



The Need for a New Normal

Putting the Fish First

Jesse Trushenski / 15 June 2023 / Lofotseminaret / Mortsund, Norway

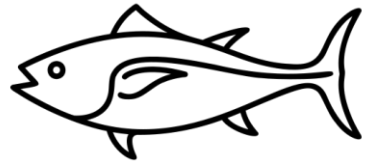


PART I

Nutritional demands are driven
by fundamental biology



Trophic levels can be used to predict nutrient demands



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Apex predators



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Carnivores, tertiary consumers



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Herbivores, primary consumers



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Carnivores, secondary consumers

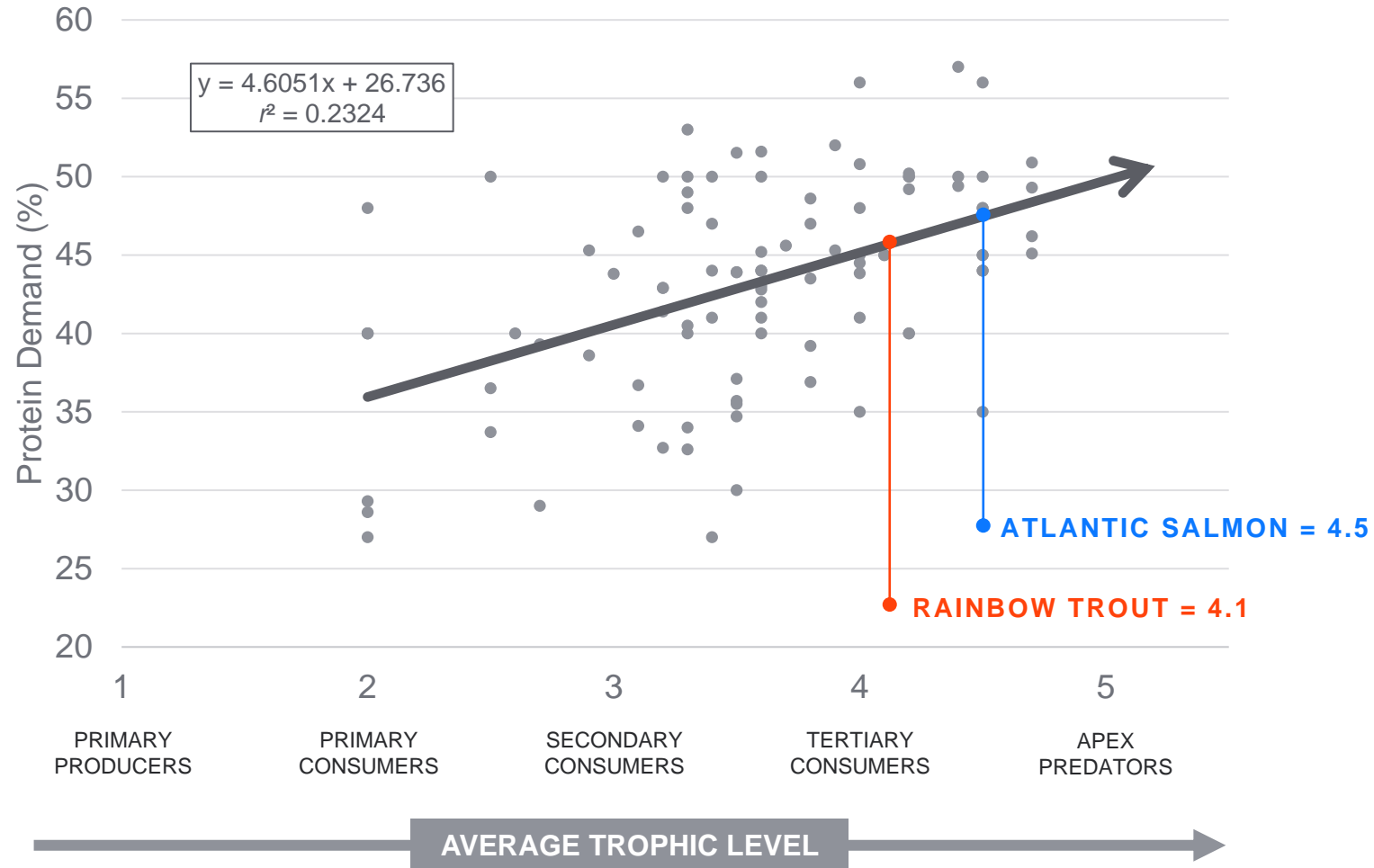


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Primary producers



Carnivory predicts protein demand



PROTEIN IS THE MOST EXPENSIVE MACRONUTRIENT

ADEQUATE QUANTITY AND QUALITY OF PROTEIN IS CRITICAL FOR FAST-GROWING, HEALTHY FISH

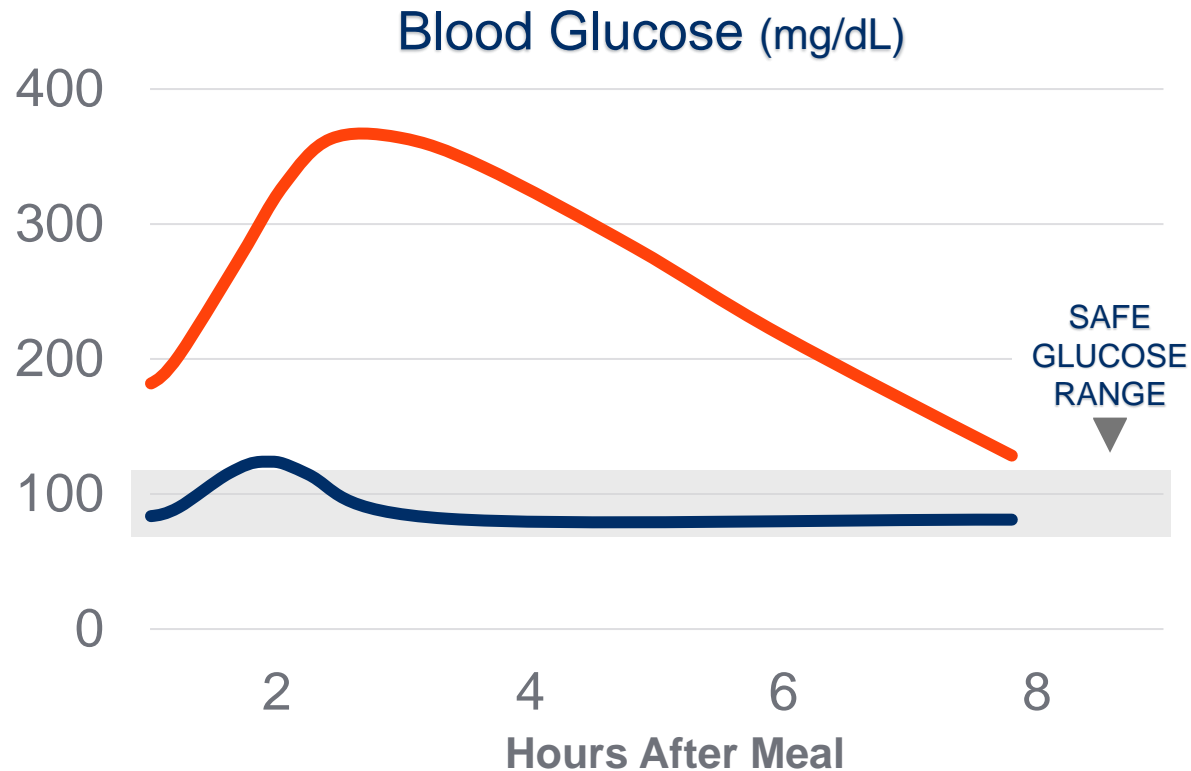


PART II

The biology of carnivores is different



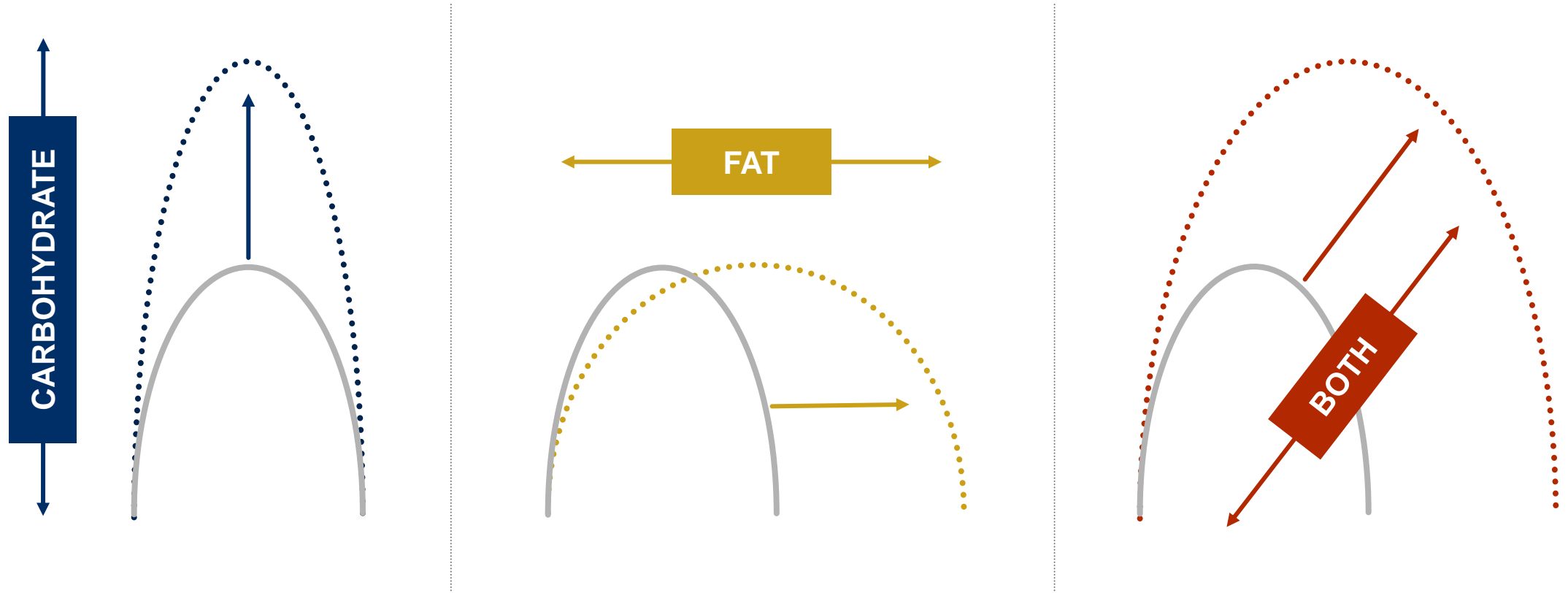
Effects of diabetes or glucose intolerance



LONG-TERM EFFECTS OF GLUCOSE INTOLERANCE INCLUDE **HEART**, **KIDNEY**, AND **LIVER FAILURE**, **SLOW WOUND HEALING** AND OTHER **SKIN PROBLEMS**



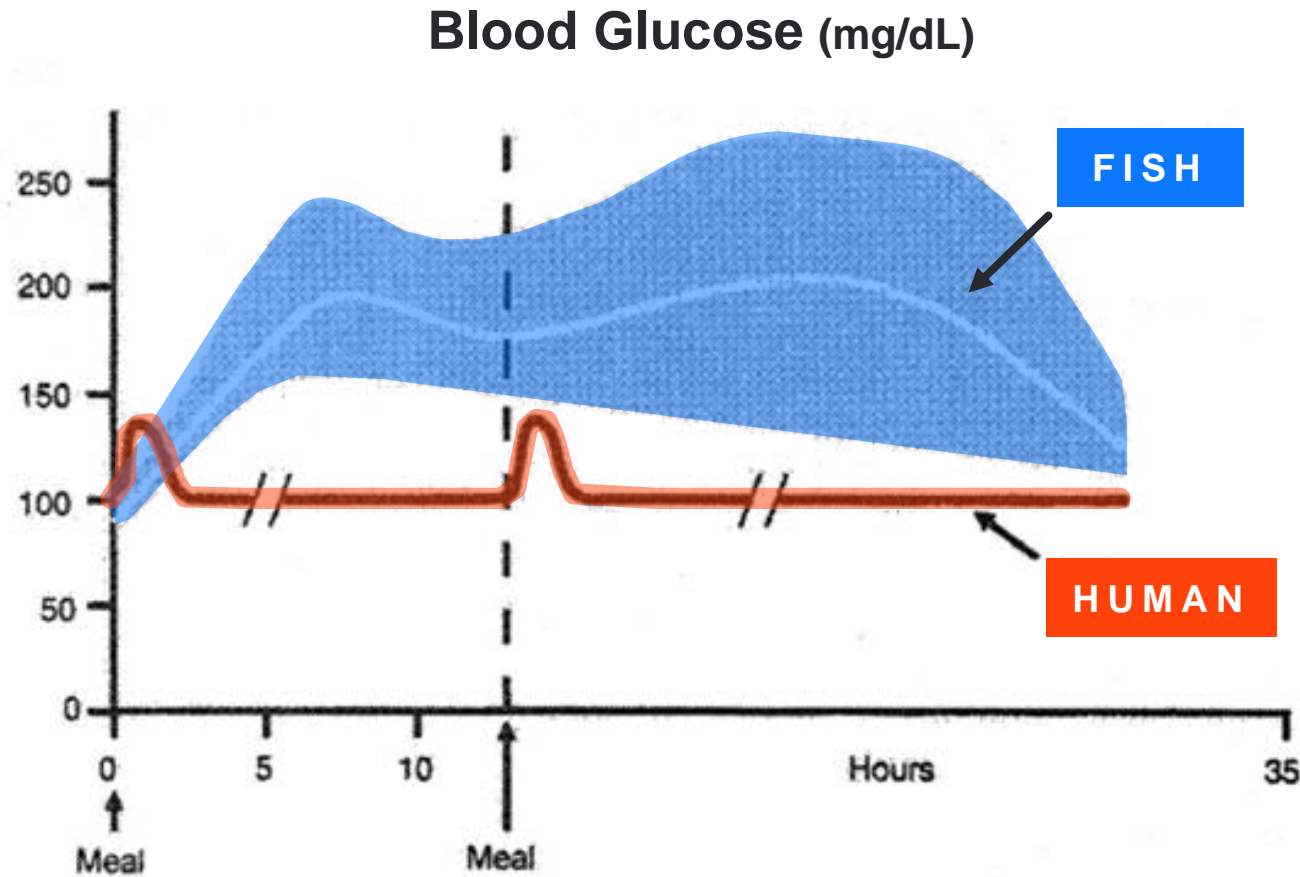
Diet determines the severity of diabetic effects



DIETS LOW IN PROTEIN, HIGH IN FAT AND CARBOHYDRATES MAKE GLUCOSE INTOLERANCE WORSE



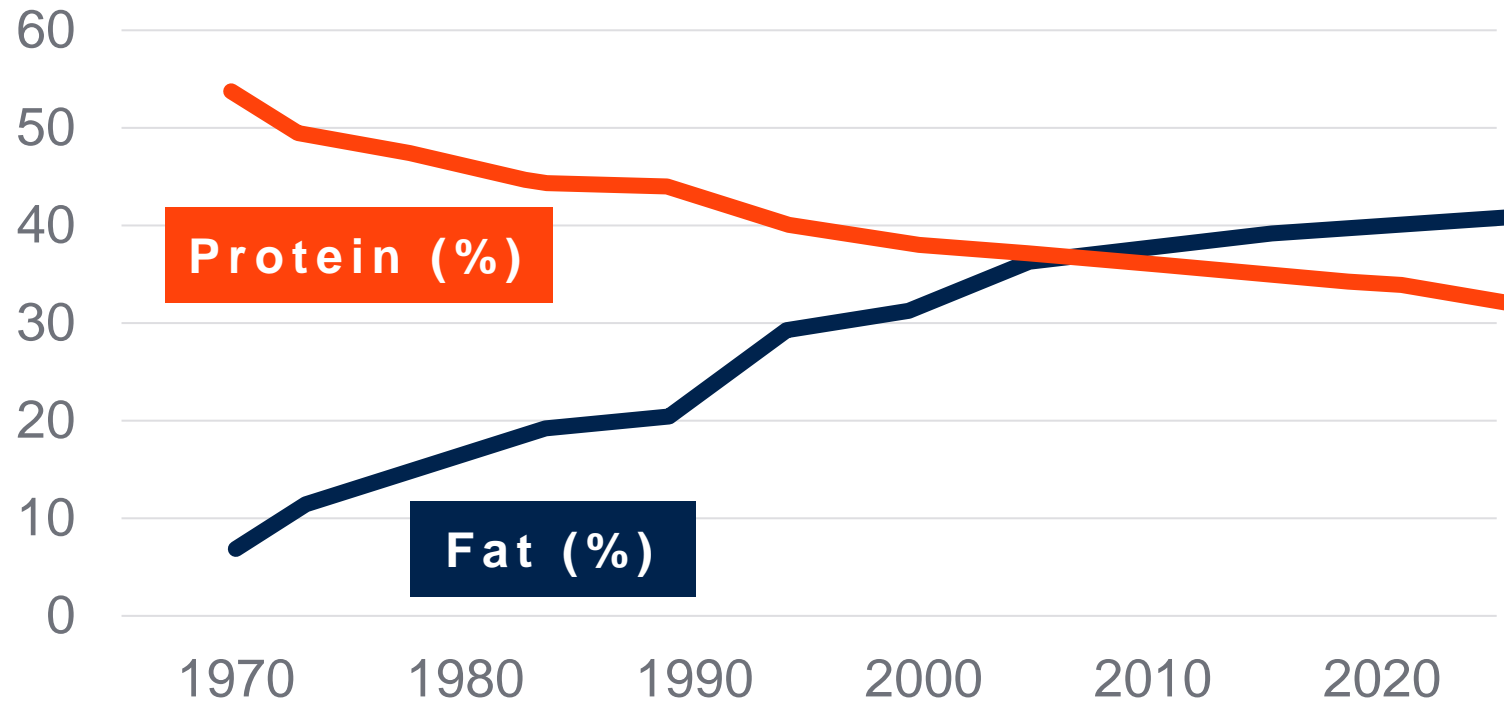
Carnivorous animals are functionally 'diabetic'



CARNIVORES LIKE SALMON AND TROUT ARE GLUCOSE INTOLERANT AND SUFFER SIMILAR EFFECTS WHEN FED LOW PROTEIN, HIGH ENERGY FEEDS



Feed formulations have changed



FAT HAS INCREASED AND PROTEIN HAS DECREASED DRAMATICALLY OVER THE LAST 30 YEARS

TYPICAL SALMON AND TROUT FEEDS TODAY ARE THE OPPOSITE OF WHAT THEY SHOULD BE TO MANAGE 'DIABETES'



PART III

Remembering what we have forgotten about nutrition



Nutritional demands and tolerances vary with life stage

Smaller life stages



Small fish expend more energy, have higher resting metabolic rates

Small fish must be fed more to meet bioenergetic demand for maintenance and growth

If properly fed, small fish can achieve much greater growth rates

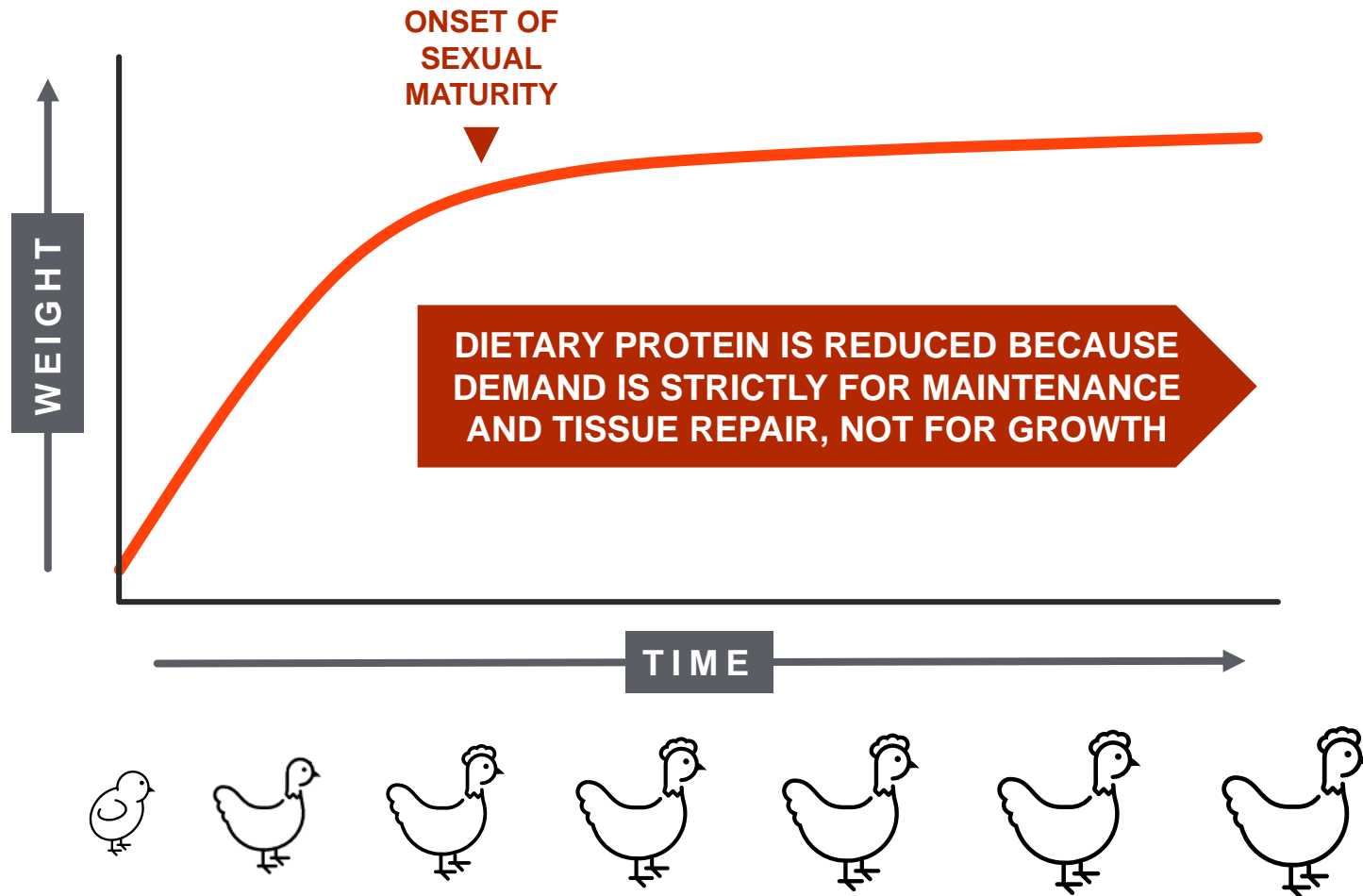
Large fish typically accept a wider range of raw materials, are more robust to dietary imbalance

Large fish consume more feed, so the cost of inferior growth and conversion is much greater

Larger life stages



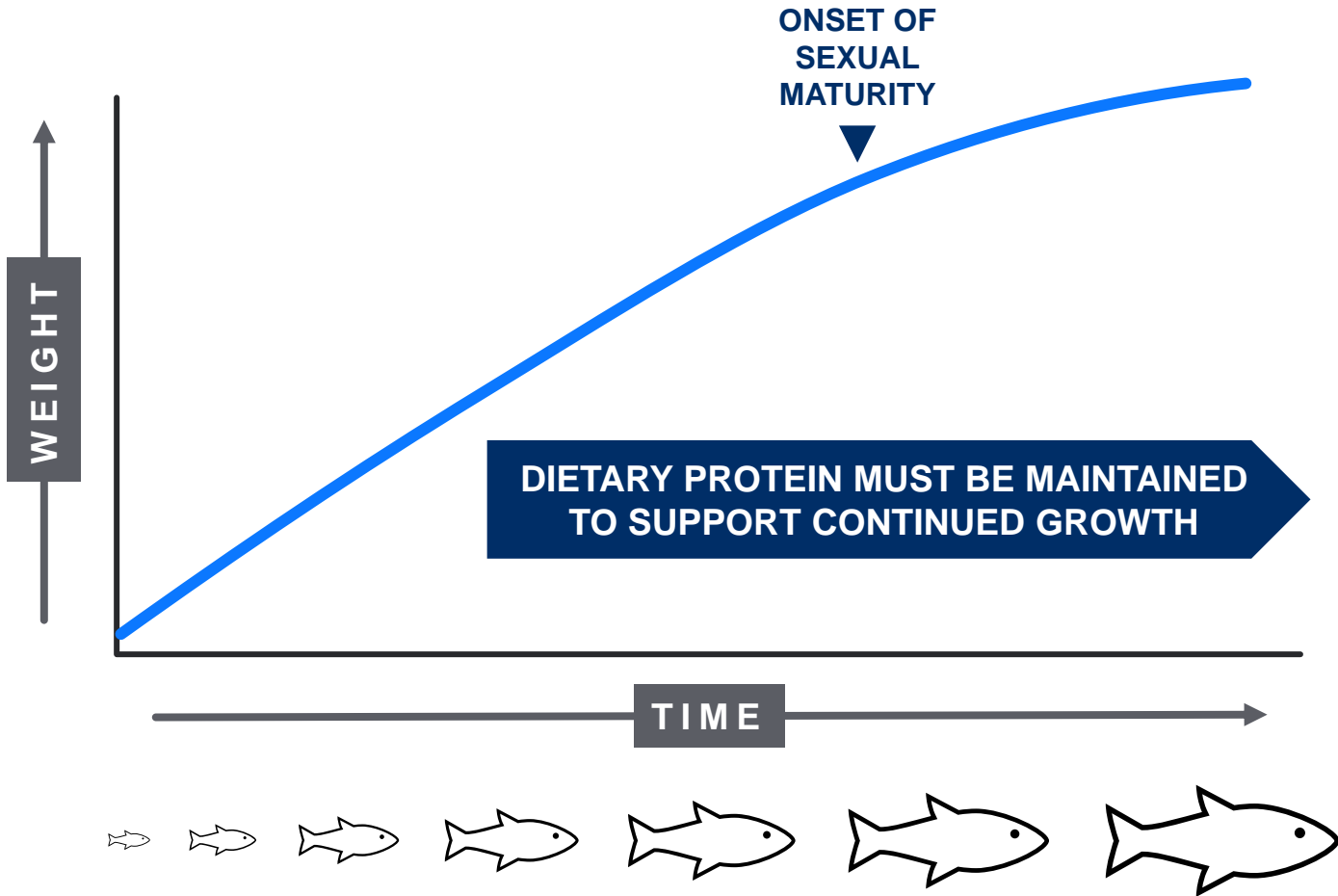
Determinate vs. indeterminate growth



ALL
TERRESTRIAL
LIVESTOCK ARE
DETERMINATE
GROWERS
AFTER SEXUAL
MATURATION
SIZE DOES NOT
INCREASE
APPRECIABLY



Determinate vs. indeterminate growth

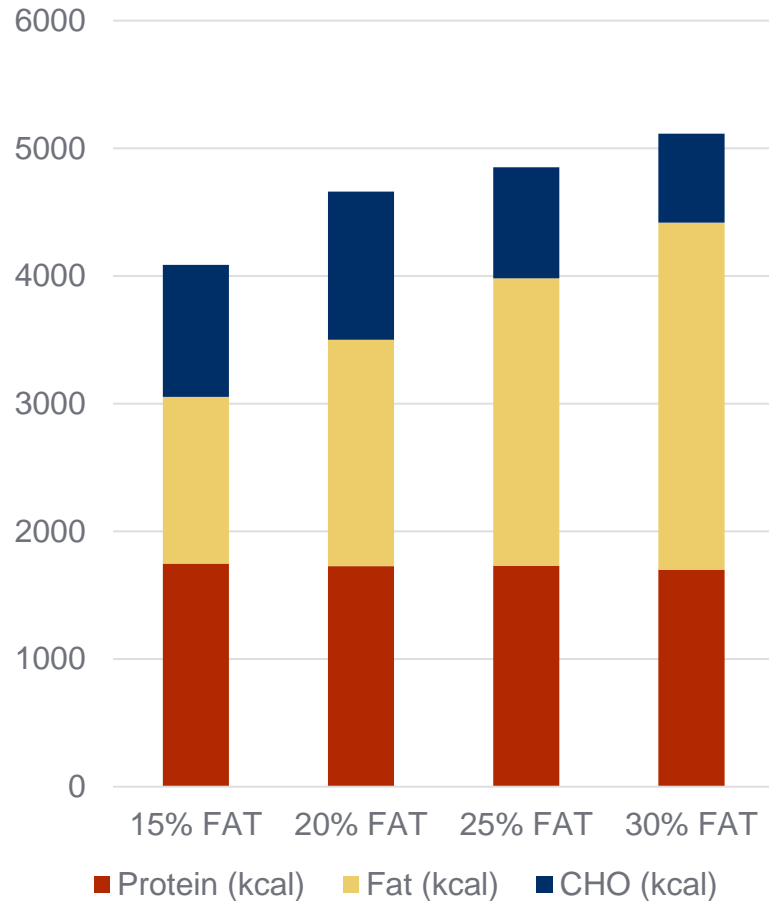


SALMON AND TROUT ARE **INDETERMINATE** GROWERS

GROWTH CONTINUES AFTER SEXUAL MATURATION, BUT AT A SLOWER, LESS EFFICIENT RATE



Too much of a good thing—fat can limit feeding and growth



FAT → FAT

▶▶▶ EQUAL GROWTH RATE

▲▲▲ HIGHER FAT GAIN

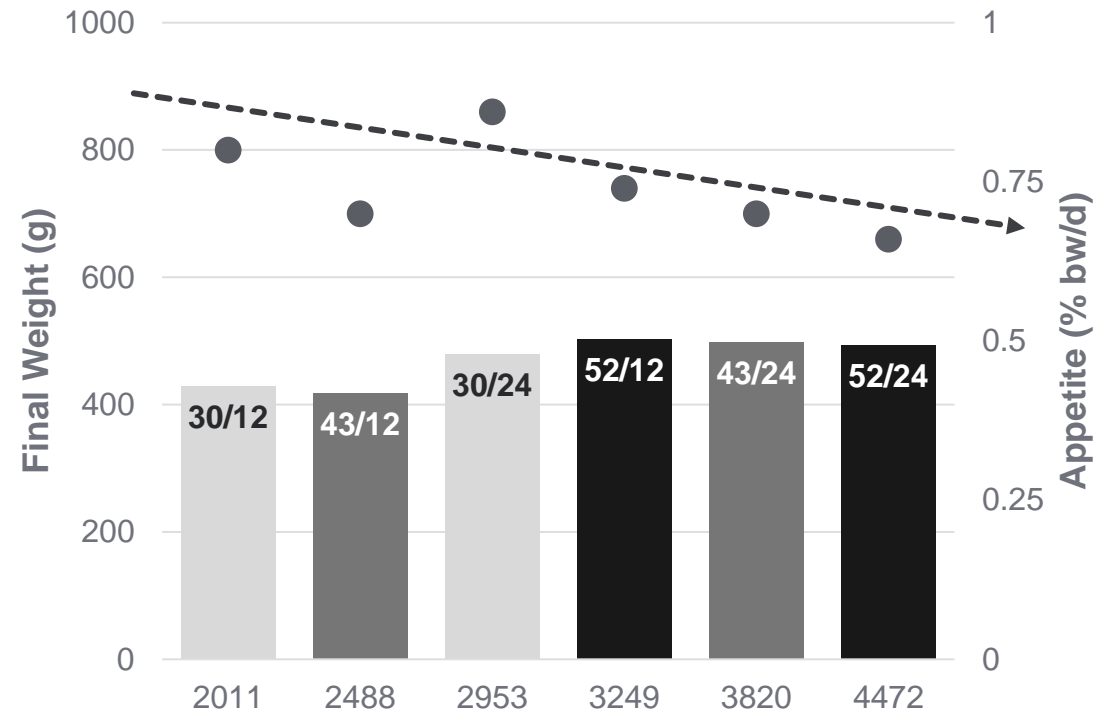
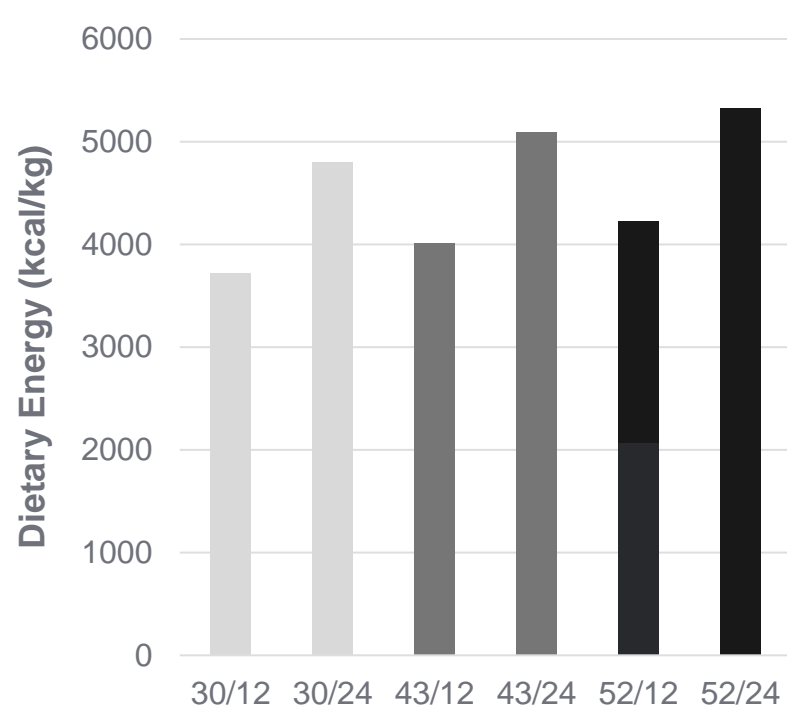
▼▼▼ LOWER PROTEIN GAIN

▼▼▼ LOWER FEED INTAKE

EXPERIMENTAL EVIDENCE AND ON-FARM EXPERIENCE INDICATE THAT **HIGH-FAT FEEDS PRODUCE HIGH-FAT FISH AND CAN LIMIT GROWTH POTENTIAL**



A few words about protein sparing



PROTEIN SPARING OCCURS, BUT ONLY AT MODEST FAT LEVELS AND FEED INTAKE IS STILL REDUCED BY INCREASING DIETARY ENERGY LEVELS

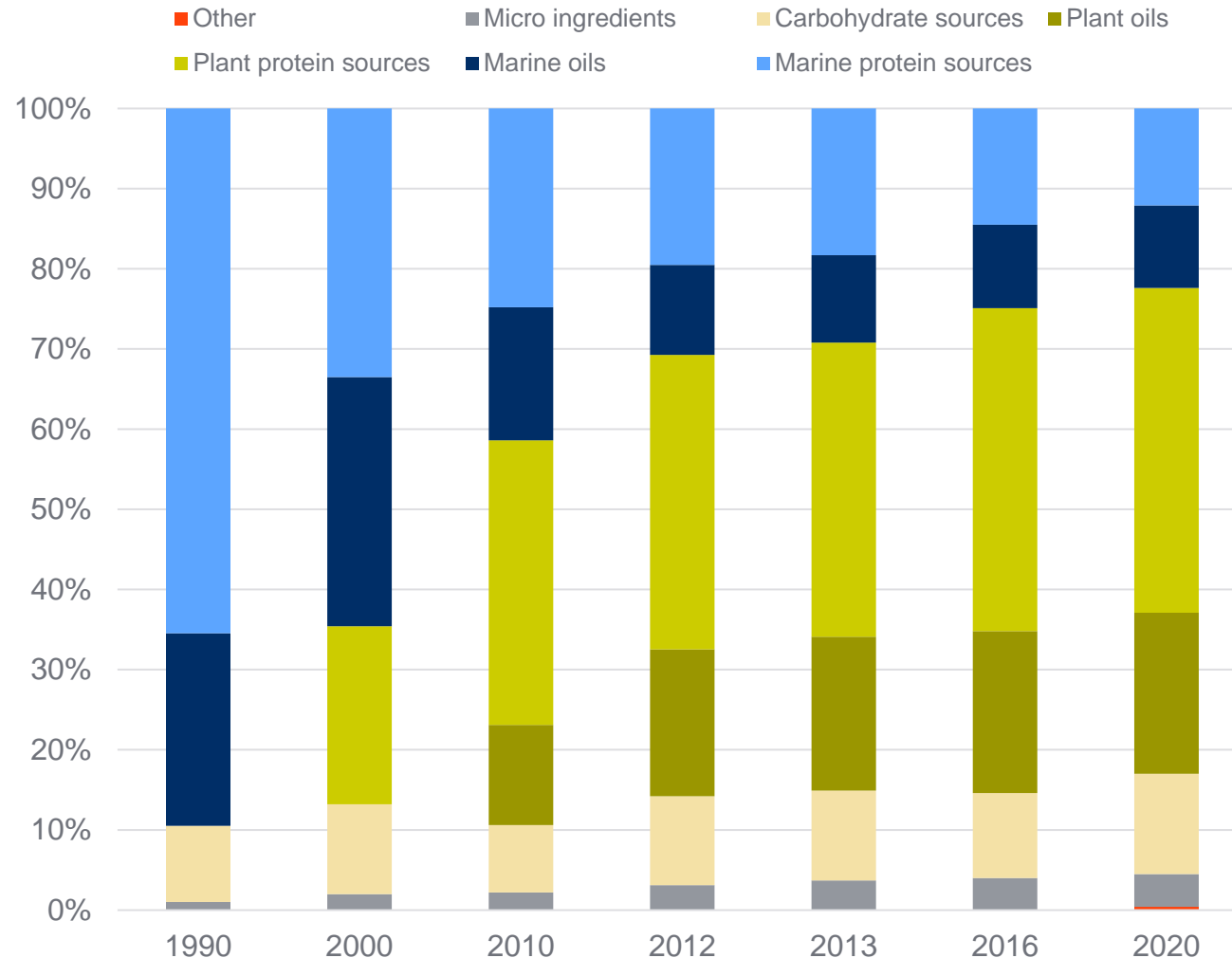


PART IV

Sustainability is a concept,
not an ingredient



Feed formulations have changed

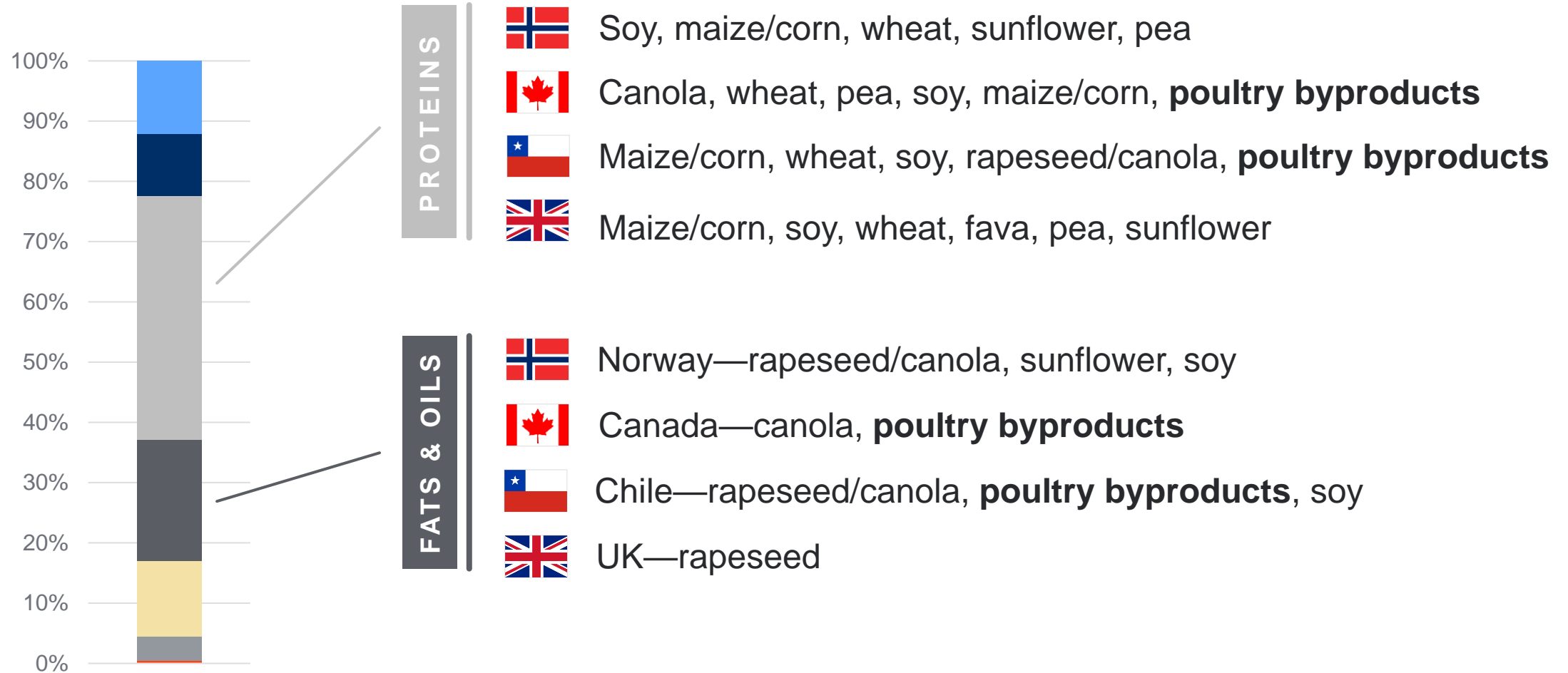


USE OF MARINE INGREDIENTS HAS DECLINED RAPIDLY SINCE THE 1990s

TYPICAL SALMON & TROUT FEEDS ARE NOW **MOSTLY PLANT-BASED**



Countries vary in their approach to filling the gap



There are no perfect ingredients

MARINE INGREDIENTS



TERRESTRIAL CROPS &
RELATED INGREDIENTS



PROCESSED ANIMAL
PROTEINS & FATS



FERMENTED
INGREDIENTS



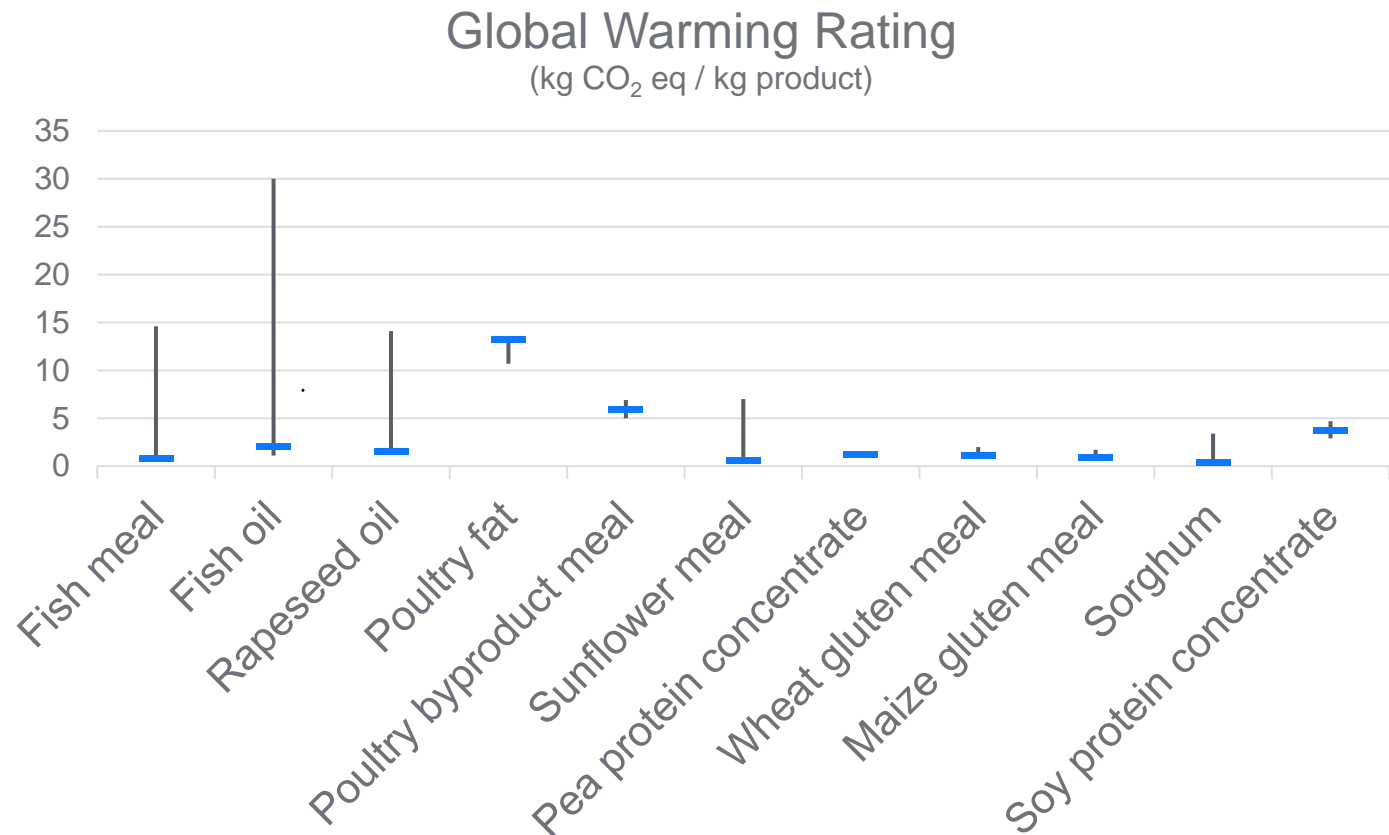
INSECT MEALS, ALGAE &
SINGLE-CELL PROTEINS



- Cost, limited opportunities for increased volume
- Antinutritional factors, digestibility
- Customer perceptions, marketing opportunities
- Excess microbial content, marketing opportunities
- Cost, availability



Not all ingredients are what they seem



“ Plant proteins typically have a much **higher carbon footprint** than fish meal, which has pushed the overall footprint of feed up over the last 20 years ”

▶ **CO₂ EQUIVALENTS
FRESHWATER
PHOSPHORUS
ARABLE LAND**



SUMMARY

The need for a new normal

- If we expect peak performance, we must put the fish first
- We must remember the basics of nutritional science, but recognize that fish are fundamentally different
- If we feed fish based on the assumption that they will grow more slowly, they certainly will!
- Sustainability is about using all of the resources that are available and considering both inputs and outputs
- Although we were the first, we are not the only ones calling for a reset in how we feed salmon and trout





Bondevennen

19 May 2023

☞ We already have different feed alternatives, and we will need all of them in order to reach the ambitious goals set by the government ☞

Professor Margareth Øverland
Norwegian University of Life Sciences

RAW MATERIALS MUST BE SUSTAINABLE,
CONTRIBUTE TO A REDUCED CARBON
FOOTPRINT

MUST USE ALL RESOURCES AVAILABLE,
INCLUDING ANIMAL PROTEINS AND FATS,
FERMENTATION PRODUCTS, ETC.

IMPLEMENTATION WILL REQUIRE
REASSESSMENT OF REGULATORY
BARRIERS AND PERCEPTIONS

SOLUTIONS MUST BE BOLD TO AFFECT
CHANGE AT THE NECESSARY SCALE



An aerial photograph of a Polarfeeder ship, a specialized vessel for feeding polar bears, at sea. The ship is a white cabin with a blue deck and a crane. It is positioned next to a large, flat, grey concrete or metal platform. The background features a vast expanse of blue water and a range of rugged, snow-capped mountains under a clear blue sky. A dark blue semi-transparent box is overlaid on the left side of the image, containing contact information.

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