Sustainable and cost-efficient replacement of fish meal by **animal** and **plant** protein in feeds for Atlantic salmon *salmo salar*

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Objectives

Replace the fish meal in salmon diets by ***plant protein*** and ***avian by-products*** to investigate effects on

1. Growth and feed utilisation
2. Cost efficiency
3. Fish in / fish out
4. Productivity

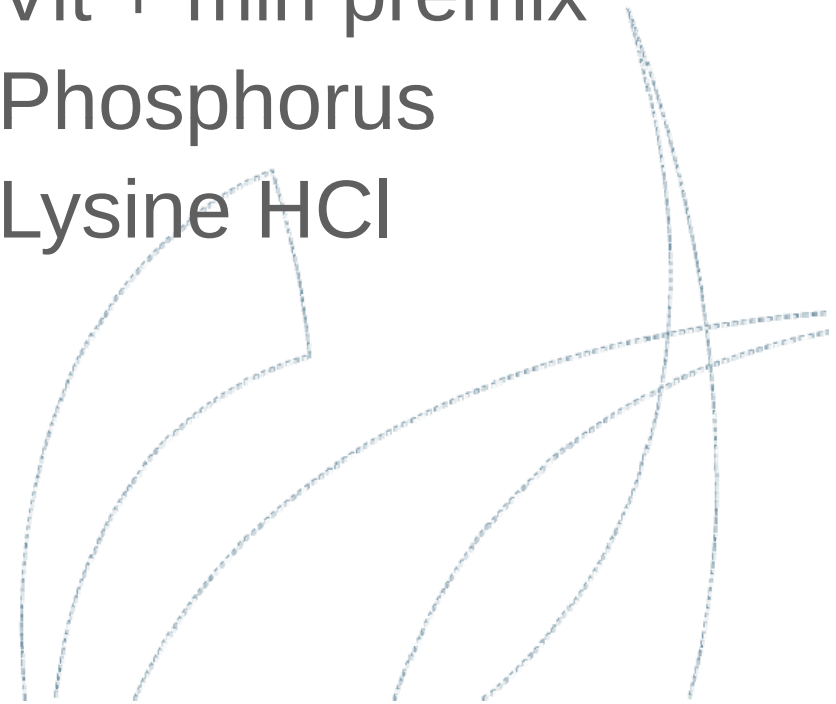
Feedstuffs

Protein sources:

- Fish meal (**FM**)
- Shrimp meal
- Poultry by-products meal
- Feather meal
- Corn gluten meal
- Wheat gluten
- Soybean meal
- Lupin kernel meal

Other:

- Fish oil
- Wheat meal
- Vit + min premix
- Phosphorus
- Lysine HCl

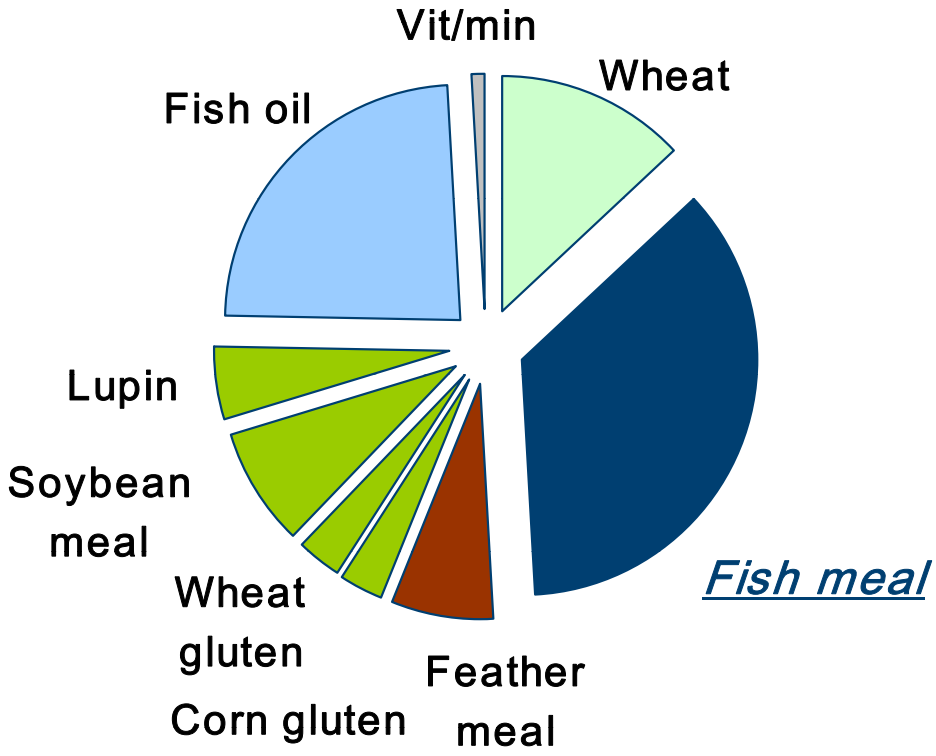


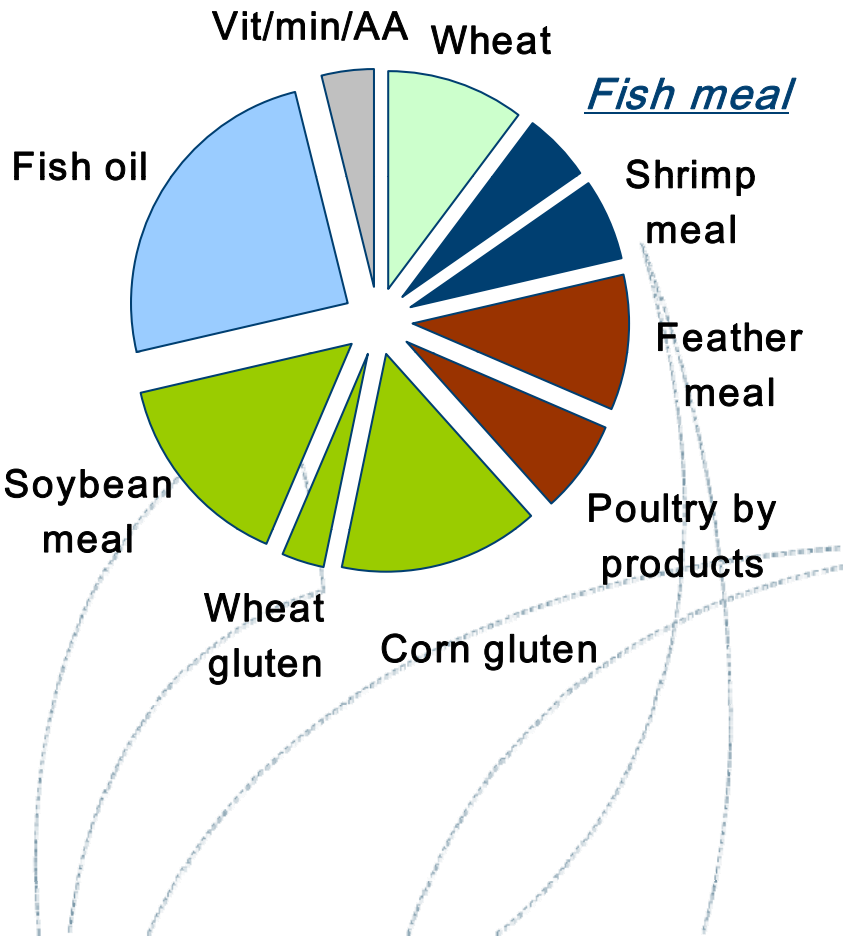
Test diets - composition

	5% FM	10% FM	20% FM	36% FM
CP, %	41.0	41.2	40.7	41.4
Lipid, %	29.8	29.9	30.1	30.2
Ash, %	5.1	5.9	5.9	7.1
USD / tonn*	620	663	772	860

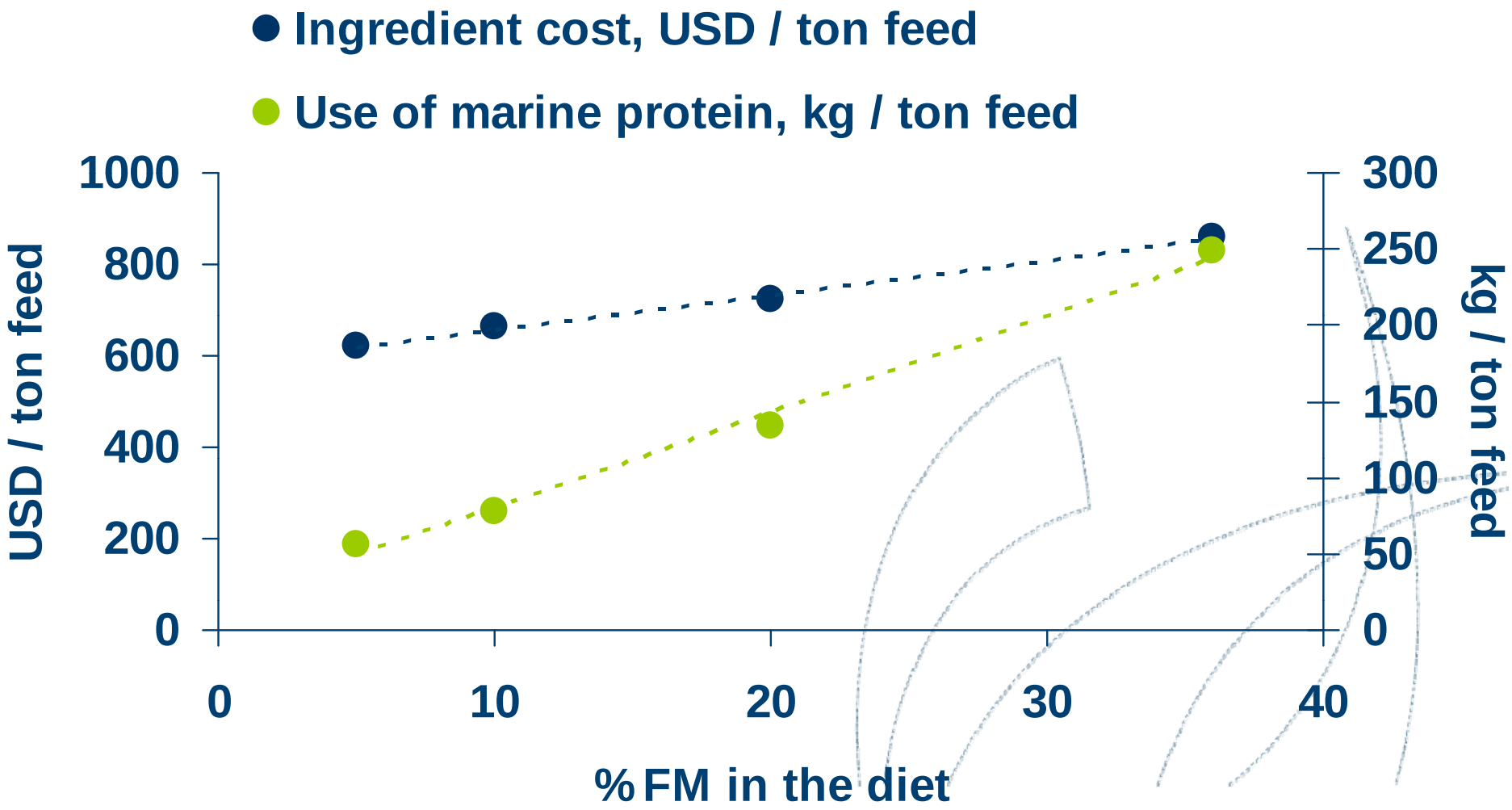
*Prices on Chiloe Island in July 2006

Test diets – 36% vs. 5% fish meal





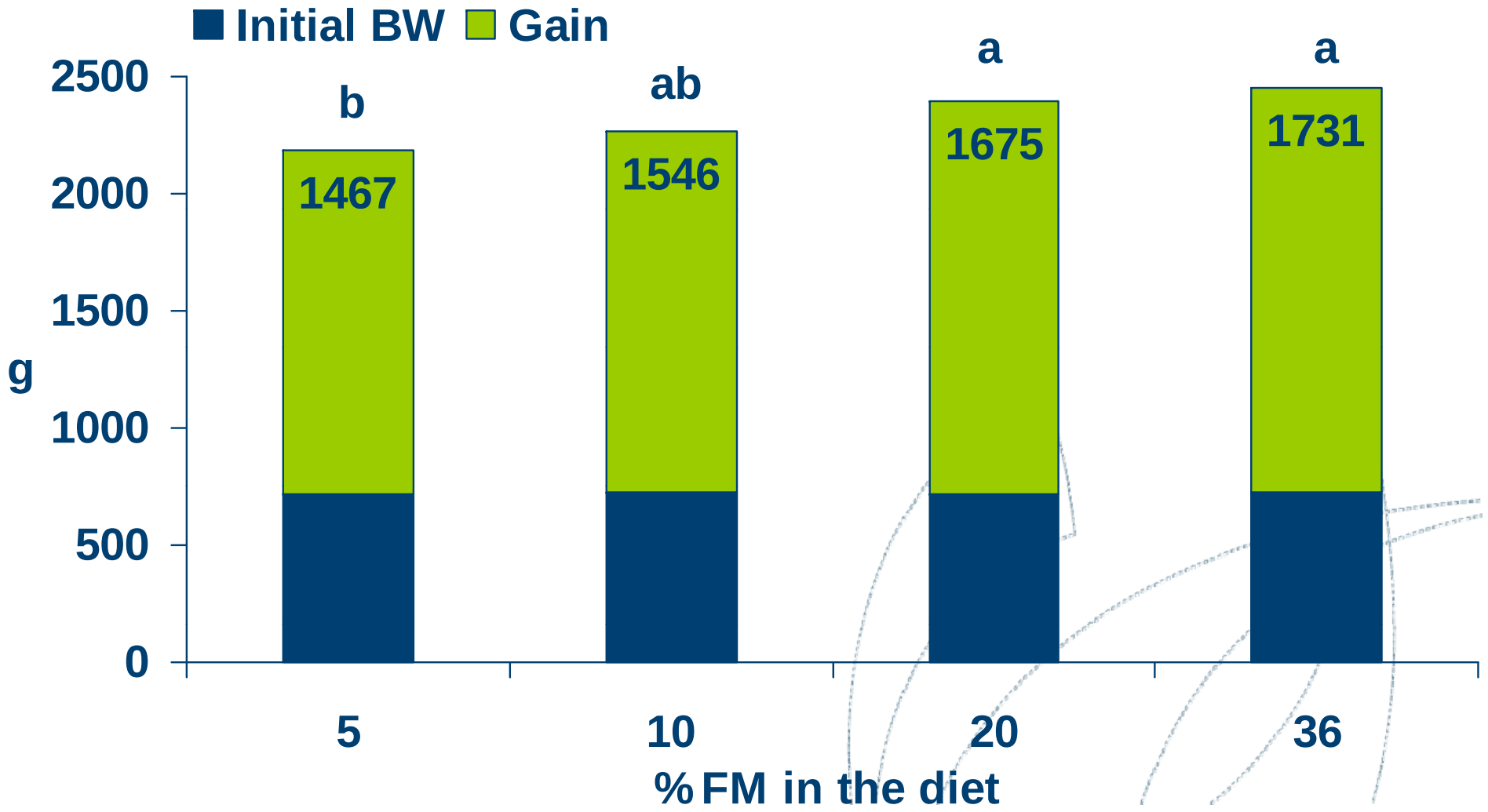
Ingredient cost and use of marine protein in the diets



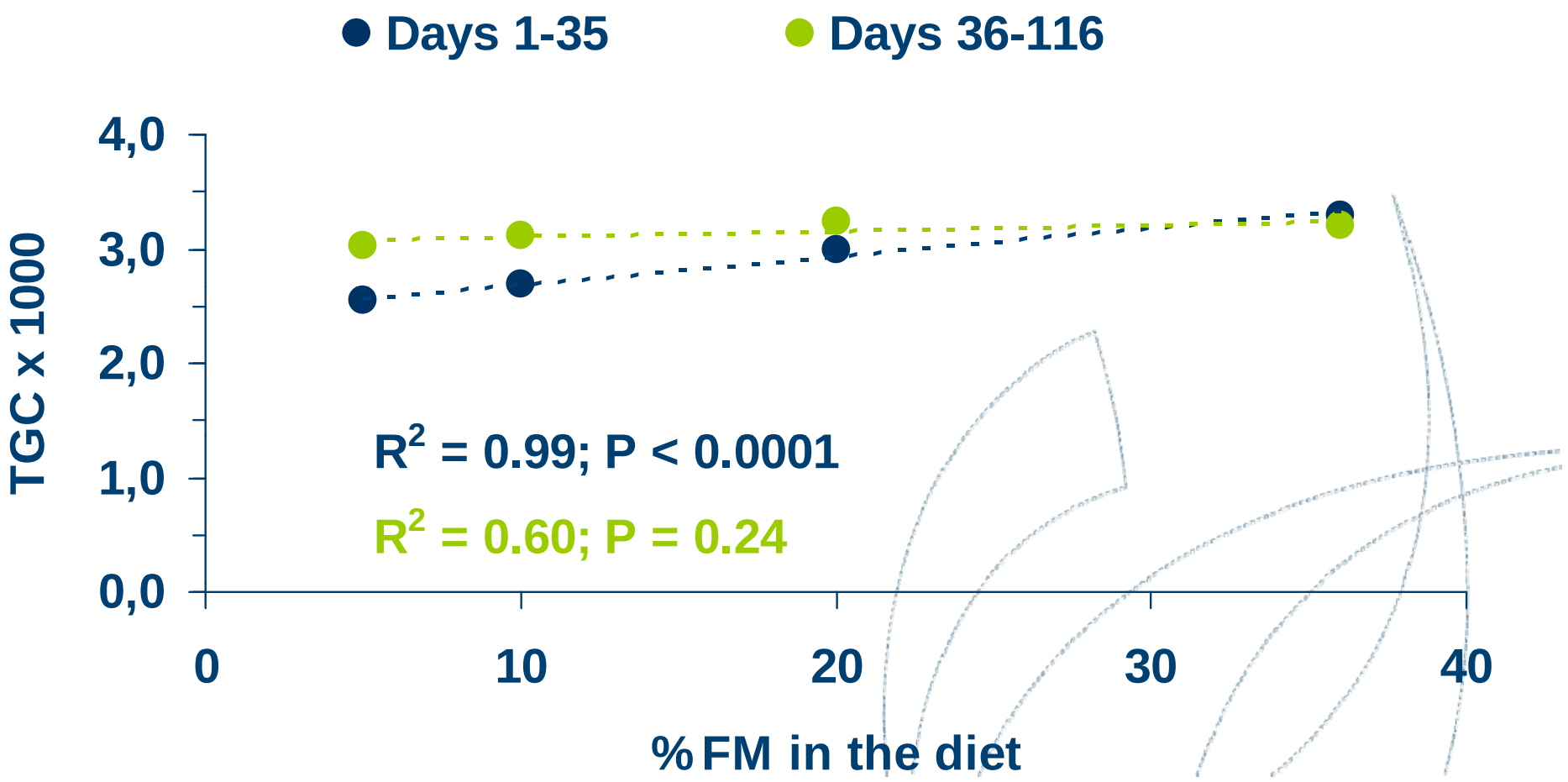
Fish and experimental details

- Location: Salmofood's model sea farm at Liucura (Chiloe, Chile)
- Fish: Atlantic salmon; IBW = 721 g
  1500 fish / pen
- Pens: 12 7 x 7 x 7 m
- Replication: 3 pens / treatment
- Saltwater (11 -13 °C)
- 116 feeding days

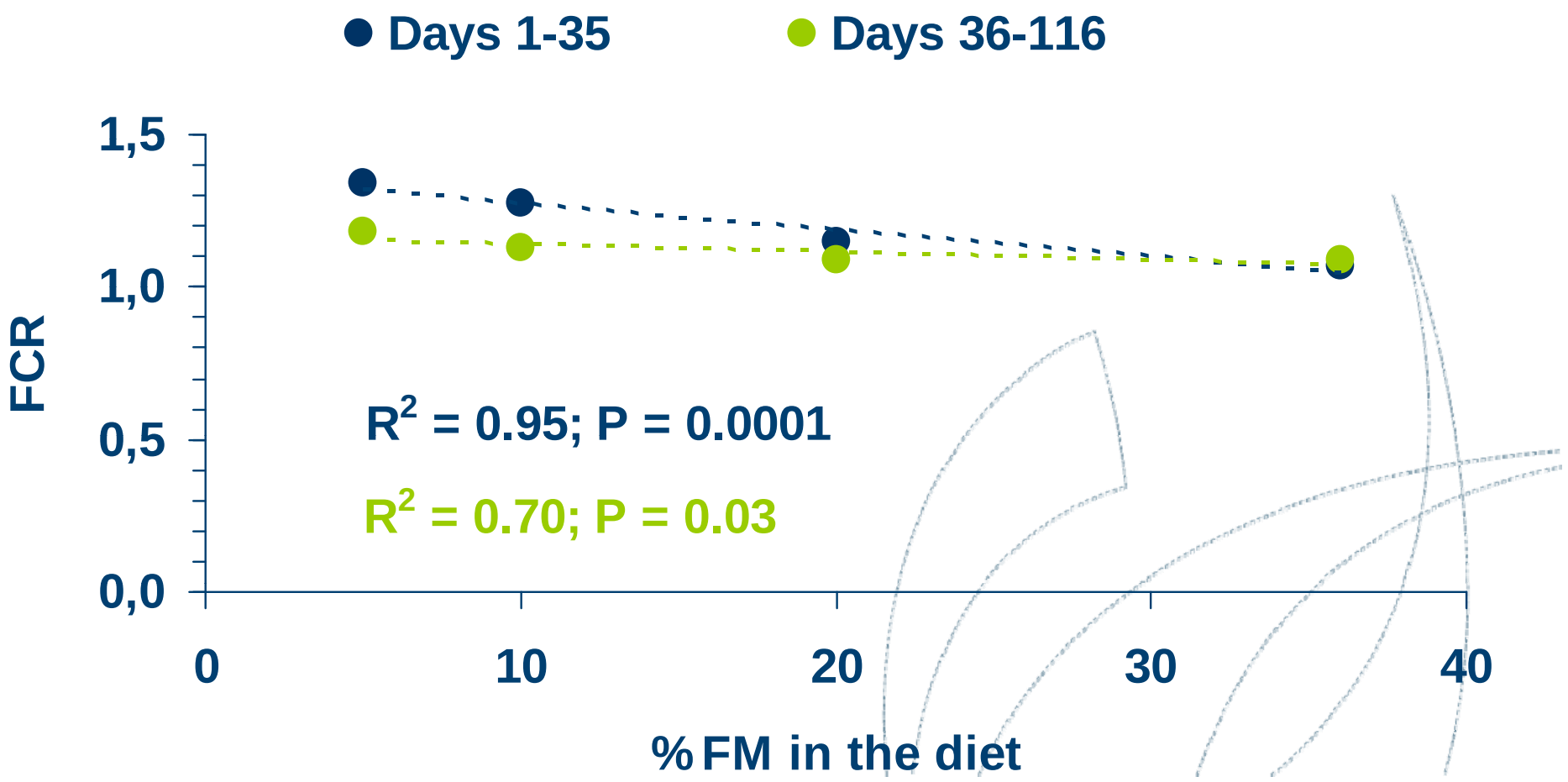
Weight gain


Initial BW
Gain
2500
2000
1500
1000
500
0
g
b
ab
a
a
1467
1546
1675
1731
5
10
20
36
% FM in the diet

Growth (TGC x 1000)



FCR (feed intake / gain)

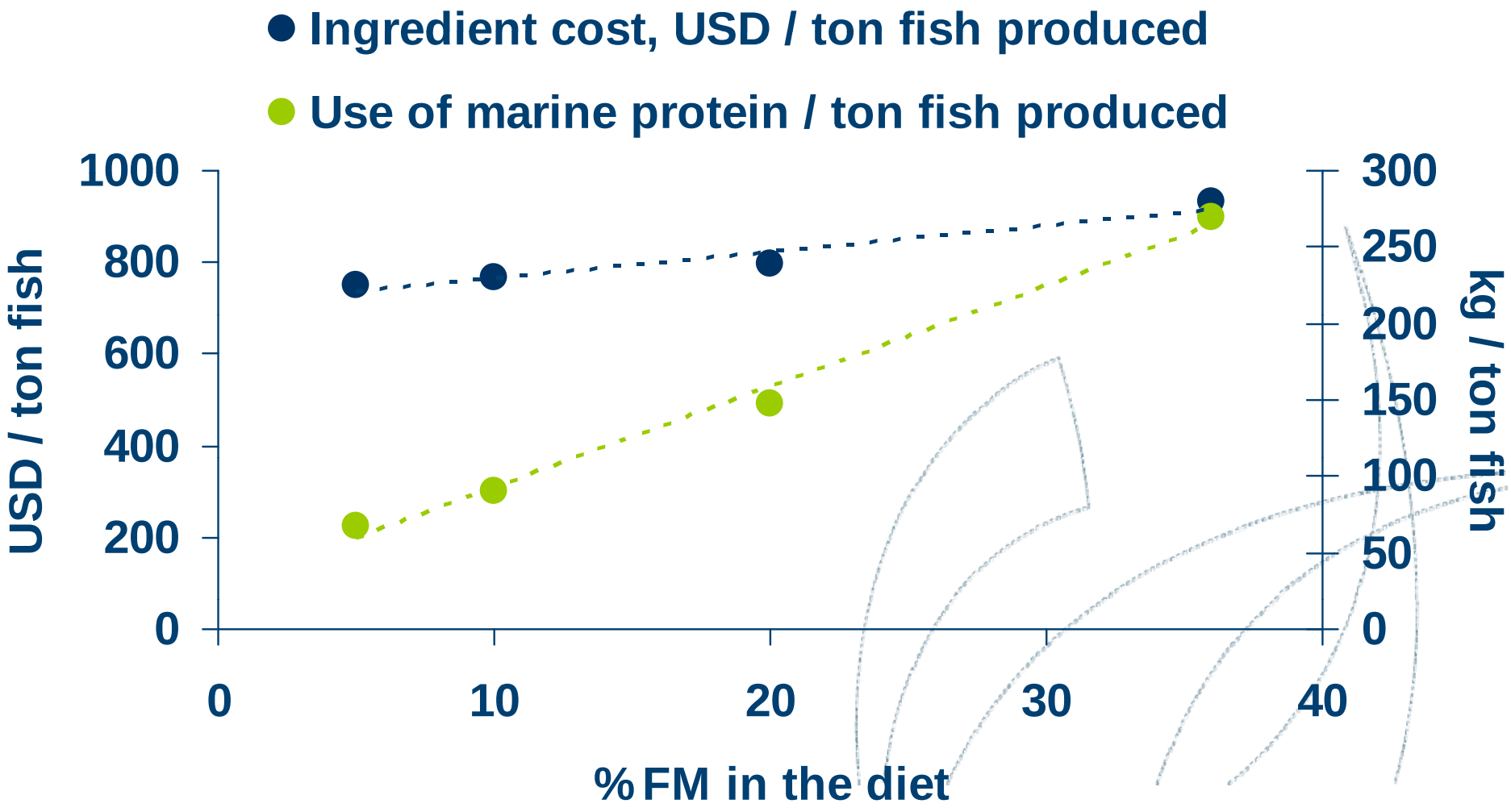


The aim of productivity is maximum efficient utilisation of resources

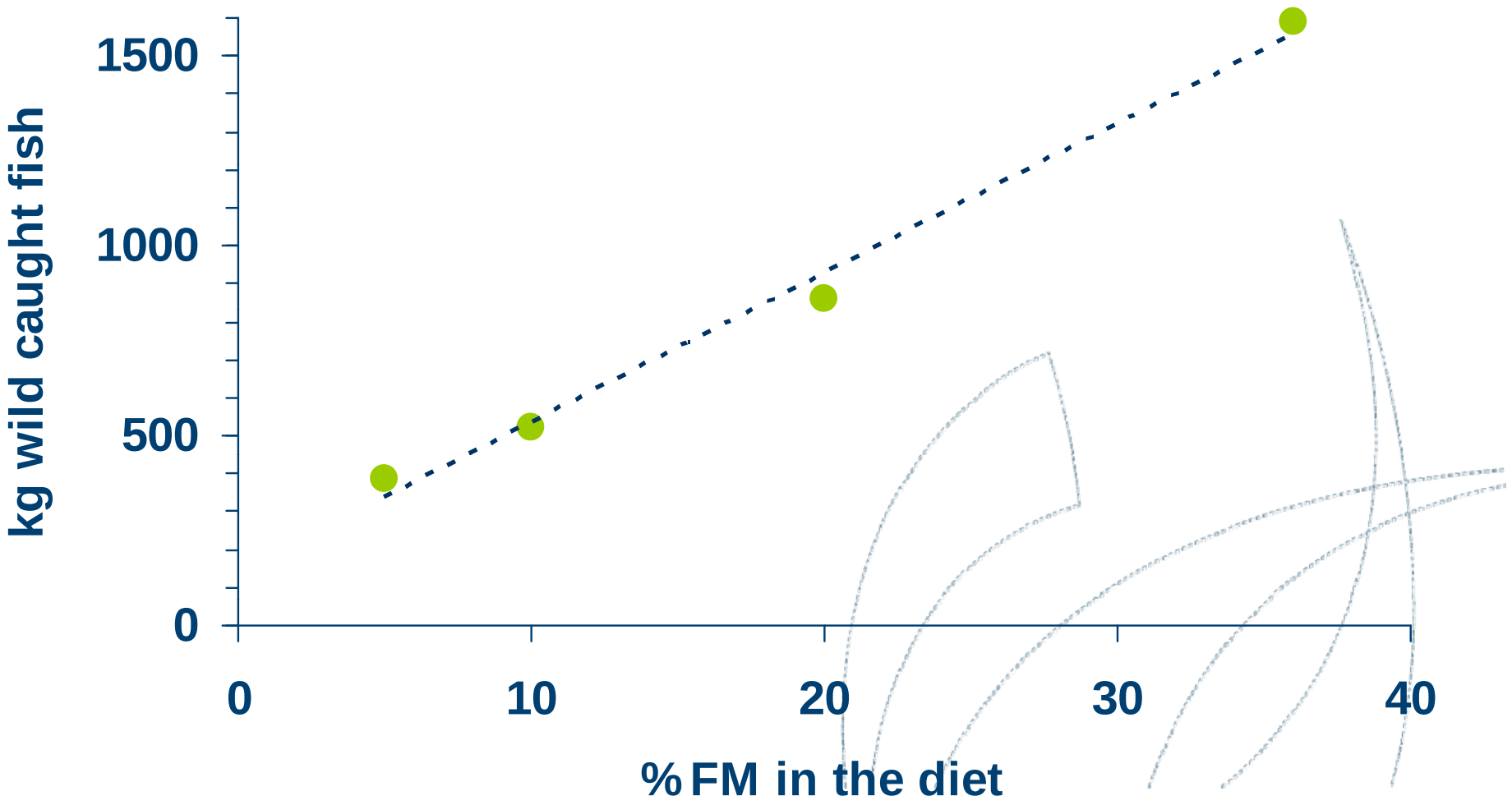
➔ **Increased** net fish production

(fish in / fish out < 1)

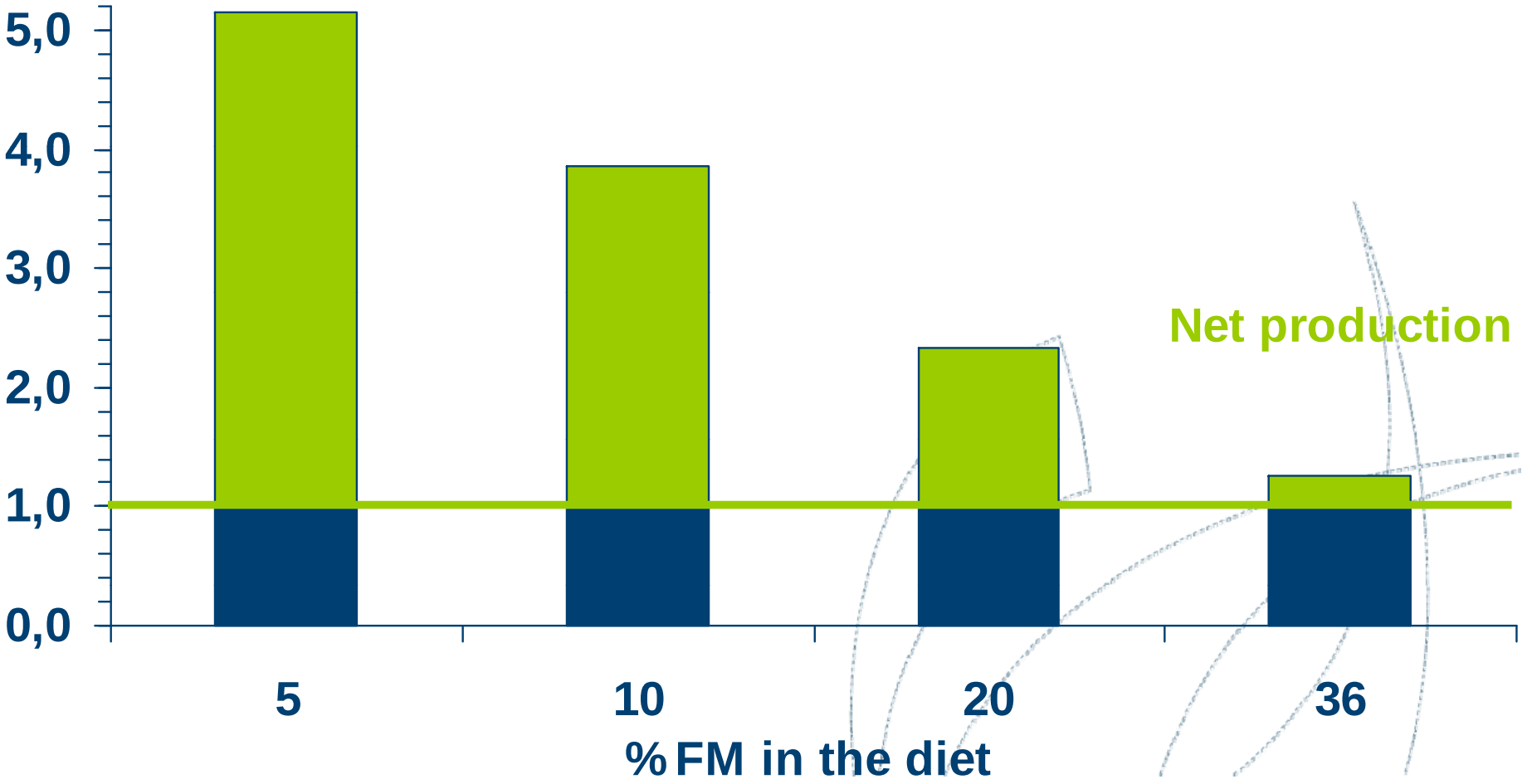
Ingredient cost and use of marine protein per ton salmon produced



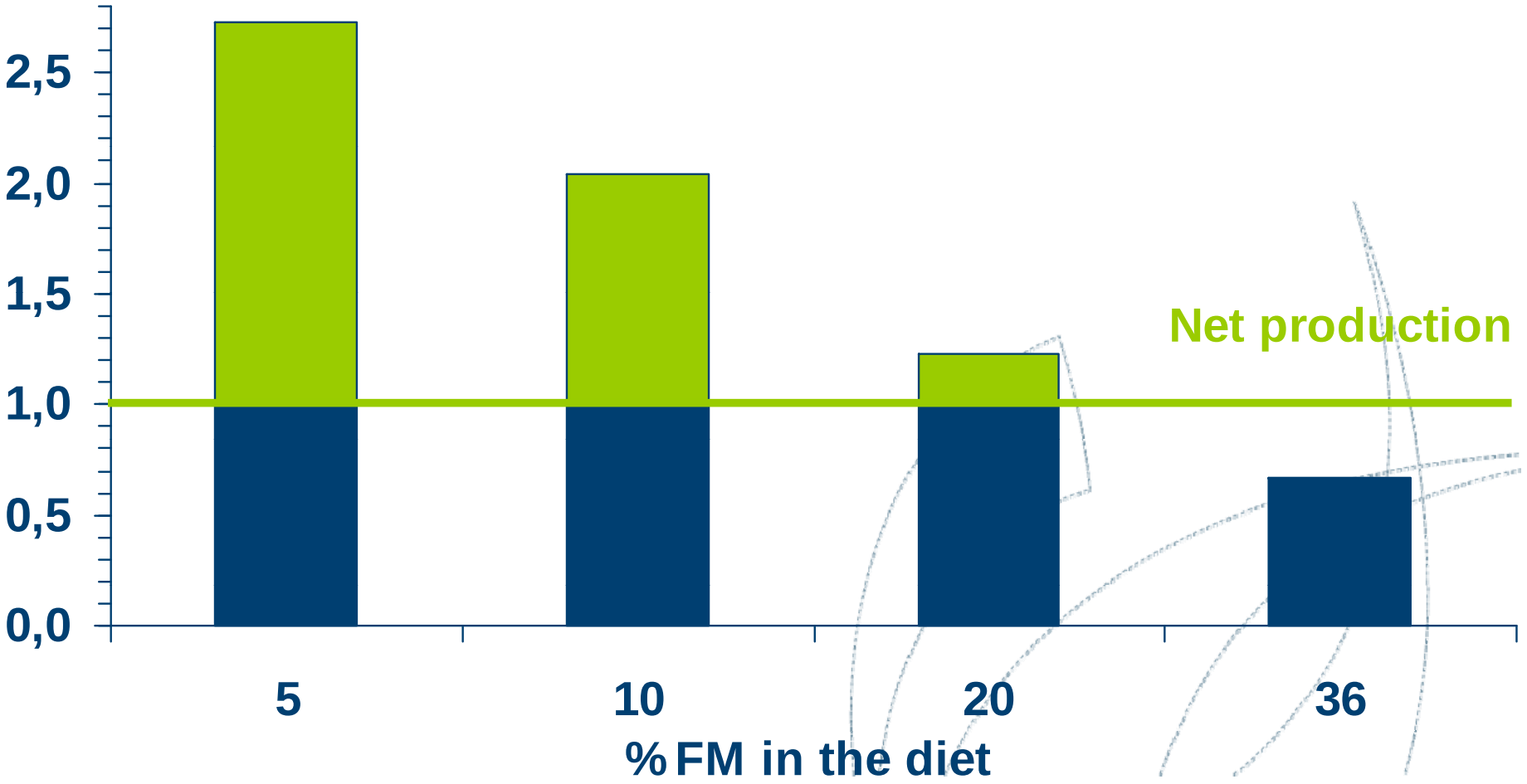
Wild fish caught for fish meal production / ton salmon produced



Ton **edible** salmon produced / ton **edible** fish caught for fish meal production



Unit produced / unit spent marine protein



Conclusions

Reducing the dietary FM from 36 to 5%

- Only marginally affected growth
- Increased the FCR by 8.5%
- Reduced raw material costs by 31%
- Reduced marine protein use by 76%
- Made Atlantic salmon a net producer of marine protein, producing 2.5 times as much as it consumed

Perspectives

- Further growth in aquaculture requires efficient use of marine feedstuffs
- Production and processing of grains offers a wide variety of protein sources
- Animal and aquaculture by products may be “re-circulated” into excellent protein sources for fish
- Salmon farming may become independent of fish meal


Future fish feeds contains little fish!
Thank you.