Roeblade og strandopskyl? Hvor finder vi økonomisk og bæredygtigt larvefoder?

Dansk Bioøkonomi Konference 2019, Sakskøbing

Lars-Henrik Lau Heckmann, Sektionsleder, ph.d.

Main challenges of the insect industry

- **Upscaling (industrial level)**
  - Insect biology in production environment
  - Development of (customized) automation
  - Development of species-specific feed
- **Legal barriers (EU) in feed and food**
  - Increasing the knowledge-level on feed/food safety of insects
  - Political priority to promote the use of insects as feed and food
- **Consumer acceptance**
  - Information...

EU insect production – current and future volumes

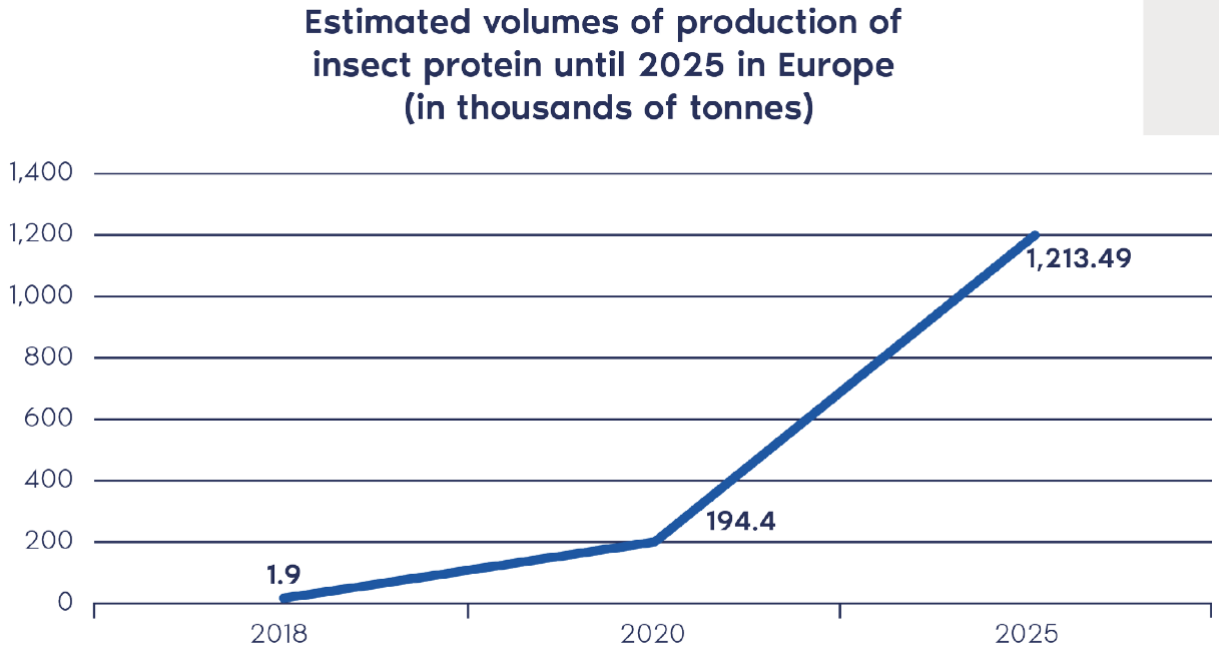
Did you know?

15
Different countries represented

€355
Million Invested in members' companies

>€500M private investments by 2019-Q1

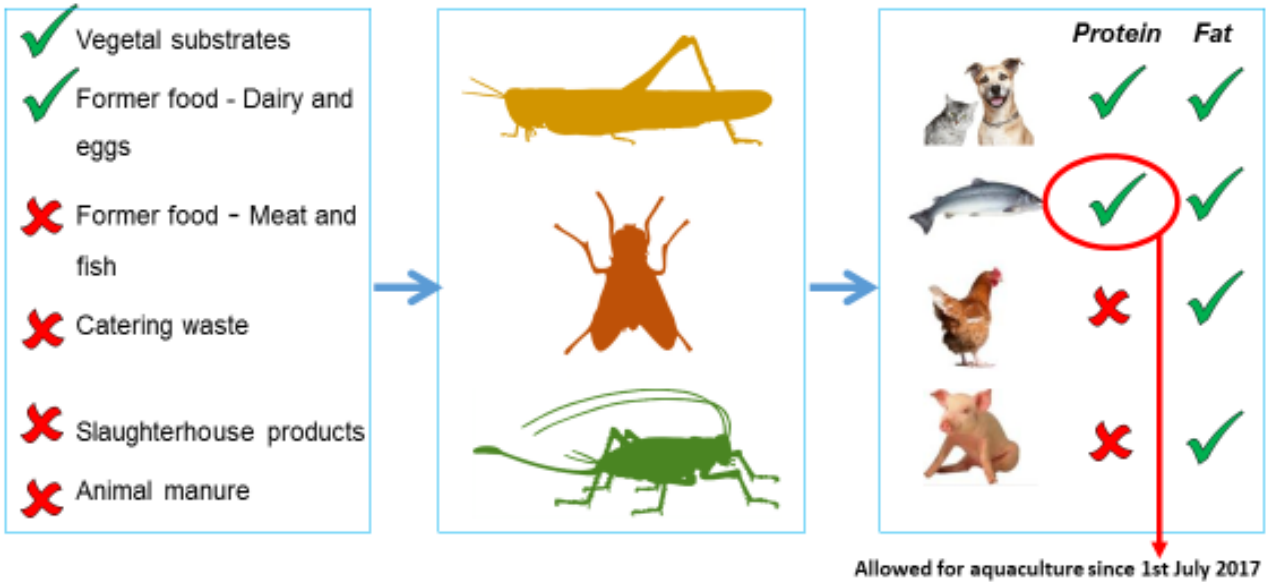
ipiff



Source: IPIFF Vision Paper

Insects: EU regulatory overview – feed (generic)

Seven species defined by EU as farmed animals for feed use

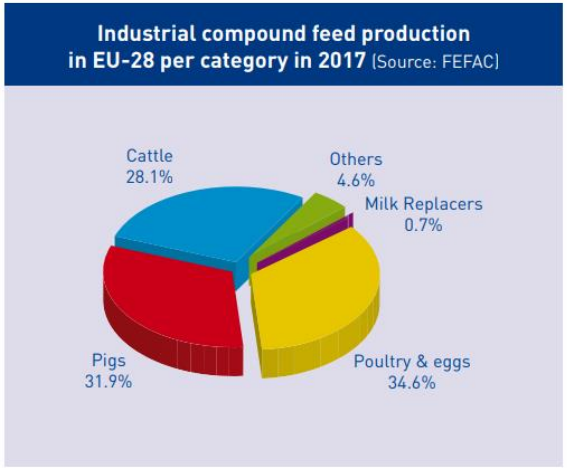


Currently legal US/CA – EU expected in 2019

Currently not legal EU or US/CA – EU expected in 2020+

Markets (Pet food and feed)

- Pet food (EU)
  - ~8 mill t/yr – insects may capitalize on **~1M t/yr**
- Feed (EU)
  - **Aquaculture (global)**: 3M t fish meal/yr needed in 2030-2040 – insects may capitalize on **>1M t/yr**
  - **Poultry:** ~55M t/yr – insects may capitalize on **>5M t/yr** (poultry expected to double by 2050)
  - **Pigs:** ~51M t/yr – insects may capitalize on **>5M t/yr**



BIOCAS (01 July 2017 - 30 June 2021)

GULDBORGSUND

Interreg
North Sea Region
BIOCAS
European Regional Development Fund

EUROPEAN UNION

Substrate selection for BSF* feed trial

*Black soldier fly (*Hermetia illucens*)

DANISH TECHNOLOGICAL INSTITUTE

GULDBORGSUND

Interreg North Sea Region BIOCAS

European Regional Development Fund

EUROPEAN UNION

Dry matter (dm), protein, lipid and ash content (%) and availability of different substrates from Guldborgsund Municipality.

Substrates	Dry matter (% dm)	Protein (% dm)	Lipid (% dm)	Ash (% dm)	Seasonability
Seaweed	13	7	1	31	all year
Spent grain	17	25	11	3	all year
Apple pomace	20	5	4	4	autumn
Wheat	88	12	3	1	all year
Rapeseed cake	74	35	10	8	all year
Sugarbeet tops	14	29	3	24	autumn
Malt	75	24	3	7	all year
Butter cookies	96	6	22	1	all year

Diet formulation for BSF feed trial

Percentage of different substrates and water used in the formulation of 4 diets

Substrates	Diet 1 (%)	Diet 2 (%)	Diet 3 (%)	Diet 4 (%)
Seaweed	10	5	0	0
Spent grain	15	20	19	25
Apple pomace	0	10	0	10
Wheat	20	10	11	10
Rapeseed cake	0	2	0	2
Sugarbeet tops	5	0	2	0
Malt	5	10	3	10
Butter cookies	5	0	3	0
Water	40	43	62	43

Experimental parameters of BSF feed trial

DANISH TECHNOLOGICAL INSTITUTE

GULDBORGSUND

Interreg North Sea Region BIOCAS European Regional Development Fund

EUROPEAN UNION

Total protein, lipid and ash content of different diets used in the dietary experiment

	Diet 1	Diet 2	Diet 3	Diet 4
Protein (% dm)	24	28	19	29
Lipid (% dm)	10	7	9	7
Ash (% dm)	6	7	3	6

Experimental parameters

- Tray size: 30x20 cm
- Replicates: 3 per diet
- Temperature: 27ºC
- Density: 11 larvae/cm²
- Total feed per replicate: 2 kg
- Dry matter: 19%
- Feeding episodes: 3
- Experimental time: 12 days

Dietary experiment

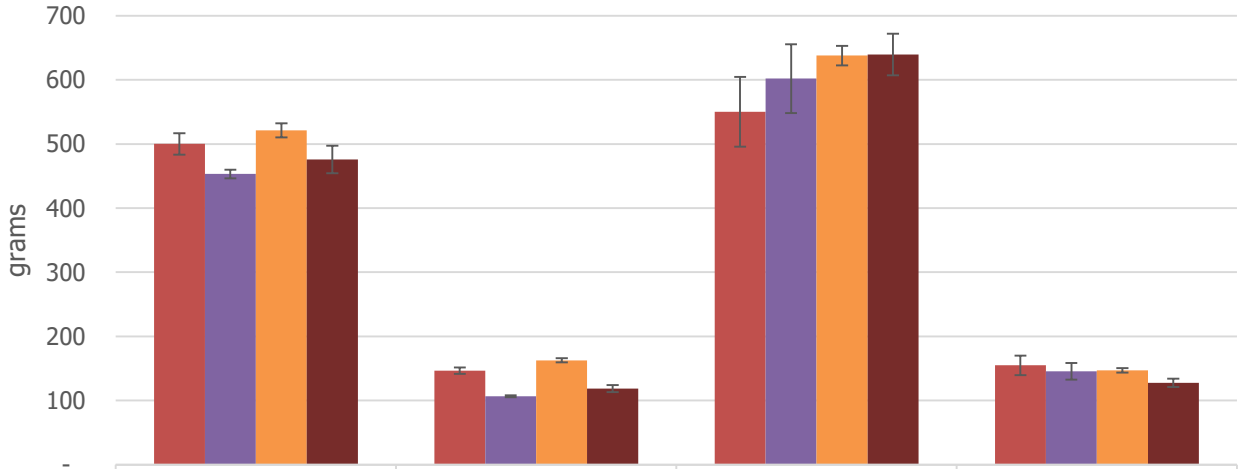
DANISH TECHNOLOGICAL INSTITUTE

GULDBORGSUND

Interreg North Sea Region BIOCAS European Regional Development Fund

EUROPEAN UNION

Larval and insect frass production during the dietary experiments (avg±sd)



	Larval production (fw)	Larval production (dm)	Insect Frass (fw)	Insect Frass (dm)
Diet 1	500	147	550	155
Diet 2	453	107	602	146
Diet 3	521	163	638	147
Diet 4	476	119	640	127

Dietary experiment

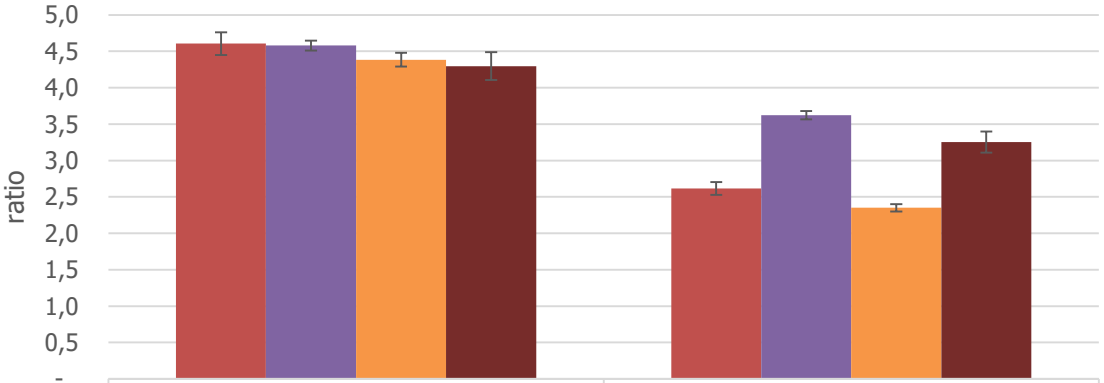
DANISH TECHNOLOGICAL INSTITUTE

GULDBORGSUND

Interreg North Sea Region BIOCAS European Regional Development Fund

EUROPEAN UNION

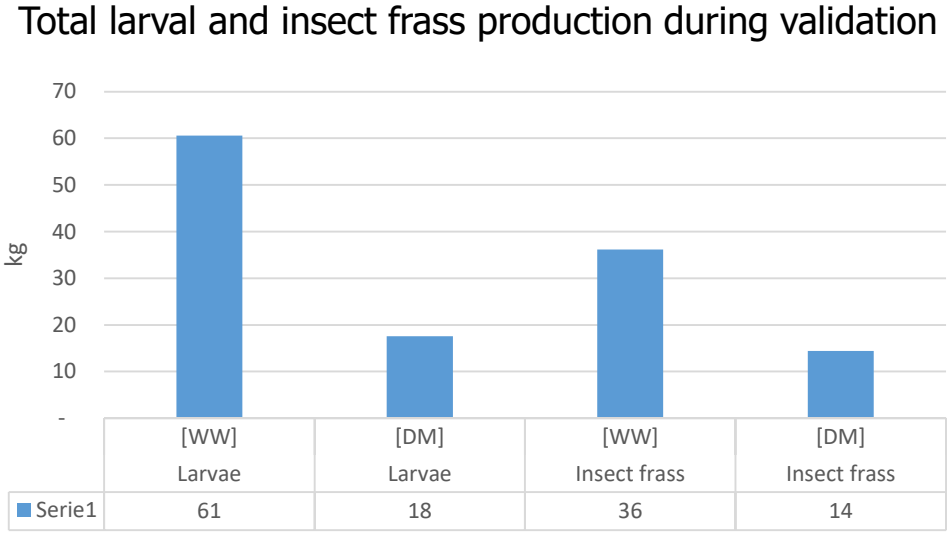
Feed conversion ratio in the dietary experiment (avg±sd)



	FCR (fw)	FCR (dm)
Diet 1	4,6	2,6
Diet 2	4,6	3,6
Diet 3	4,4	2,4
Diet 4	4,3	3,3

Survival rate of BSFL during the dietary experiment was 79-82%

Validation of Diet 3 in pilot production

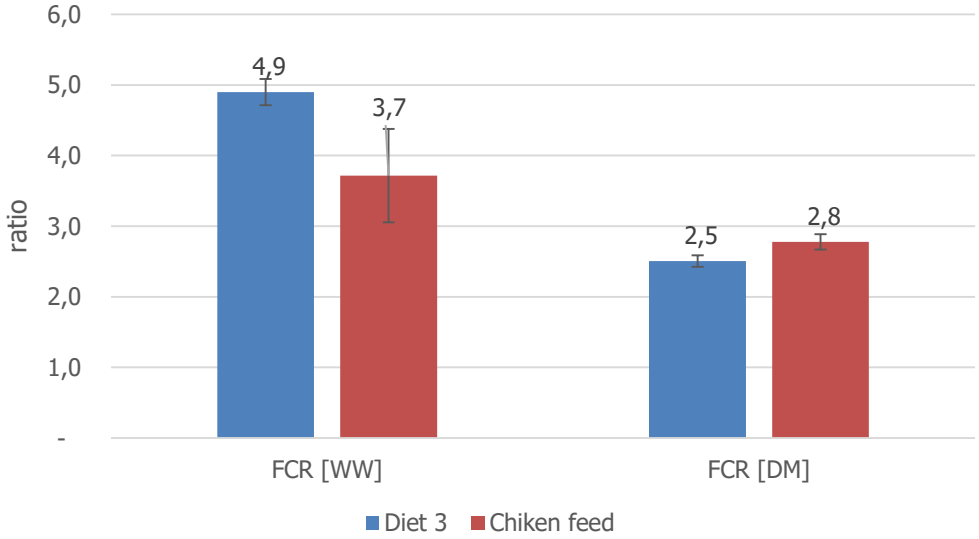


Production parameters

- Tray size: 60x40
- Temperature: 27ºC
- Density: 10 larvae/cm²
- Feed used: Diet 3
- Total feed per replicate: 8 kg
- Dry matter: 19%
- Feeding episodes: 2
- Experimental time: 10 days

Validation of Diet 3 in pilot production

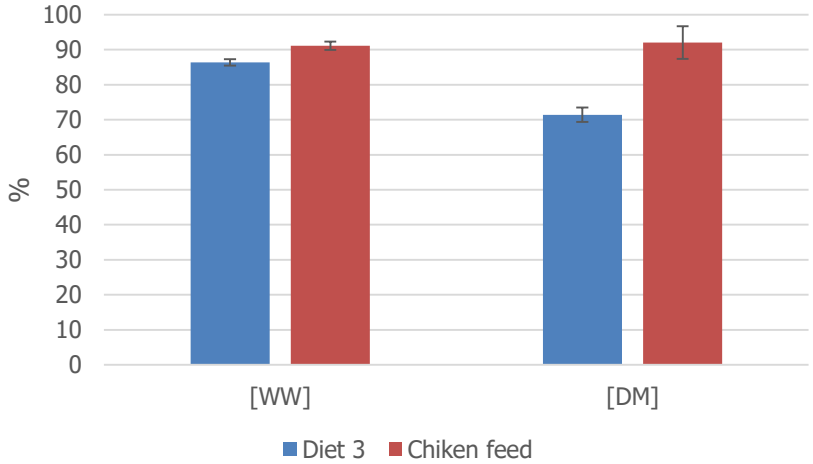
Feed conversion rate from two pilot productions using Diet 3 and Chicken feed



Survival rate

- Diet 3: 84%
- Chicken feed: 91%

Substrate reduction from two pilot productions using Diet 3 and Chicken feed



Validation of Diet 3 in pilot production

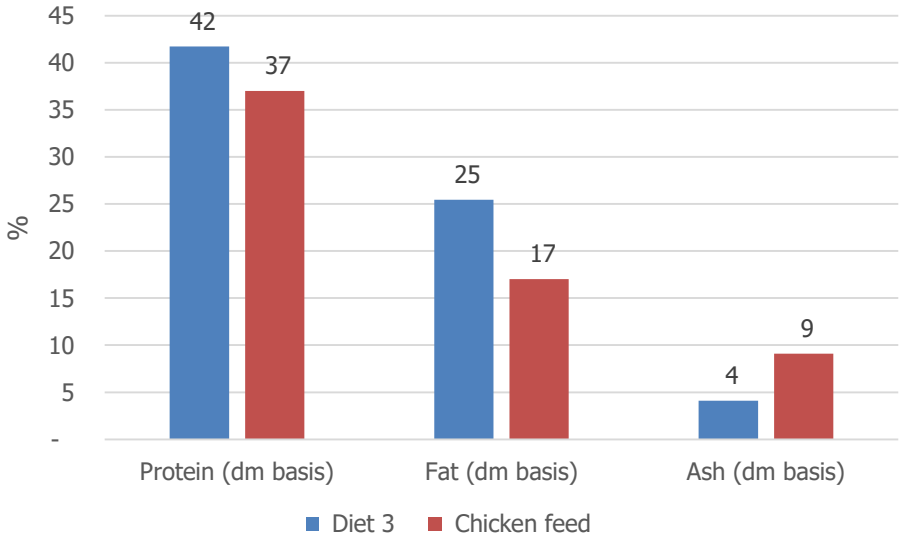
DANISH TECHNOLOGICAL INSTITUTE

GULDBORGSUND

Interreg North Sea Region BIOCAS European Regional Development Fund

EUROPEAN UNION

Total protein, lipid and ash content of BSFL reared on Diet 3 and Chicken feed (avg.)



Nitrogen, Phosphorus and Potassium content in insect frass (Diet 3)

	Nitrogen (kg/tonne)	Phosphorus (kg/tonne)	Potassium (kg/tonne)
Insect frass	17.2	4.8	7.4

Demo-scale factory (~1,000 tonne BSFL/yr)

DANISH TECHNOLOGICAL INSTITUTE

GULDBORGSUND

Interreg North Sea Region BIOCAS European Regional Development Fund

EUROPEAN UNION

2. Factory data and estimated yield		
Production areal	600	m2
Production days	350	days/yr.
Tray size	1	m2
No. Handlings/tray	2	Handlings/tray/productions cycle
Tray stack height	10	m
Employees salary	25,000	dkk/month
Production trays	30,000	trays in production
Production trays	3,000	no. trays/day
No. Handlings/day	6,000	no tray handeled /day
Requiered time for handeling	16.67	hour/day
Requiered personel	3.33	personel/day
Feed requiered	4,596	tons/year [FW]
Feed requiered	873	tons/year [DM]
Neonates requiered	300	mil neonates/day
BSFL production	1,164	tons/year [FW]
BSFL meal	349	tons/year [DM]
Insect frass	683	tons/year [70% DM]

Return on investment (demo-scale)

5. Revenues		
BSFL meal	4,191,264	12000 dkk/tonne
Insect frass	682,500	1000 dkk/tonne
Total	4,873,764	dkk/year
6. Return on investment		
Revenues	4,873,764	dkk/year
OPEX costs	4,070,882	dkk/year
Diference	802,882	dkk/year
CAPEX	5,950,000	dkk/year
Return on investment	7.4	years

Conclusions

- By-products from Guldborgsund Municipality are feasible to be used for production of Black solider fly larvae (BSFL)
- Low FCR - indicating high efficiency of the system
- High protein and lipid content
- A facility producing ~1,000 tonne BSFL (ww)/yr requires 5,000 tonne substrate (ww)/yr

Tak for opmærksomheden!

Kontakt

Lars-Henrik Lau Heckmann

E: LHLH@teknologisk.dk

M: 7220 1537

TEKNOLOGISK INSTITUT