPC was 111 g kg⁻¹. Protein productive value and condition factor of the fish decreased and mortality increased with the increase in the proportion of dietary PPC.

General information
Publication status: Published
Organisations: Section for Aquaculture, National Institute of Aquatic Resources, Danish Institute for Fisheries Technology and Aquaculture
Contributors: Xie, S., Jokumsen, A.
Pages: 183-186
Publication date: 1998
Peer-reviewed: Yes

Publication information
Journal: Aquaculture Nutrition
Volume: 4
Issue number: 3
ISSN (Print): 1353-5773
Original language: English
Source: orbit
Source-ID: 282544
Research output: Contribution to journal › Journal article – Annual report year: 1998 › Research › peer-review

Incorporation of potato protein concentrate in diets for rainbow trout: effect on feed intake, growth and feed utilization

Five isonitrogenous and isoenergetic diets were composed to investigate the effects of incorporation of potato protein concentrate (PPC) in the diet of rainbow trout, Oncorhynchus mykiss (Walbaum), on feeding rate, growth, feed utilization and body composition. The experimental diets contained 0, 22, 56, 89 and 111 g kg⁻¹ PPC, respectively. A 4-week trial
was conducted at about 12°C. The results showed that with increased incorporation levels of PPC, feeding rate, growth and feed efficiency decreased significantly. Incorporation of PPC in the diets significantly decreased the dry matter content and fat content of fish body, while protein and ash contents increased.

General information
Publication status: Published
Organisations: Danish Institute for Fisheries Technology and Aquaculture
Contributors: Xie, S., Jokumsen, A.
Pages: 223-226
Publication date: 1997
Peer-reviewed: Yes

Publication information
Journal: Aquaculture Nutrition
Volume: 3
Issue number: 4
ISSN (Print): 1353-5773
Original language: English
Source: orbit
Source-ID: 282545
Research output: Contribution to journal › Journal article – Annual report year: 1997 › Research › peer-review

Projects:

Future growth in sustainable, resilient and climate friendly organic and conventional European aquaculture (FutureEUAqua) (39567)
The overall objective of FutureEUAqua is to effectively promote sustainable growth of resilient to climate changes, environmentally friendly organic and conventional aquaculture of major fish species and low trophic level organisms in Europe, to meet future challenges with respect to the growing consumer demand for high quality, nutritious and responsibly produced food. To this end, FutureEUAqua will promote innovations in the whole value chain, including genetic selection, ingredients and feeds, non-invasive monitoring technologies, innovative fish products and packaging methods, optimal production systems such as IMTA and RAS, taking into account socioeconomic considerations by the participation of a wide spectrum of stakeholders, training and dissemination activities.

To achieve the objective and to relate to the work program, nine work packages will contribute to improvements of future aquaculture. To ensure sustainable and resilient production of fish FutureEUAqua will work with tailor made fish and feed, and validate fish performance and water quality in cost effective production systems. Consumer demand and awareness of how to choose sustainable and climate friendly seafood. With the increasing production of seafood, we face space-conflicts, which, in combination with the current regulatory frameworks will be considered. Wireless sensor technology for health and welfare monitoring and novel technology for product quality and packaging to meet future demands, will be implemented.

Stakeholders' knowledge and views will be important, and communication, dissemination as well as training sessions will be emphasized.

The project is coordinated by NOFIMA, Norway and is funded by HORIZON 2020 Blue Growth Programme.
Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Pedersen, P. B., Project Participant, National Institute of Aquatic Resources
Pedersen, L., Project Participant, National Institute of Aquatic Resources
Dalsgaard, A. J. T., Project Participant, National Institute of Aquatic Resources
von Ahnen, M., Project Participant, National Institute of Aquatic Resources
01/11/2018 → 30/09/2022
Keywords: Research area: Aquaculture
Project: Research

Nordic Centre of Excellence Network in Fishmeal and Fish oil (39496)
Due to the change in markets and demands there is an urgent need for improved knowledge about the nutritional value which fish meal and fish oil can provide in the feed industry in order to increase the value of these commodities.
To facilitate and strengthen the Nordic cooperation – and bio economy – this Nordic Centre of Excellence in Fishmeal and
Fish oil is established. A detailed review of the current knowledge on raw material quality and seasonal variation, processing methods and the nutritional properties and characteristics of fishmeal and –oils will be provided. Background knowledge of protein production intended for human consumption from various raw materials, and how these products have been utilized up to date will also be established. Literature will be reviewed on processing methods, both traditional and new, applied analytical methods, effect of producing fish proteins from various fish species on the nutritional properties and characteristics of fishmeal and –oils, their seasonal variation, preservation methods throughout the value chain, food grade production regulations and more. References will be sought both in peer reviewed articles, reports and other published sources, as well as from personal communications with the industry and specialists within the field. The obtained knowledge will be summarized and published in a scientific review (workshop review) and communicated in a simple way e.g. infographs, fact sheets and 1-2 videos.

The results will create a road map for future research projects to create innovations in the field and to improve the Nordic bio economy.

This project is coordinated by Matís ohf, Iceland and is funded by the Nordic Council of Ministers and EU Fishmeal.

Jokumsen, A., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
01/01/2018 → 31/12/2018

Keywords: Research area: Aquaculture
Collaborators: EUfishmeal and Marine Ingredients Denmark, Matís ltd., Fiskernes Fiskeindustri, Havsbrún, Nofima, TripleNine Group A/S

Project: Research

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**Green switch in Danish Aquaculture by changeover to recirculation (GODAOR) (39462)**

The overall aim of the project is to disseminate scientific knowledge and practical experiences regarding optimum use of recirculation technology in land based fish farming.

The main concrete aims are:

1. To promote green and economic sustainability in recirculation fish farming by optimum use of recirculation technology to minimize the specific discharge of nutrients (nitrogen, phosphorus and organic matter) from the fish production.
2. To strengthen green switch by increased use of recirculation technology by supporting the changeover from traditional pond farming to modern recirculation technology. This is based on knowledge and experience from research- and development projects. E.g. will optimum designed farms and management reflect less fish diseases, less mortality and improved feed utilization concomitant with better fish welfare.

This project is coordinated by the Danish Aquaculture Organisation and is funded by Green Growth and Development Program (GUDP).

Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Pedersen, P. B., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
Pedersen, L., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
Dalsgaard, A. J. T., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
von Ahnen, M., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
01/07/2017 → 30/06/2021

Keywords: Research area: Aquaculture
Collaborators: University of Copenhagen, The Danish Veterinary Association, Danish Aquaculture Association

Project: Research

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**Helpdesk for aquaculture (HelpDesk) (38696)**

In the project different environmental issues related to regulation of aquaculture have been addressed according to specific needs and questions from the Ministry of Food, Agriculture and Fisheries and the Ministry of Environment. Specifically, a calculation model for predicting waste generated from fish farming has been developed. This Excel-based model is able to calculate the waste generated by the fish depending only on the fish performance (FCR) and the composition and digestibility of the feed used.

The model, valid for rainbow trout up to 800 g/pcs in freshwater, was verified through various experiments using commercial feed types, and is now a central element in the regulation of the Danish freshwater trout farming industry. It is used throughout the industry and administration and has generated a common background and baseline for all stakeholders.

A group consisting of the Ministry for Food, Agriculture and Fisheries, the Ministry of Environment, the Danish municipalities’ organization Local Government Denmark was formed and acted as reference/steering group.

The project was coordinated by DTU Aqua.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

Pedersen, P. B., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Jokumsen, A., Project Manager, National Institute of Aquatic Resources
Dalsgaard, A. J. T., Project Participant, National Institute of Aquatic Resources
01/01/2010 → 30/11/2013

Keywords: Research area: Aquaculture

Project: Research
Development of educational opportunities for Danish aquaculture (39157)
Danish aquaculture systems have faced substantial changes during the recent years, which have necessitated further education and practical implementation of new knowledge. This project was initiated by Danish Aquaculture Organization (DAO). Based on an increasing demand for improved and updated education/training to people in the aquaculture industry, DAO identified various initiatives to develop educational for Danish aquaculture. Key players within the aquaculture sector were identified to support these initiatives. The outcome of the project was
- Initiation and implementation of a new education at Hansenberg in Kolding, (www.hansenberg.dk),
- Participation in developing the courses for aquaculture trainees (practical/theoretical exercises),
- Production of advertising material (posters, pamphlets) promoting the education and aquaculture in general,
- Production of the first public available E-book (Aquaculture: 14 chapters, 360 pp.) (http://www.danskakvakultur.dk/uddannelse/e-bog/)
This project was coordinated by the Danish Aquaculture Organization.
The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).
Pedersen, L., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
Jokumsen, A., Project Participant, National Institute of Aquatic Resources
Pedersen, P. B., Project Participant, National Institute of Aquatic Resources
07/08/2013 → 01/08/2015
Keywords: Research area: Aquaculture
Collaborators: Aarhus University, University of Copenhagen, Danish Aquaculture Association, Hansenberg Technical College, Seges Knowledge Centre for Agriculture
Project: Research

Welfare in farmed rainbow trout, social and environmental preferences
Laursen, D. C., PhD Student, National Institute of Aquatic Resources
Höglund, E., Main Supervisor
Skov, P. V., Supervisor
Jokumsen, A., Examiner
Kristiansen, T. S., Examiner
Sneddon, L. U., Examiner
1/3 FUU, 1/3 inst 1/3 Andet
01/03/2010 → 03/07/2013
Award relations: Welfare in farmed rainbow trout, social and environmental preferences
Project: PhD

New approaches and methods to improve the removal of dissolved nutrients in aquaculture
von Ahnen, M., PhD Student, National Institute of Aquatic Resources
Dalsgaard, A. J. T., Main Supervisor
Pedersen, P. B., Supervisor
Jokumsen, A., Examiner
Healy, M. G., Examiner
Schulz, C., Examiner
1/3 DTU-stip, 2/3 FUR/andet
01/04/2013 → 30/06/2016
Award relations: New approaches and methods to improve the removal of dissolved nutrients in aquaculture
Project: PhD

Efficient and innovative fish production via best available technology (RAS2020) (39328)
This project includes a full scale test and development of a conceptual recirculating aquaculture system (RAS) for king fish production. The innovative aspect of this modular RAS2020 concept regards the design—a one unit circular module designed to have a 1200 MT/Y capacity. The aim of this project is to build and develop a RAS unit with small footprint, low cost and reduced construction time. The RAS2020 unit includes state of the art treatment units (Hydrotech drumfilters, Krüeger biofilters—nitrification and denitrification) and is built with flexible interconnected rearing sections. When the RAS2020 is built and stocked with kingfish, an extended sampling and monitoring program will be performed in order to assess system performance in particular N, P and organic matter removal. This project is coordinated by Sashimi Royal.
The project is funded by the Danish Environmental Protection Agency.
Pedersen, L., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
Pedersen, P. B., Project Participant, National Institute of Aquatic Resources
Jokumsen, A., Project Participant, National Institute of Aquatic Resources
Møller, B., Project Participant, National Institute of Aquatic Resources
Sproegel, U., Project Participant, National Institute of Aquatic Resources
Frandsen, D., Project Participant, National Institute of Aquatic Resources
New possibilities for growth and robustness in organic aquaculture (ROBUSTFISH) (39159)

Main aim:
To support the credibility, growth and robustness in the production of healthy and stress resilient Danish organic rainbow trout, considering environmental, ethical as well as economic aspects.

Sub goals:
1) Develop methods for selecting robust fry.
2) Investigating how sustainable non-fish based feed given early in the development affect the robustness of the fry.
3) Include welfare and environmental aspects in relation to water treatment procedures.
4) Improve economic competitiveness of Danish organic aquaculture.

The project is coordinated by DTU Aqua.
This project is funded by Organic RDD 2 Programme, which is coordinated by the International Centre for Research in Organic Food Systems (ICROFS). It has received grants from the Danish Ministry of Food, Agriculture and Fisheries through the Green Growth and Development Programme (GUDP).

Jokumsen, A., Project Coordinator, National Institute of Aquatic Resources, Section for Aquaculture
Pedersen, L., Project Participant, National Institute of Aquatic Resources
Skov, P. V., Project Participant, National Institute of Aquatic Resources
Larsen, E., Project Participant, National Institute of Aquatic Resources

Organic line mussels – Securing availability for the consumers (ØKOMUS) (39155)

The project objectives was to establish and develop an economically sustainable market for organic line mussels in Denmark by support and development of relevant channels of distribution to secure availability of Danish organic mussels for the consumers.

The project was coordinated by Danish Aquaculture Association.
The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture

European organic aquaculture - Science-based recommendations for further development of the EU regulatory framework and to underpin future growth in the sector (OrAqua) (39131)

The overall vision of the OrAqua project is the economic growth of the organic aquaculture sector in Europe, supported by science based regulations in line with the organic principles and consumer confidence.

OrAqua will suggest improvements for the current EU regulatory framework for organic aquaculture based on
- a review of the relevant available scientific knowledge
- a review of organic aquaculture production and economics
- consumer perceptions of organic aquaculture.

The project will focus on aquaculture production of relevant European species of finfish, molluscs, crustaceans and seaweed.
To ensure interaction with all relevant stakeholders throughout the project a multi stakeholder platform will be established.
The project will assess and review existing knowledge on fish health and welfare, veterinary treatments, nutrition, feeding, seeds (sourcing of juveniles), production systems, including closed recirculation aquaculture systems (RAS), environmental impacts, socio-economic and aquaculture economic interactions, consumer aspects, legislations and private standards for organic aquaculture. The results will be communicated using a range of media and techniques tailored to involve all stakeholder groups. Further, Multi Criteria Decision Analysis (MCDA) and SWOT analysis will be used to generate relevant and robust recommendations.
A wide range of actors from several countries will participate and interact through a participatory approach. The 13 OrAqua project partners form a highly qualified and multidisciplinary consortium that includes four universities, five aquaculture research institutes, three research groups in social science, a fish farmer organisation, a fish farmer and two organic certification/control bodies.
The main outcomes of the project will be recommendations on how to improve the EU regulation, executive dossiers and a Policy Implementation Plan (PIP). Further the project will deliver recommendations on how to enhance economic
Development of the European organic aquaculture sector. The project is coordinated by NOFIMA, Norway. The project is funded by EU, Framework Programme 7.

Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
01/01/2014 → 31/12/2016

Keywords: Research area: Aquaculture

Pilot certification of freshwater farms and sea cages (Aquaculture Stewardship Council – ASC) (39041)

The project
- developed and tested systems and procedures for ASC certification of trout from Freshwater farms and Sea Cages
- collected and disseminated knowledge and experiences with ASC certification
- aimed at Danish ASC certified trout to be the first on the global market.

The project was coordinated by Danish Aquaculture Organization.
The project was funded by the Danish Ministry of Food, Agriculture anf Fisheries and the European Fisheries Fund (EFF).
Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
01/01/2013 → 30/06/2014

Keywords: Research area: Aquaculture
Collaborators: Aarhus University, Danish Aquaculture Association, Bureau Veritas

Development of a strategy for aquaculture in the Baltic Sea Region (38978) (BESTAQ)

Development of a strategy for aquaculture in the Baltic Sea Region. The acronym is BESTAQ (Baltic Environmentally Sustainable Aquaculture) and the project was a flagship project, including a range of stakeholders along the whole value chain to provide a tool for the governments and industries for decisions for development of aquaculture as well on national as on regional level.

The project was coordinated by the Finnish Game and Fisheries Research Institute.
The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).
Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
01/12/2010 → 31/12/2014

Keywords: Research area: Aquaculture
Collaborators: Food Safety, Animal Health and Environment Research Institute, Lund University, Swedish National Board of Fisheries, Finnish Game and Fisheries Research Institute, County Council of Jämtland

MISTRA Working Group for Aquaculture Research in Sweden (38977)

The main task of the Working Group was to provide MISTRA’s Board with background information for its upcoming decision on whether the foundation should invest or not in aquaculture research. MISTRA is a Foundation for Strategic Environmental Research.
The Working Group should
- describe current Swedish aquaculture research and perform a state of the art review putting Swedish research in an international context,
- make an overview of Swedish aquaculture industry in a global context,
- briefly compare aquaculture to other food production systems,
- briefly discuss the bottlenecks for Swedish aquaculture development,
- critically analyse the arguments for why MISTRA should invest in aquaculture research (cf. MISTRA’s statutes),
- suggest scope and focus of a new MISTRA research initiative (if recommended).
The project was coordinated by DTU Aqua.
The project was funded by Swedish Environmental Strategic Research Foundation MISTRA.
Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
01/08/2012 → 31/03/2013

Keywords: Research area: Aquaculture
Collaborators: Institute of Marine Research, Finnish Game and Fisheries Research Institute

Certification of eel and other minor species (38952)

Implementation of the “Sustainable Eel Standard” (cf. www.sustainableeelgroup.com ) for sustainable production of eel in a Danish pioneer eel-farm as well as dissemination of knowledge about eel and assessment of potentials of sustainability certification of other minor species.
The project was coordinated by Danish Aquaculture Association.
The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).
Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
01/01/2011 → 31/12/2013
Keywords: Research area: Aquaculture
Collaborators: Danish Eel Farmers Association, Danish Aquaculture Association
Project: Research

Organic Fry-1: Development of Danish farming of organic trout fry (38961)
Research based advisory for Danish farmers for conversion and management of the first Danish farms for production of organic fry according to the EU regulation on Organic aquaculture (EC no. 710/2009, article 25e) as well as further development of the applied and scientific platform for development of organic aquaculture in Denmark.
The project was coordinated by Danish Aquaculture Association.
The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).
Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Pedersen, L., Project Participant, National Institute of Aquatic Resources
01/06/2011 → 31/12/2014
Keywords: Research area: Aquaculture
Collaborators: Producers of Trout Fry, Danish Aquaculture Association
Project: Research

Aquaponics NOMA (Nordic Marine) – New innovations for sustainable aquaculture in the Nordic countries (38987)
A detailed study of the nutritional status of effluents from land-based fish farms as fertilizer for relevant plant species, adapt state-of-the-art technology and compare several aquaponic systems to meet the current and future challenges of both the aquaculture and horticulture industry, to develop commercial Aquaponics in the Nordic countries.
The project was coordinated by Bioforsk Øst, Landvik, Norway.
The project was funded by Nordforsk, Nordic Council of Ministers.
Paulsen, H., Project Participant, National Institute of Aquatic Resources, Section for Aquaculture
Jokumsen, A., Project Participant, National Institute of Aquatic Resources
Pedersen, P. B., Project Participant, National Institute of Aquatic Resources
01/01/2012 → 01/01/2015
Keywords: Research area: Aquaculture
Collaborators: FB Aqua Nor, Aquaponics AS, Matorka, Leithbridge College, Hobas AS, Government of Alberta, Norwegian Institute for Agricultural and Environmental Research, Norwegian Institute for Water Research, Icelandic Food Research, Institute of Global Food and Farming
Project: Research

Implementation of Global Certification (Aquaculture Stewardship Council - ASC) for rainbow trout and assessment of sustainable certification of new species (38809)
Aquaculture is globally the fastest growing food producing sector. However, to continue that trend requires efficient solutions to negative environmental and socioeconomic impacts that may be associated with aquaculture production. This project aimed to support the process of global certification of rainbow trout, i.e. to develop global, measurable, performance-based, and transparent standards that minimize negative environmental and social impacts from farming of trout in fresh water and maintain economic sustainability of trout production. The basis was the current types of production and strategies for farming of rainbow trout in fresh water in Denmark from the embryonic stage to marketable size and broodstock fish. Also included were the principles and the main national and EU regulations related to fish farming as well as issues related to feed, veterinary health conditions, and use of antibiotics and therapeutants. Production facilities included the design and construction, of the various types of fish farms (i.e., traditional farms, model trout farms, and Fully Recirculation Aquaculture (FREA) systems). Finally, farming of organic trout in Denmark and the related regulations affiliated with the organic label were included. The project was part of the Aquaculture Trout Dialogue facilitated by World Wide Fund for Nature (WWF) to develop the certification standards in cooperation with the other partners. Once the certification standards were fixed the Aquaculture Stewardship Council (ASC) became responsible for the certification of the produces.
The project was coordinated by Danish Aquaculture Association, Denmark.
The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).
Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
01/09/2010 → 01/04/2012
Keywords: Research area: Aquaculture
Collaborators: Aarhus University, World Wide Fund for Nature (WWF), Danish Aquaculture Association
Project: Research

Further development of Danish organic aquaculture (ØKOAKVA-1) (38806)
The first Danish organic rainbow trout with the Danish red Ø label was introduced to the market in 2005. The demand for organic trout is increasing and Danish trout farmers are currently converting to organic production. However, the development of organic trout production in Denmark has been challenged by a very strict national legislation for organic
aquaculture production. However, by the coming into force of the EU regulation for organic aquaculture by 1 July 2010 equality was established between the European organic fish farmers, but new challenges were faced by the Danish organic farmers. Therefore, further development and establishment of sustainable organic fish production in Denmark required strengthened research efforts, i.e. nutritional and environmental aspects, farming conditions, health, green energy and water consumption to improve the competitiveness and efficiency in production.

The project aim was to facilitate the implementation of the EU regulation on Organic Aquaculture for the production of rainbow trout in fresh and sea water, organic production of line mussels and sea weed.

The project was coordinated by Danish Aquaculture Association, Denmark.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
01/01/2010 → 31/03/2013

Keywords: Research area: Aquaculture
Collaborators: Danish Aquaculture Association, Danish Veterinary and Food Administration
Project: Research

**Strategies to improve health and welfare in rainbow trout farming (38193)**

The main aim of the project is the developing of sustainable strategies for improving the health, welfare and quality of cultured rainbow trout by implementing three interrelated approaches: management, immune prophylactics, and selective breeding. The management approach determines how increased water current at given rearing densities and water temperatures can reduce the stress of trout. The immune prophylactic approach determines the relationship between immune response profiles and induction of protective immunity at different water temperatures and hereby establishing efficient strategies for use of vaccination and feed stimulants in prevention of diseases. The selective breeding approach determines how physiological and immunological traits can improve the genetically basis for resistance of trout to stress and disease.

The project is coordinated by DTU Aqua.
Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Höglund, E., Project Participant, National Institute of Aquatic Resources
Larsen, B. K., Project Participant, National Institute of Aquatic Resources
Skov, P. V., Project Participant, National Institute of Aquatic Resources
McKenzie, D. D., Project Participant
01/01/2007 → 31/12/2010

Keywords: Research area: Aquaculture
Collaborators: Aarhus University, University of Copenhagen
Project: Research

**Innovative practices and technologies for developing sustainable aquaculture in the Baltic Sea region (AQUABEST) (38924)**

In opposite to the global trend, aquaculture production in the Baltic Sea region had stagnated. It is widely accepted that aquaculture had great potential to feed the growing human population in the era of declining wild stocks ("Blue Revolution"), but new production has to be built on sustainable practices and technologies. The European Union has identified this challenge and has adopted aquaculture as a flaghip project in the EU strategy for the Baltic Sea region.

Firstly, AQUABEST demonstrated that Baltic Sea region aquaculture was capable of becoming a nutrient neutral food production system. This was assessed to be achieved by replacing oceanic feed ingredients and plant products harvested at other continents with regional feed ingredients. Potential regional ingredients included Baltic Sea fish catches and Baltic Sea grown mussels not used for human consumption, as well as plant proteins and single cell proteins produced and processed in the region.

Secondly, AQUABEST adapted lessons from maritime spatial planning projects, developed them into guidelines and by regional testing demonstrated that spatial planning tools can be adapted to create environmentally, economically and socially sustainable aquaculture. Spatial planning activities were completed by activities that could support farmers to move fish cages offshore and which could support mussel farmers to adapt technologies that tolerated harsh winter conditions in the northern Baltic Sea.

New farming technologies using recirculating water have been developed especially in Denmark. The third solution of AQUABEST was to transfer these technologies to other regions and further develop them to adapt to brackish water conditions of the Baltic Sea. Furthermore, although recirculation farms already released much less nutrients in the effluent than conventional farms, nitrogen release of these farms could be further diminished.

As the final outcome, AQUABEST carried out regional self-evaluation of current environmental regulation models in aquaculture. A novel ecosystem-based regulation needed new approach, environmental policy instruments and economic incentives. Concrete improvements were proposed after dialogue between major stakeholders.

The project was coordinated by Finish Game and Fisheries Research Institute, Finland.

The project was funded by EU, InterReg (regional collaboration).

Jokumsen, A., Project Manager, National Institute of Aquatic Resources, Section for Aquaculture
Pedersen, P. B., Project Participant, National Institute of Aquatic Resources
Suhr, K. I., Project Participant, National Institute of Aquatic Resources
Dalsgaard, A. J. T., Project Participant, National Institute of Aquatic Resources
Pedersen, L., Project Participant, National Institute of Aquatic Resources
01/01/2011 → 31/12/2014
Keywords: Research area: Aquaculture
Collaborators: Association of Marine Aquaculture Ltd, Jämtland County Council, Lund University, University of Helsinki, Belarusian State Agricultural Academy, Danish Aquaculture Association, The Government of Åland, Institute of Food Safety Animal Health and Environment, Thunen-Institut, Finnish Game and Fisheries Research Institute, University of Tartu, Swedish Board of Agriculture, Polish Trout Breeders Association
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
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