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"Strengthening Circular Economy and Valorisation of side-streams in RAS Aquaculture"

AQUALOOP International Conference

By-products characterization and valorization of African catfish (*Clarias gariepinus*)

Ballesteros-Redondo et al. (in prep.)

Bremerhaven, Germany | 25 February 2026

Speaker: Dr. Christina Schmidt, Chair of Aquaculture and Sea-Ranching, University of Rostock

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Introduction

BY-PRODUCTS CHARACTERIZATION AND VALORIZATION (LIVER, SKIN, GONADS) OF AFRICAN CATFISH (*Clarias gariepinus* BURCHELL, 1822) BASED ON FATTY ACIDS

Laura Ballesteros-Redondo[a,*], Alexander Wacker[b], Harry Palm[a], Adrian A. Bischoff[a]

[a]University of Rostock, Faculty of Agricultural and Environmental Sciences, Department of Aquaculture and Sea-Ranching, Justus-von-Liebig-Weg 6, 18059 Rostock, Germany. laura.redondo@uni-rostock.de , adrian.bischoff-lang@uni-rostock.de, harry.palm@uni-rostock.de

[b]University of Greifswald, Department of Animal Ecology, Zoological Institute and Museum, Greifswald, Loitzer Str. 26, 17489 Greifswald, Germany alexander.wacker@uni-greifswald.de

Background

- Study was part of Pilot 2, NEMATIC (Increasing the Nutrient Efficiency of coMmercial Aquaculture Through Increased application of Circular economy concepts)
- Aquaculture grows rapidly worldwide
- **African catfish (*Clarias gariepinus*)**
  - suitable for intensive production systems (RAS)
    - ➢ fast-growing, tolerates high stocking densities, robust

Introduction

Background

- <u>Economically problematic:</u>
  low market price & high proportion of waste (skin, gonads, liver, head…)

- Some by-products contain high amounts of lipids, including valuable omega-3 fatty acids

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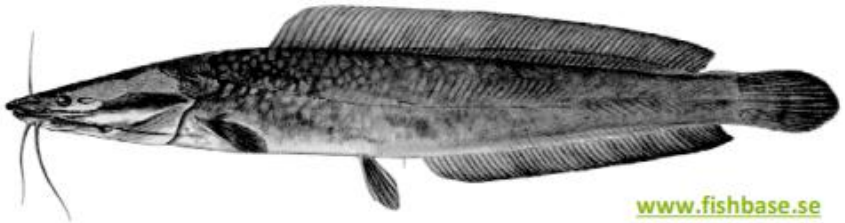
Introduction

Background

- There's a lack of systematic data on…
  - how fatty acids are distributed among individual organs
  - how sex & age affect lipids
  - what ecological potential lies in the utilization of by-products

- The **aim of the study** is therefore to characterize the **liver, skin, & gonads** in terms of fatty acid content, analyze sex & age differences, & identify the optimal slaughter time



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Material & Methods

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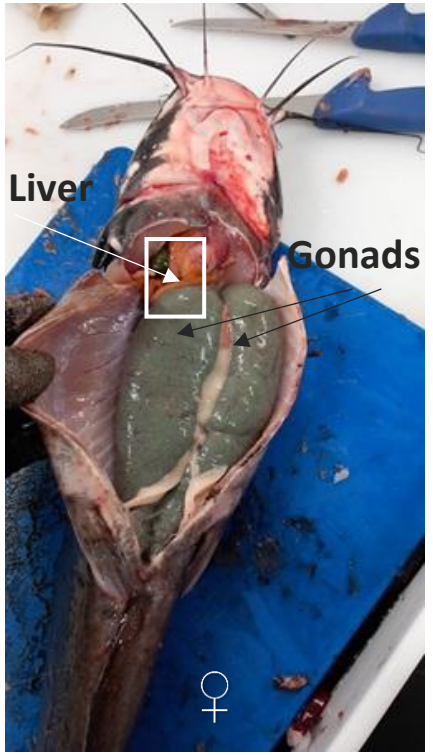
- **Test facility & fish farming:**
  - African catfish from the commercial RAS facility at the University of Rostock
  - Raised for up to 48 weeks, final weight up to 2 - 2.5 kg
- **Sampling**:
  - Regular sampling at 3-week intervals
  - Focus on commercially relevant age groups: 24-48 weeks
  - 5 fish per tank (3 tanks in total)
  - Sex determination
  - From each fish (n=120) (male n=52 & female n=68) samples of liver, gonad & skin were taken



African catfish
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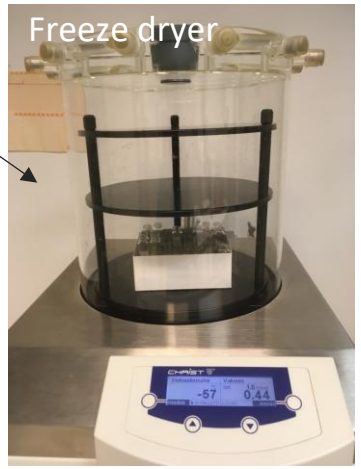
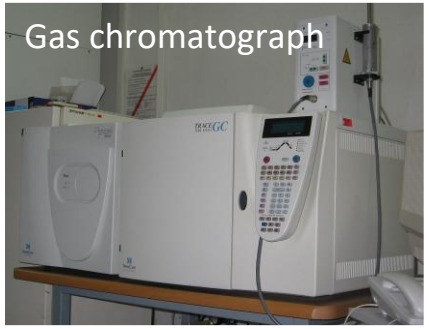
Material & Methods

Analyses

Tissue sample



- Determination of body weight, fillet-, skin-, liver-, & gonad weight
- Heptosomatic & gonadosomatic index
- Fatty acid (FA) analyses:
    - Tissue samples were freeze-dried & homogenized into powder
    - Extraction, transesterification of lipids into fatty acid methyl esters (FAMES)
    - FAMEs were seperated & quantified using GC, identification of individual FA via comparision with known standards



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Exkursus

Lipids & fatty acids

Lipids refer to all fats; a total of 7 groups

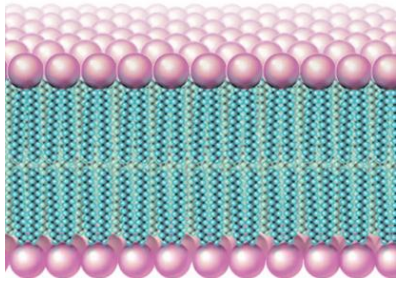
Fatty acids = one group of lipids -> consist of hydrocarbon chains with a carboxyl group

classified according to chain length & presence & position of double bonds

We distinguish between:

Saturated fatty acids (SFAs): when carbon atoms are linked only by single bonds

Unsaturated fatty acids: when the carbon chain contains double bonds



Functions:

- provide energy
- essential components of cell membranes
- can act as „raw material“ for production of hormones
- transport vitamins ....

Exkursus

Lipids & fatty acids

* **Unsaturated fatty acids:** when the carbon chain contains double bonds

PUFA (polyunsaturated fatty acid): - more than one double bond

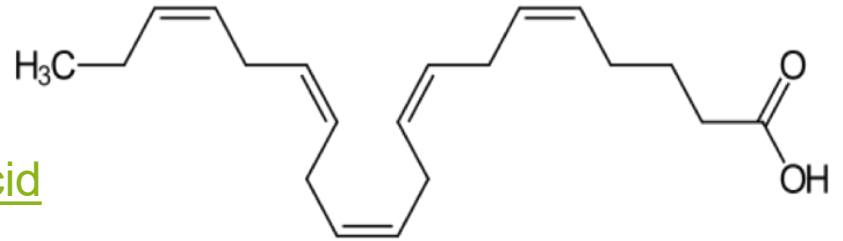
Omega-3 fatty acids are PUFAs

for example: EPA (eicosapentaenoic acid) & **DHA** (docosahexaenoic acid)

- Omega-3 fatty acids are natural fats found in fish that are considered beneficial for health, particularly for supporting heart & brain function. Also known for anti-inflammatory effects

* Eicosapentaenoic acid

(EPA)



Omega-3 fatty acid

PUFA (polyunsaturated fatty acid)

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Results

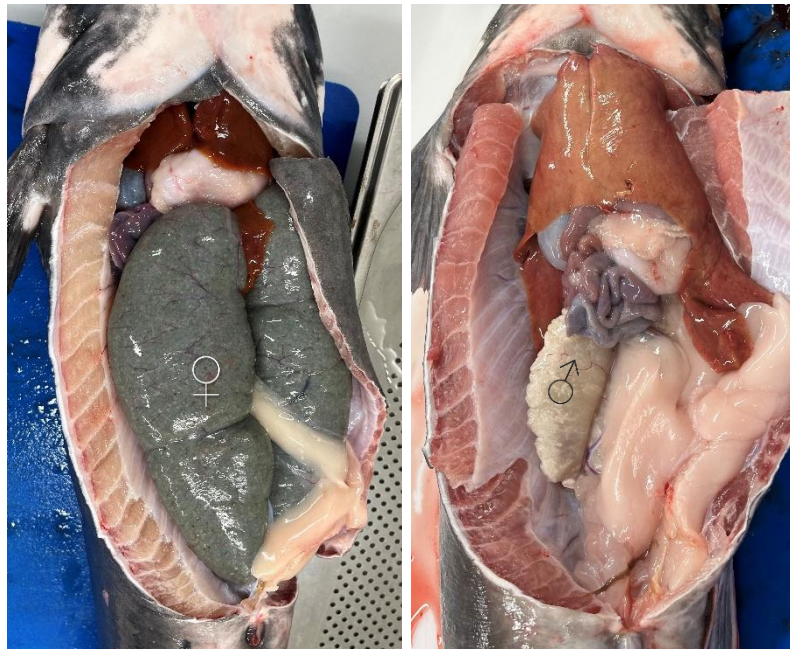
Growth & morphological indices

HSI: stable in female (**1.0** +/-0.2% to **1.2** +/-0.1%), consistently higher in male (**1.6** +/- 0.1% to **2.2** +/- 0.3%)

GSI: strong increase with age in females (up to **16%**),

low in males (less than **1%**)

In summary: females invest heavily in reproduction, males primarily in somatic growth



Results

Fatty acids distribution

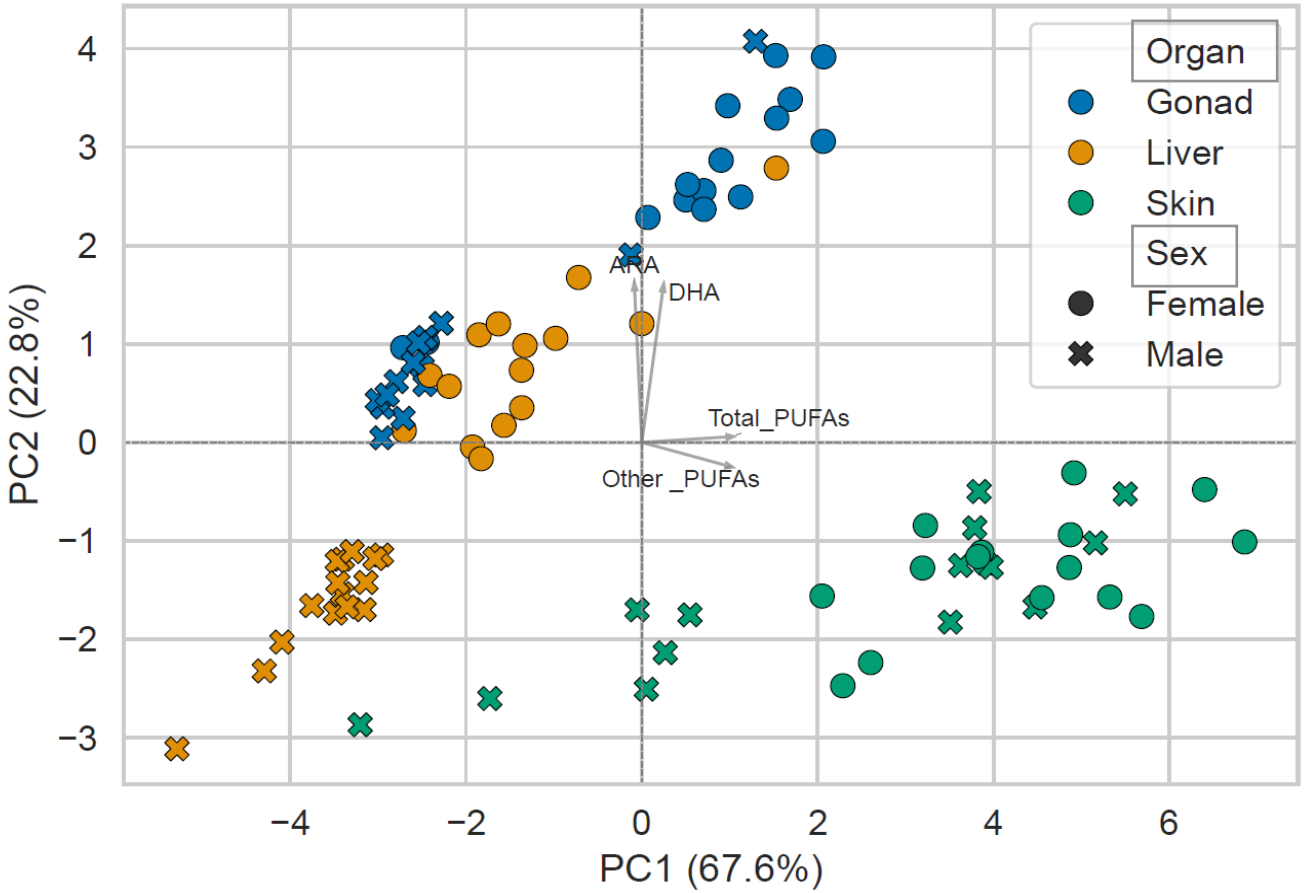
PCA visualization of organ- & sex-specific patterns

- FA distribution is organ-specific
- Skin

  Highest total FA levels, no significant sex or age effects
- Gonads

  Females: sig. higher amount of total FA & Omega-3 FA. Males: particularly small amount of Omega-3 FA
- Liver

  Females: significant higher amount of FA & Omega-3 FA than males



Additional: Mixed linear model for tests of age-effects

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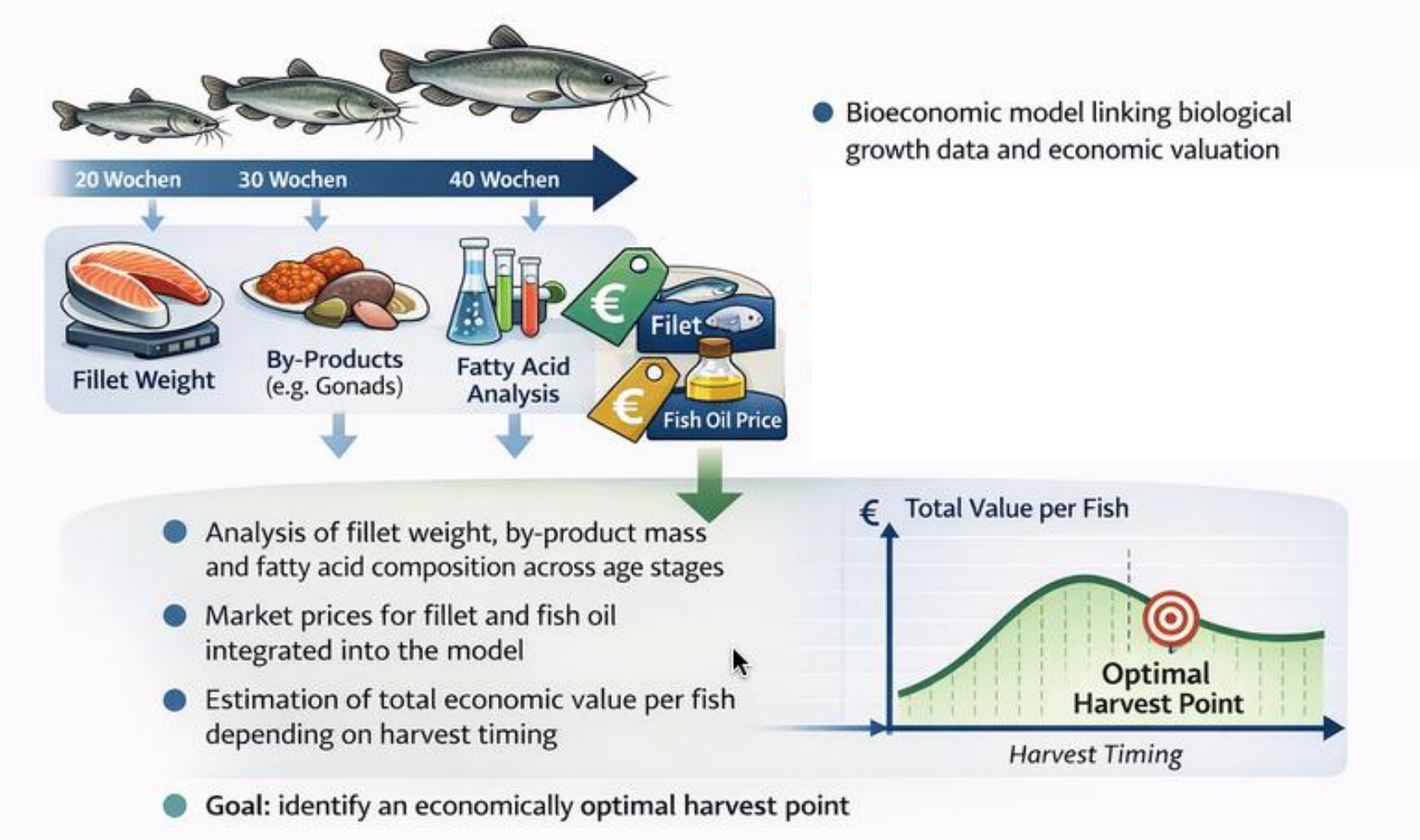
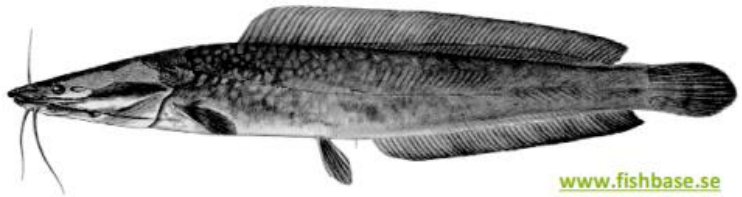
Development Bioeconomic model

in progress

Model is based on different variables:



Take-Home-Message



- **Skin has the highest FA content** (308 – 356 Microgram per Milligram dry weight)
- Tissue type strongest driver of fatty acid composition.
  Liver, gonads, & skin show clearly distinct profiles.
- Age influences fatty acid composition in a tissue-specific manner,
  with strongest effects observed in female gonads.
- **By-products are no waste**

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Thank you for your attention!

Contacts

Laura Ballesteros-Redondo

Laura.Redondo@thuenen.de

Adrian Bischoff-Lang

Adrian.Bischoff-Lang@uni-rostock.de

Christina Schmidt

Christina.Schmidt2@uni-rostock.de

@AquaLoop

@AquaLoop Interreg SB

aqualoop.edu.pl