Circularity – new possibilities, new problems

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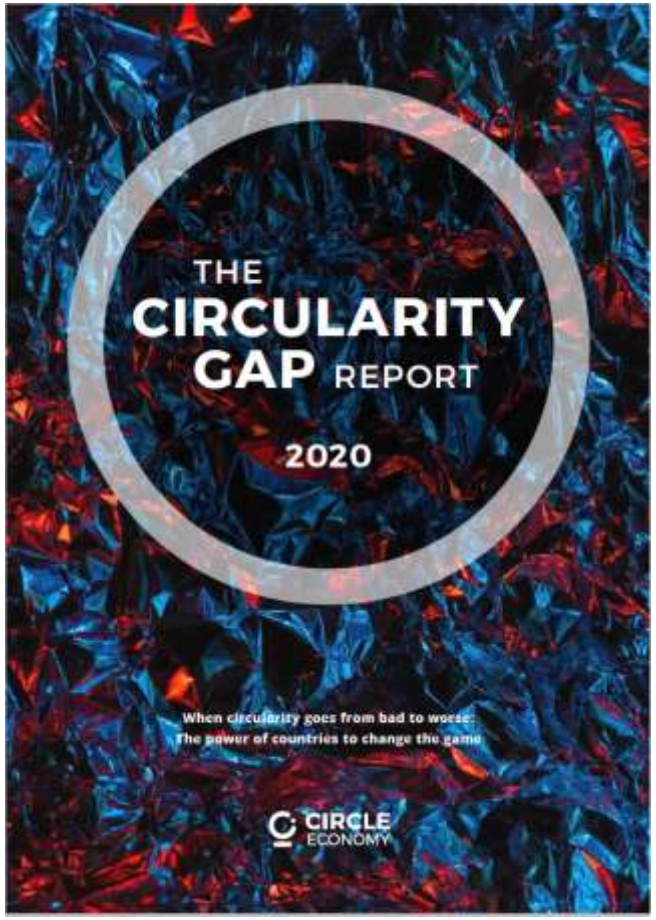
The Circularity Gap Report 2019

The Circularity Gap Report 2019 finds that **the global economy is only 9% circular** - just 9% of the 92.8 billion tonnes of minerals, fossil fuels, metals and biomass that enter the economy are re-used annually.



83% of GHG emissions in

norwegian salmon farming

from feed

RESOURCE USE

2019:01505- Unrestricted

Greenhouse gas emissions of Norwegian seafood products in 2017

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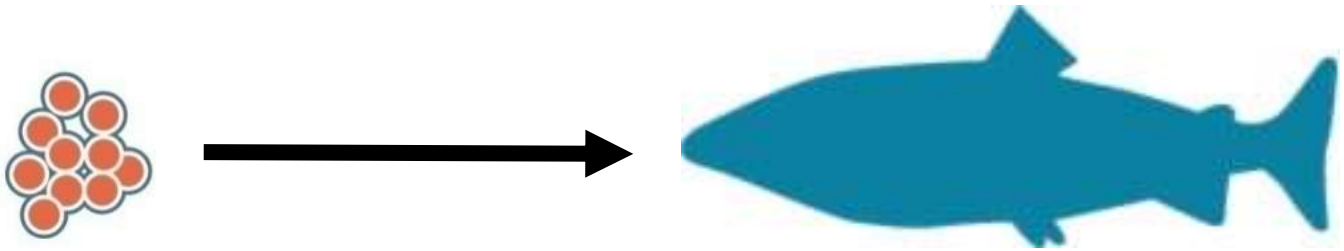
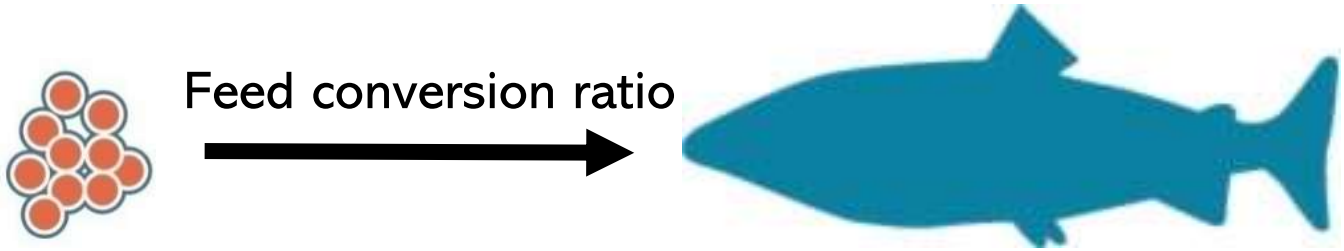
Seafood Technology
2020-02-12

Salmon farming is extremely linear



Resource use from a fish nutritionist perspective

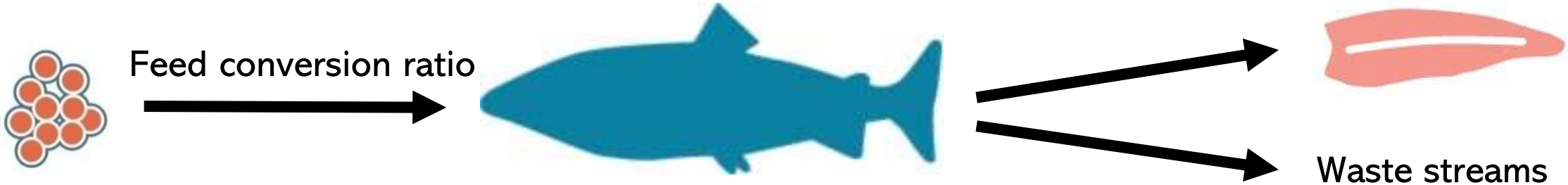


	Fish (% of fed amount)
Protein	40%
Lipid	50%
Starch	0%
Ash	30%

Hamre et al. 2016. ***PeerJ****, Hemre et al. 2016.* ***PeerJ***

Resource use from a ~~fish nutritionist~~ perspective

CIRCULAR



	Fish (% of fed amount)	Loss to environment	
Protein	40%	60%	N-compounds
Lipid	50%	50%	Used as energy by the fish
Starch	0%	100%	C-compounds
Ash	30%	70%	Minerals (e.g. P, Zn, Se)

Hamre et al. 2016. ***PeerJ****, Hemre et al. 2016.* ***PeerJ***

Valorisation of RAS waste streams

Feed conversion ratio

~~Waste streams~~

Resource: sludge

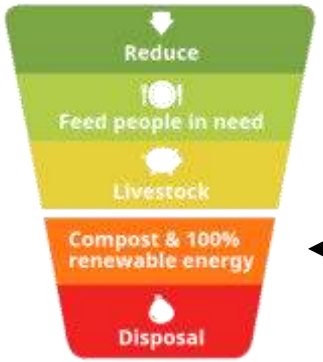
Nofima

Rapport 33/2016 • Utgitt juli 2016

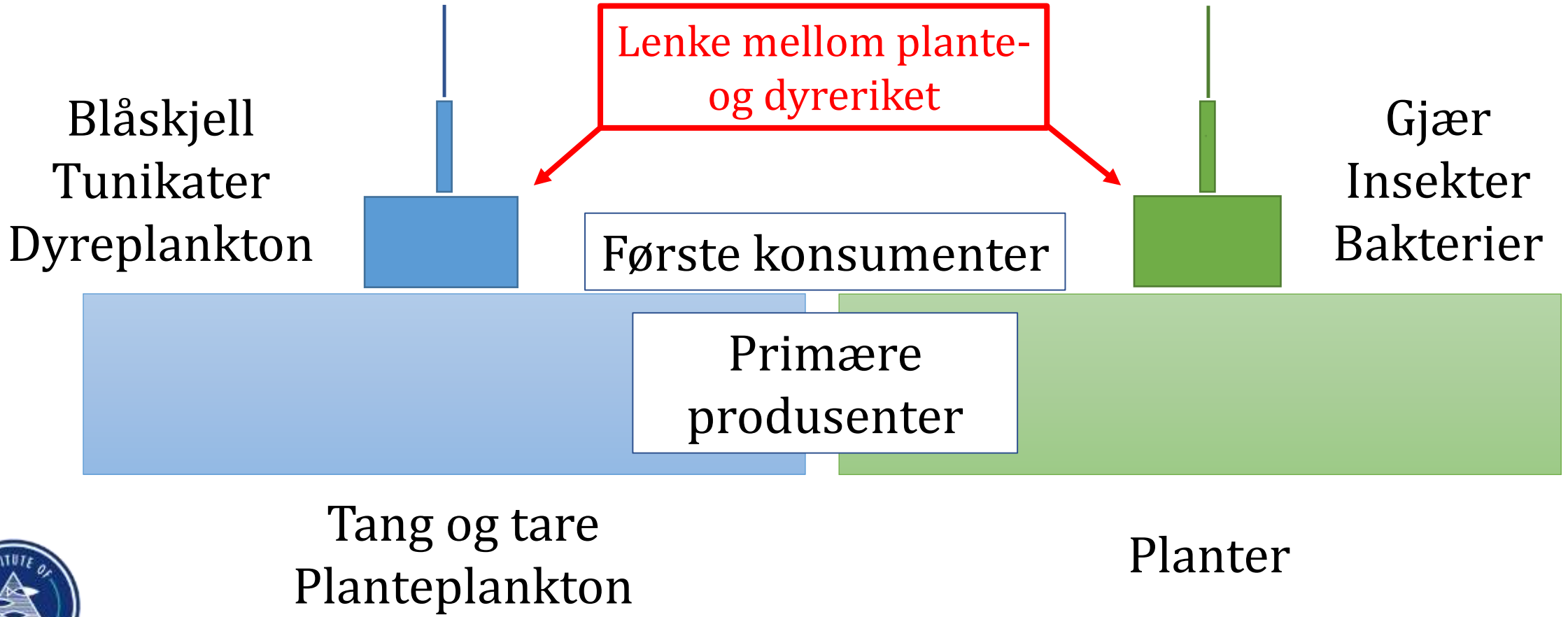
Karakterisering av slam fra tre kommersielle settefiskanlegg gjennom ett produksjonsår

Hovednæringsstoff, mineraler og tungmetaller

Trine Ytrestøyl, Turid Synnøve Aas, Kristin Skei Nerdal og Gerd Marit Berge



Produsenter og første konsumenter



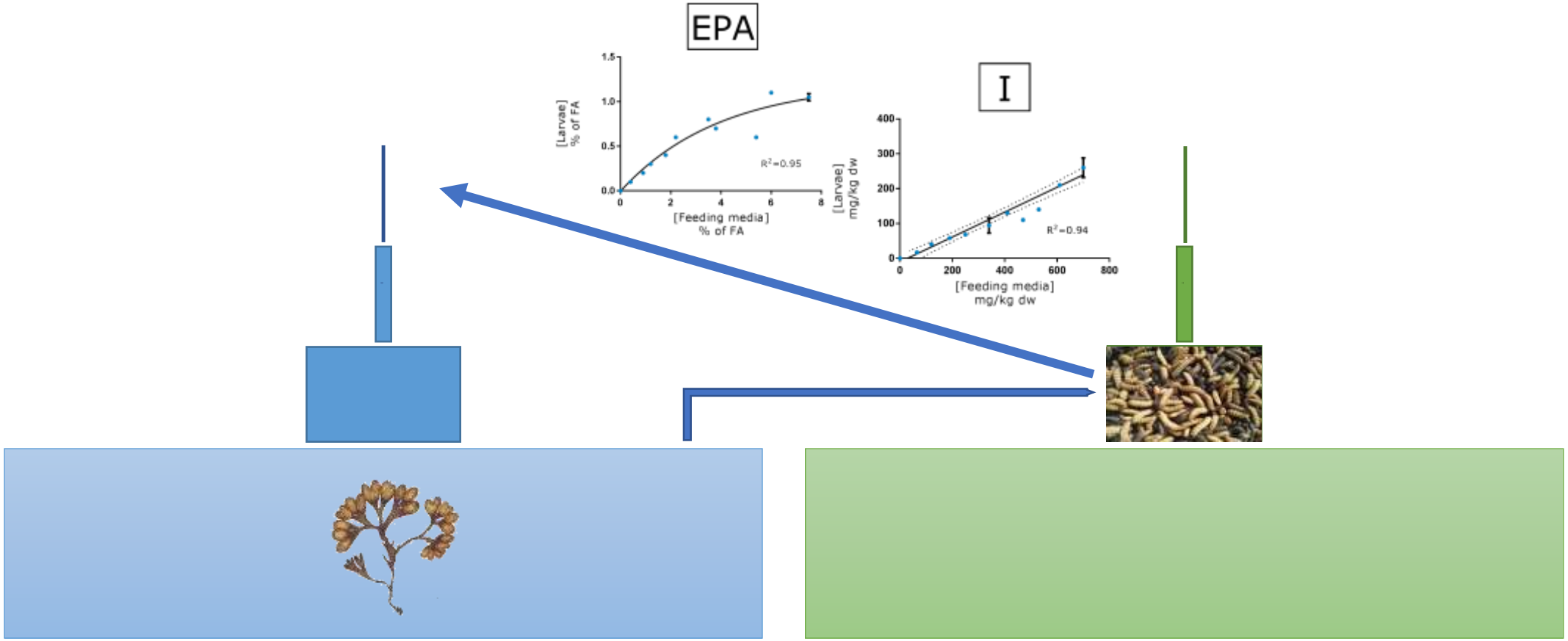
Første konsumenter som en bioreaktor

	Input (% d.w.)
Protein	10-15
Lipid	2-5
Carbohydrates	50-70
Chitin	0
Ash	4-15

Plante protein

Animalsk protein

Næringsstoffene følger den nye næringskjeden



Liland et al. 2017
Biancarosa et al. 2017

animals

MDPI

Article

Growth and Safety Assessment of Feed Streams for Black Soldier Fly Larvae: A Case Study with Aquaculture Sludge

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Simple Summary: The production of food is an intensive source of environmental impact. In aquaculture, one source of impact is solid waste, which contains high concentrations of minerals, other nutrients, and metals. The larvae of *Hermetia illucens* are capable of consuming this material, but applying technology that is based on these larvae for managing waste streams, like those from aquaculture, requires careful examination of safety risks. A study is performed examining the growth performance of larvae that were fed on solid aquaculture waste. Then, a thorough analysis of safety risks from inorganics is performed to serve as a guideline for how to assess the safety of waste streams, such as these. The practitioner can use this as a template for the safety assessment for other high risk organic streams as feed for larvae.

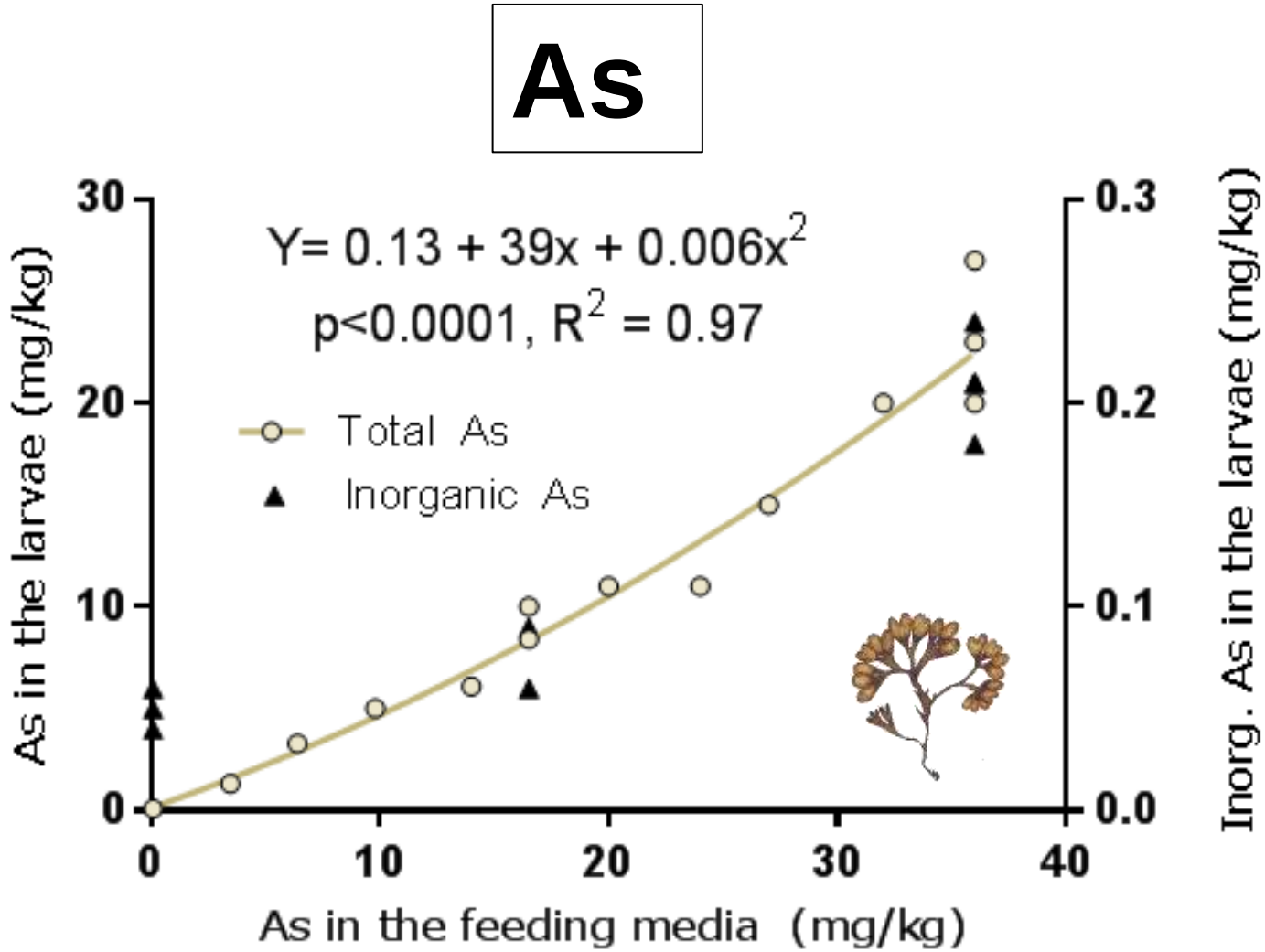
Abstract: The production of food is an intensive source of environmental impact. In aquaculture, one source of impact is solid waste, which contains high concentrations of minerals, other nutrients, and metals. The larvae of *Hermetia illucens* are capable of consuming this material, but applying technology that is based on these larvae for managing waste streams, like those from aquaculture, requires careful examination of safety risks. A study is performed examining the growth performance of larvae that were fed on solid aquaculture waste. Subsequently, a thorough analysis of safety risks from inorganics, with detailed the results on microelements that have previously received little attention in the literature, is performed to serve as a guideline for how to assess the safety of waste streams such as these. Findings confirm existing results in the literature that Cd is bioaccumulative, but also that other elements, including Hg, Mn, and especially K, are bioaccumulative. To the authors' knowledge, this is the first research where the accumulation of Ag is also tested. The results of these tests are explained within the context of regulations in various countries where *Hermetia illucens* is cultivated, serving as a reference for practitioners to rigorously screen out high risk feed streams that they may consider using as feed sources. It is intended that these references and the demonstrated accumulation of a range of elements motivate comprehensive industry safety practices when evaluating new feed sources.

Keywords: Black soldier fly larvae; sludge; Mineral composition; Safety risks; Aquaculture

Problem:

Heavy metal accumulation in insects

Kontaminanter følger også med



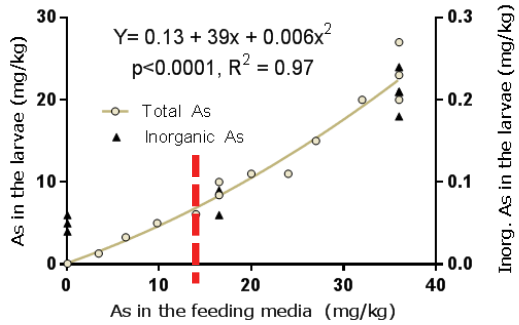
Kontaminanter følger også med

1.2 kg

Aim:
3 kg weight gain

Market size (4-4.5 kg)

As



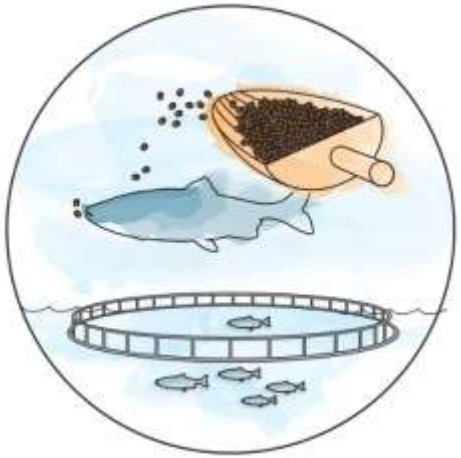
Diet 1-Ctrl

Diet 2-IM 33%

Diet 3-IM 66 %

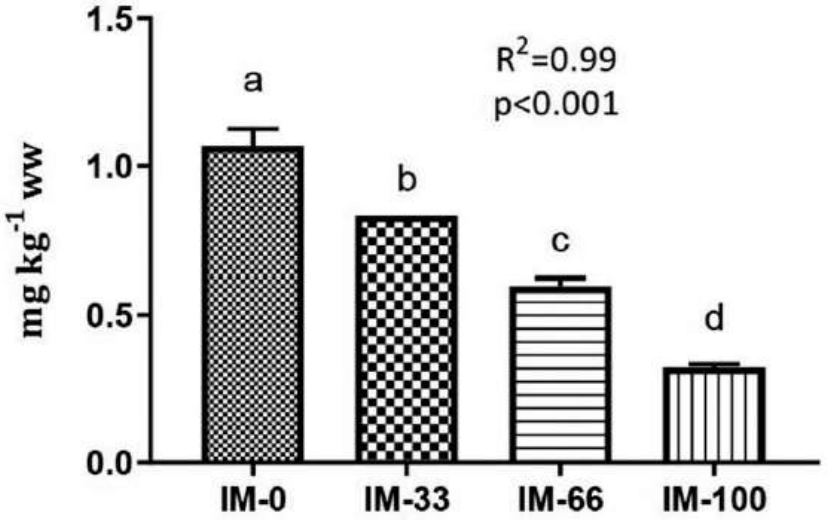
Diet 4-IM 100 %

4 x 3= 12 cages in total



90 fish in each cage
113 days

Arsen i fiskemuskel



Biancarosa et al. 2019

Arsen kommer i mange former

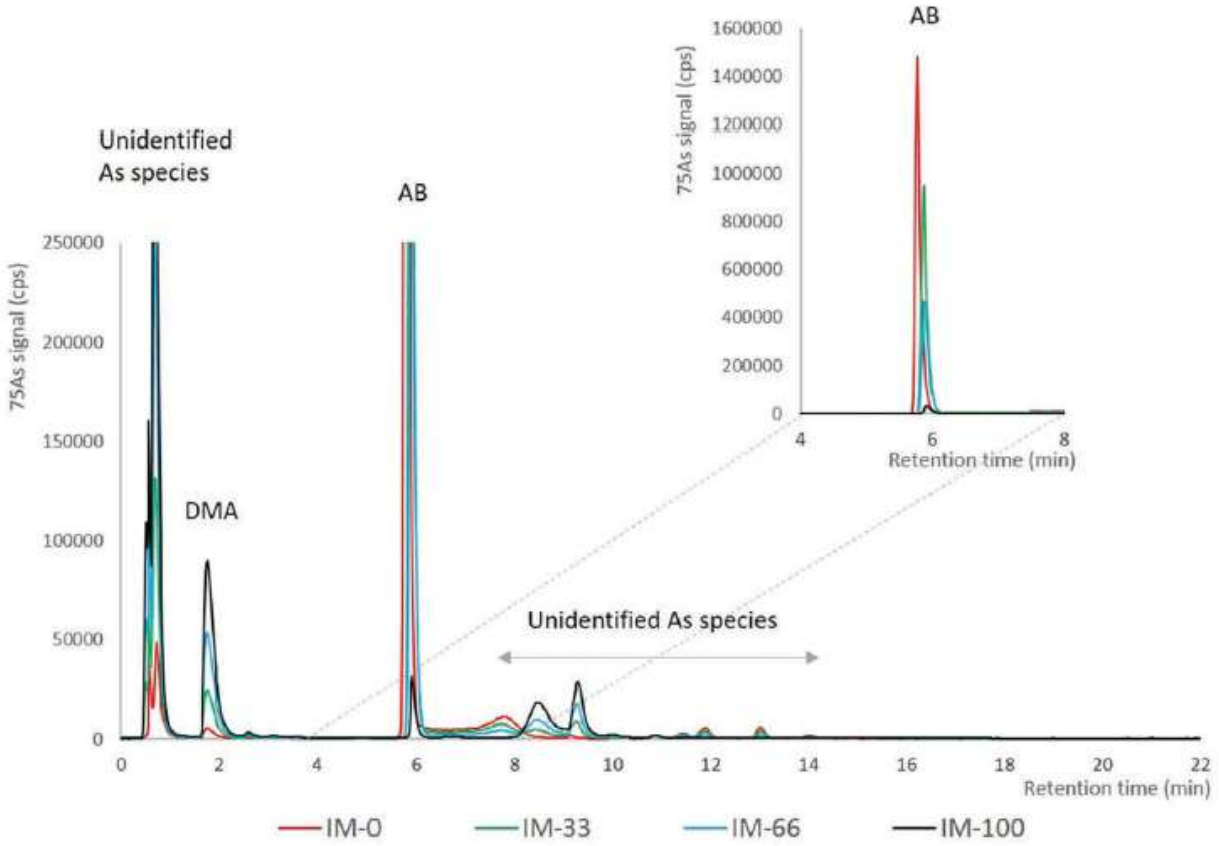


Figure 3. Chromatograms of the organic arsenic species in the diets (overlay of diet IM-0, IM-33, IM-66 and IM-100) analysed by cation-exchange HPLC-ICPMS. The major arsenic peaks are in the void of the chromatogram (< r.t. 1 min) being unidentified arsenic species, dimethylarsinate (DMA) and arsenobetaine (AB). Minor unidentified arsenic species are detected later in the chromatogram (r.t. 8–15 min). The enlargement shows the full signal scale for AB.

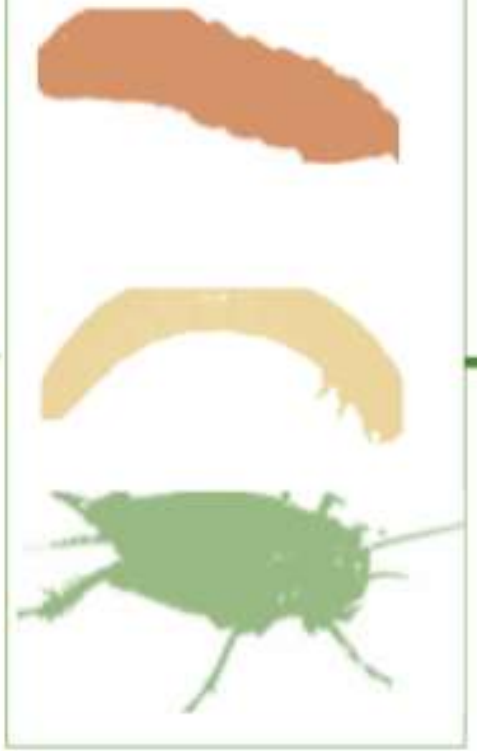
Biancarosa et al. 2019

EU Regulatory possibilities for insects' use in animal feed

Feed stocks

- ✓ Vegetal substrates
- ✓ Unprocessed former foodstuff: dairy & eggs
- ✗ Unprocessed former foodstuff: meat and fish
- ✗ Catering waste & Slaughterhouse products
- ✗ Animal manure

Insect production



Target species

Allowed to be fed to fish as from 1st July 2017.

* Non-hydrolysed protein (if classified "hydrolysed", all markets would be allowed)

Thank you for your attention!