“Tracking salmon by using rare earth elements”

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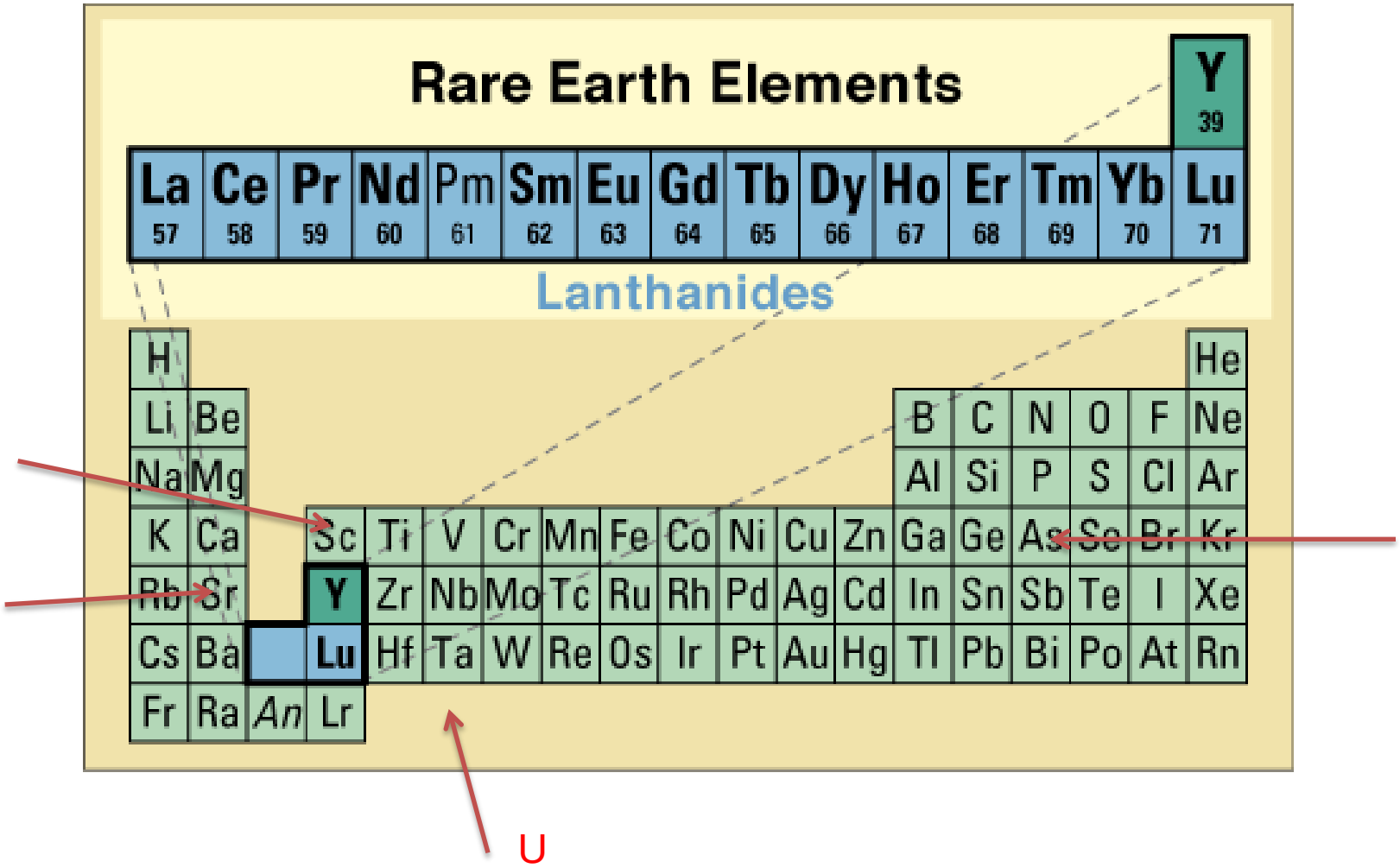
The main object of this project is to develop a method that, both simply and cheep, can distinguish farmed from wild salmon, and at the same time track the salmon back to the farm.

Rare earth elements are found in the bone structures of fishes, but in very low concentrations. Most of these elements are non-radioactive, easy to handle and have been shown to have a long retention time in bone. In my project we will test several of these elements as tracers by adding them to the feed. We will use chloride salts and the feeding period will be from 4 to 8 weeks after sea transfer.

As Ce Dy Er Eu Gd Ho La Lu Nd Pr Sc Sm Sr Tb Tm U Y Yb

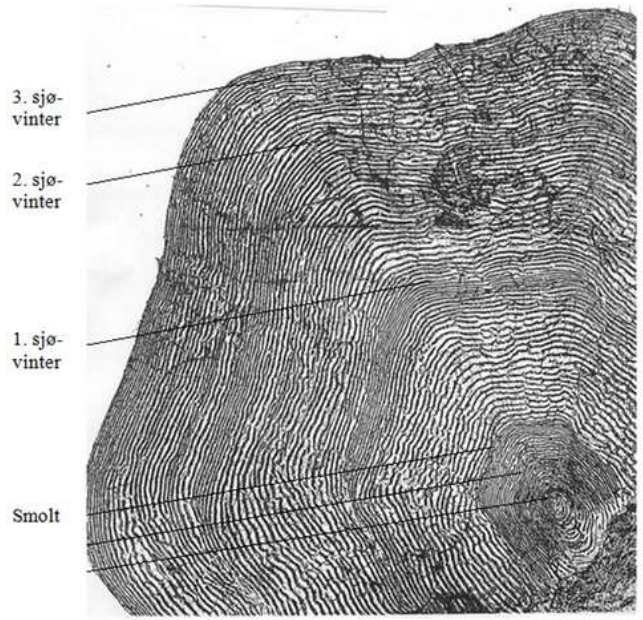


Project plan

- WP1: To get an insight into the background levels of rare earth elements in salmon smolt collected from different farms up along the coast.
- WP2: Testing of several elements in feed for 1+ smolt in seawater.
- WP3: Studying different doses/feeding periods for 0-smolt.

- Spring 2012
- May-October 2012
- Autumn- winter 2012-13

Analysis



One of the SIMPLE things about this method is that we only need to sample some scales from the fish, put them in a small plastic bag and send them in for analysis!

The analysis are done by IonCoupledPlasma-Masse

These instruments are advanced and expensive, but the analysis will still be cheep (100-200 kr)

In addition we can, for obtaining higher security, also analyse bones or otoliths (ørestener) by the same system.

Otoliths will be analysed also by our collegue in Zurich. For this he will use a special method called Laser ablation –ICP-MS, to see if he can measure the high consentrations at the growth zones.

Test of 5 different elements (=5 different «label feeds»)

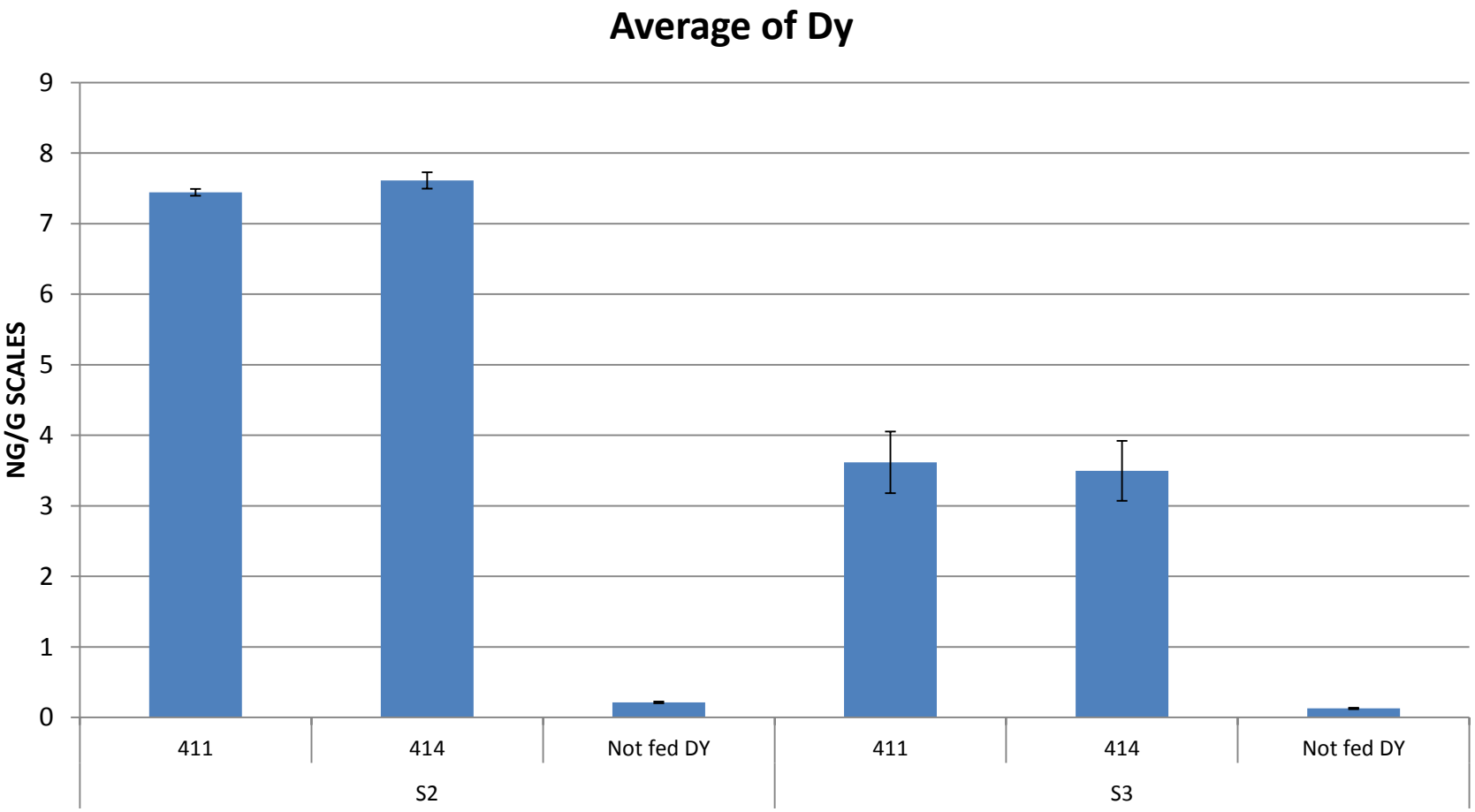
This feeding experiment was started in May with 80 grams 1+ smolt in seawater to simulate the situation in practise when «label feeds» will be used.

Chlorides of 5 different elements (cerium, lanthanum, neodymium, praseodymium and dysprosium), were used at 0,25g/kg feed, 2 tanks pr. feed. Growth measurements and sampling of fish after 5 and 9 weeks. The ”marker feeding” ended in July after 9 weeks.

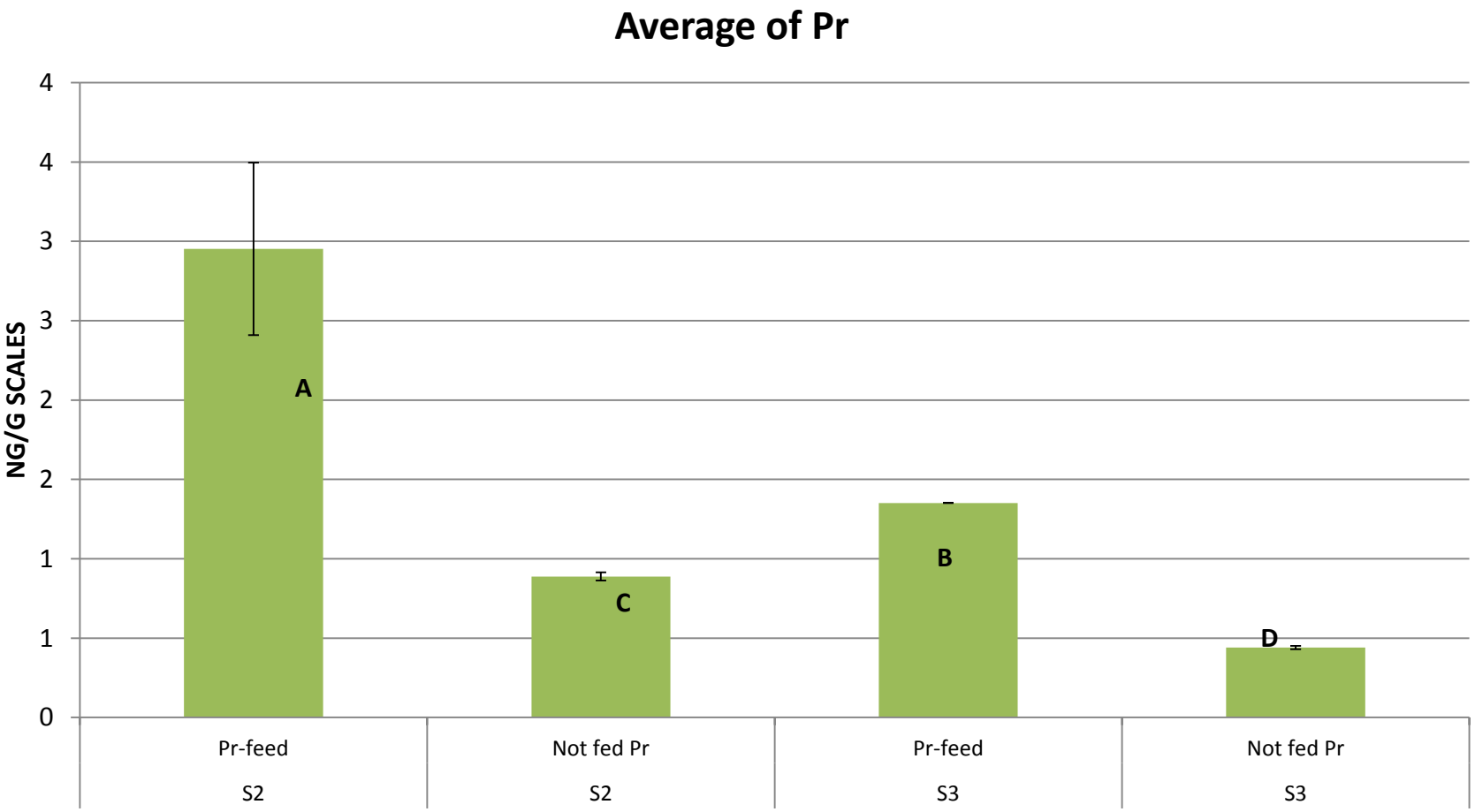
The fish were then transferred to one tank (they were all PIT-tagged) and given a commercial feed, and followed for another 2 months.

The test feeds were added Yttrium oxide, and faeces were sampled at 9 weeks for digestion (uptake) studies.

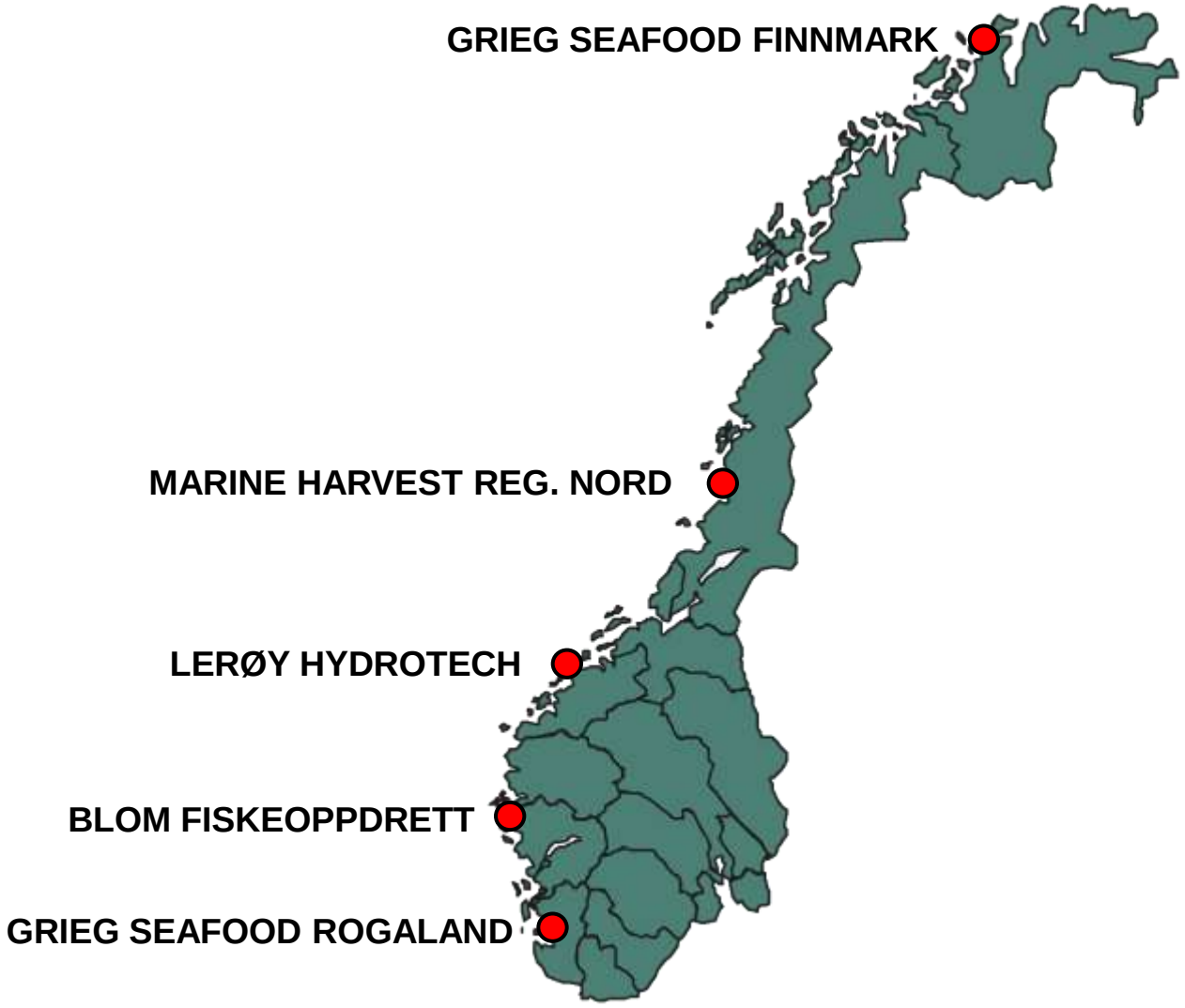
And the scales were definitely "Labelled"!!



Good results also for Pr (shown here) and Ce and Nd



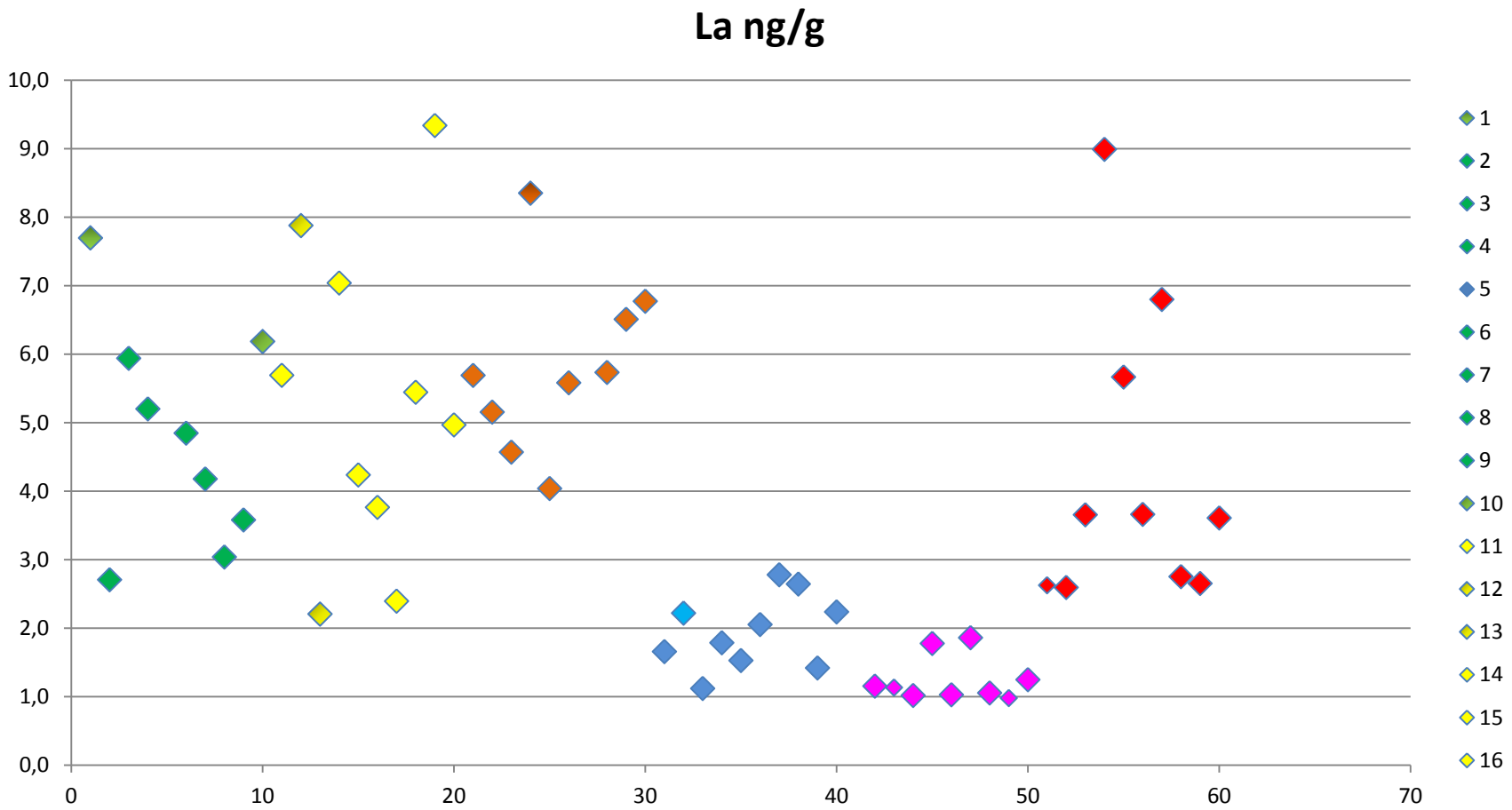
In WP1 we studied the background levels in farmed salmon



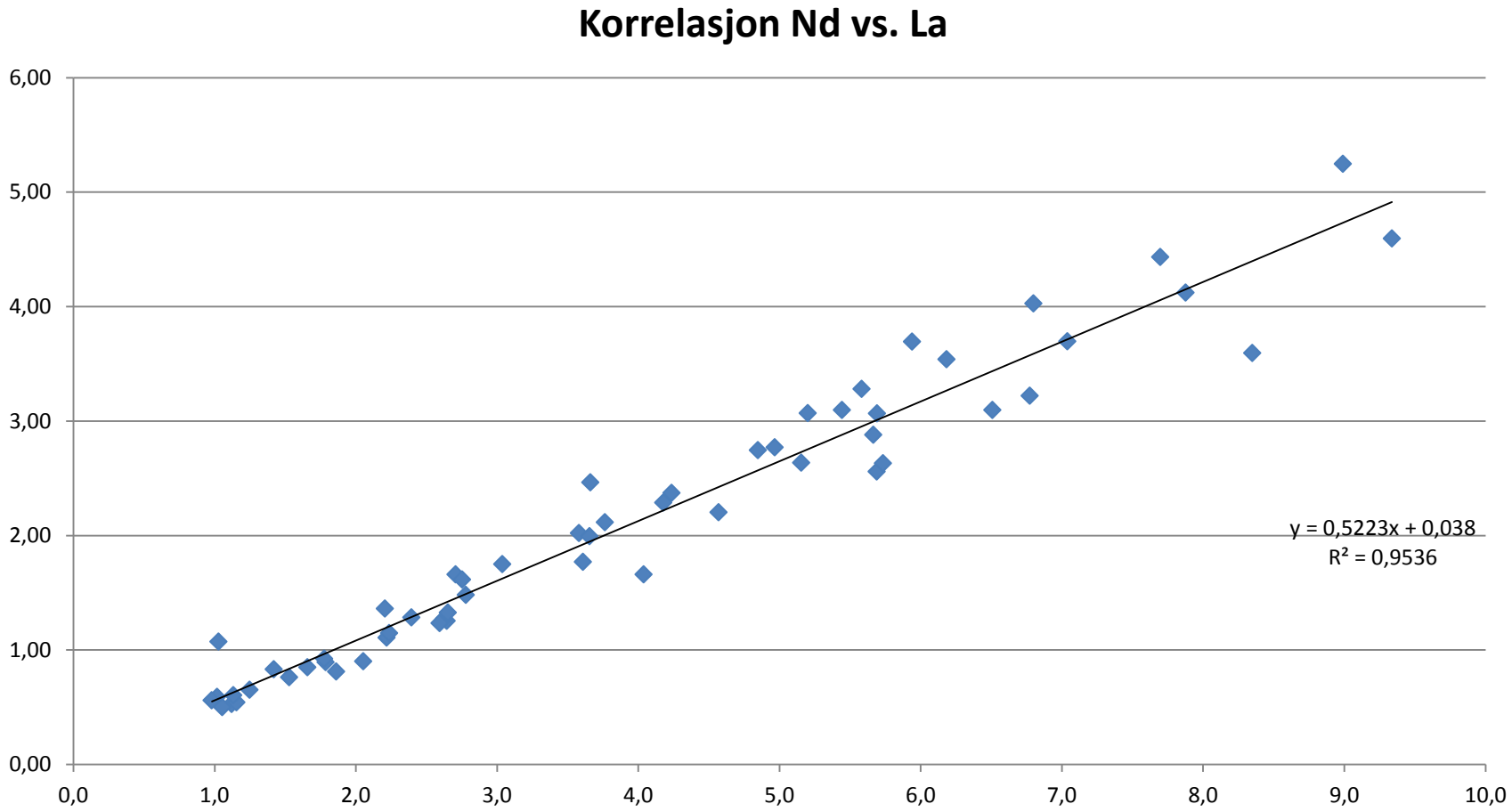
Mean background values (ng/g)

As	Ce	Dy	Er	Eu	Gd	Ho	La	Lu	Nd
647,0 ±233,0	3,51 ±0,24	0,18 ±0,11	0,17 ±0,12	4,10 ±2,92	0,46 ±0,26	0,06 ±0,04	3,90 ±2,26	0,34 ±0,35	2,08 ±1,21
Pr	Sc	Sm	Sr	Tb	Tm	U	Y	Yb	
0,60 ±0,36	12,51 ±4,73	0,37 ±0,22	327,2 ±113,7	0,40 ±0,33	0,03 ±0,03	63,73 ±28,28	5,18 ±2,03	0,14 ±0,10	

Background levels varied, both between fish and locations

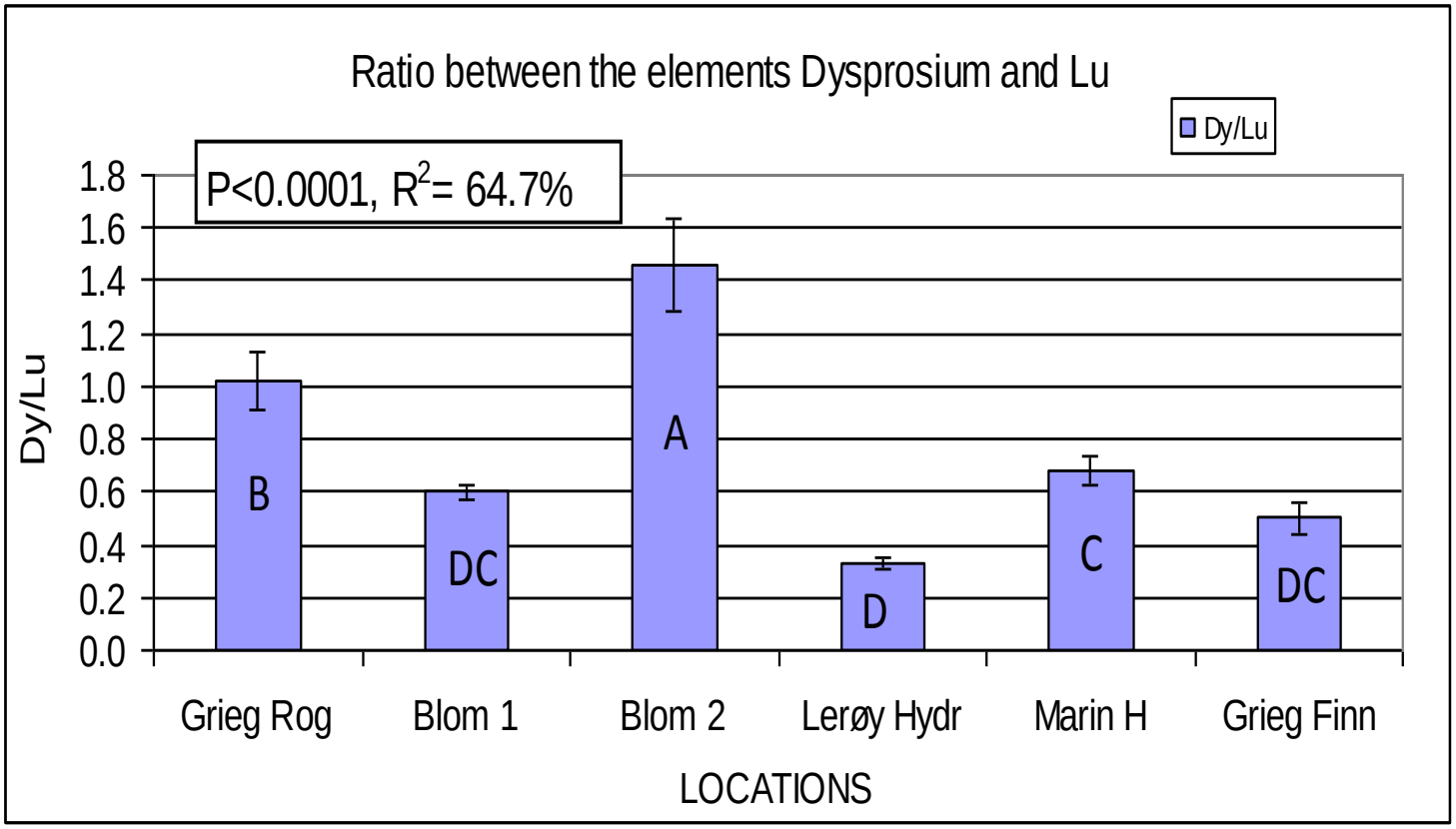


But we find a high correlation (ratios) between the contents of some of the elements

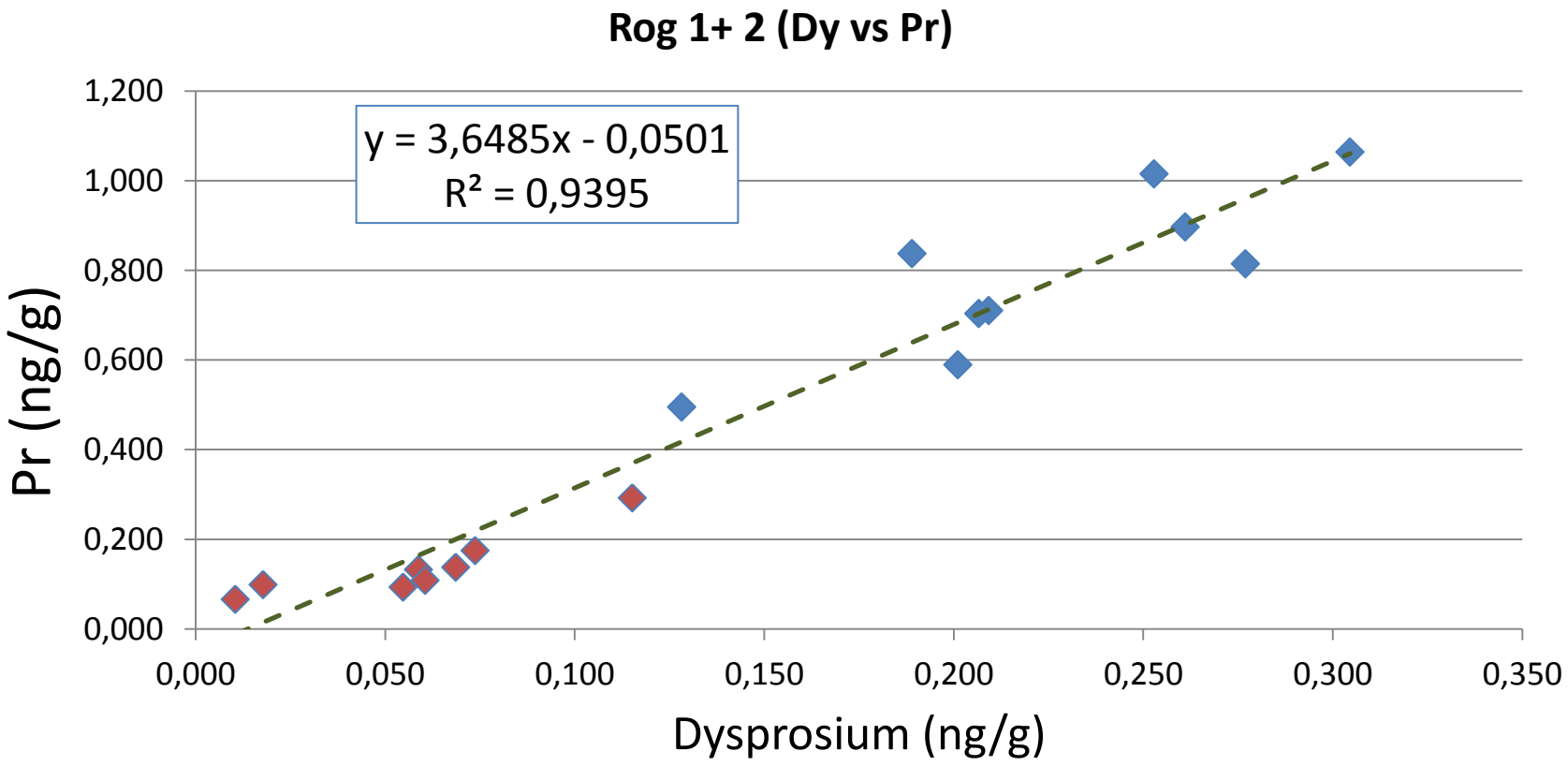


Since we get data for 19 elements at the same time, we can study moe than 300 ratios!

(= a "fingerprint" of each location!)



But we had one important question: Will this "fingerprint" stay constant over time??



This far in the project we can conclude:

- By adding small doses of rare earth elements to the feed for a sort period, scales are defenitely ”labelled”
- It is important to choose a label with low background levels
- Using ratios rather than just concentration levels gives less variation, and longer lasting differences to background levels

- The ”fingerprints” obtained just by analysing background levels gives very interesting information
- In some instances this information may be all that is needed to ”pinpoint” the farm

So a combination of a ”label feed” and more knowledge about the background (”fingerprint”) differences is really very promising in obtaining a cheep and fairly simple method of tracking escaped salmon

This is all you need

Simple?