A Captain's Guide To The Perfect Fleet;
An Analysis of
North Atlantic Fishing Data

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A Brief Note on Units / Fish Species

Throughout this presentation, **metric horsepower** (PS) will be used interchangeably with **horsepower** (hp), as the two units are virtually identical on large scales (>500 units).

Additionally, the fish species focused on in this project are Haddock, Pollock, and Cod.

As the captain of a fledgling fishing fleet, how can we maximize catch efficiency?

Using **real-world data** from North Atlantic fishing vessels, we must optimize our fleet, considering everything from the type of boats to the spot where we'll drop our trawl nets.

First, we'll briefly explore the data and its limitations.

The Dataset: Over 1.6 Million Entries

Derived from the **Norwegian Directory of Fisheries**, it catalogs:

- **Weight/dollar value** of catches

- **Characteristics of boats** that caught them

- **Season/date/surface temperature** of each catch

- The 2,107 **patches of ocean** that were fished (over 10 M km^2)

All recorded from 2002-2019.

Raster Data of Ocean Patches Used in

Map of North Atlantic Fishing Patches
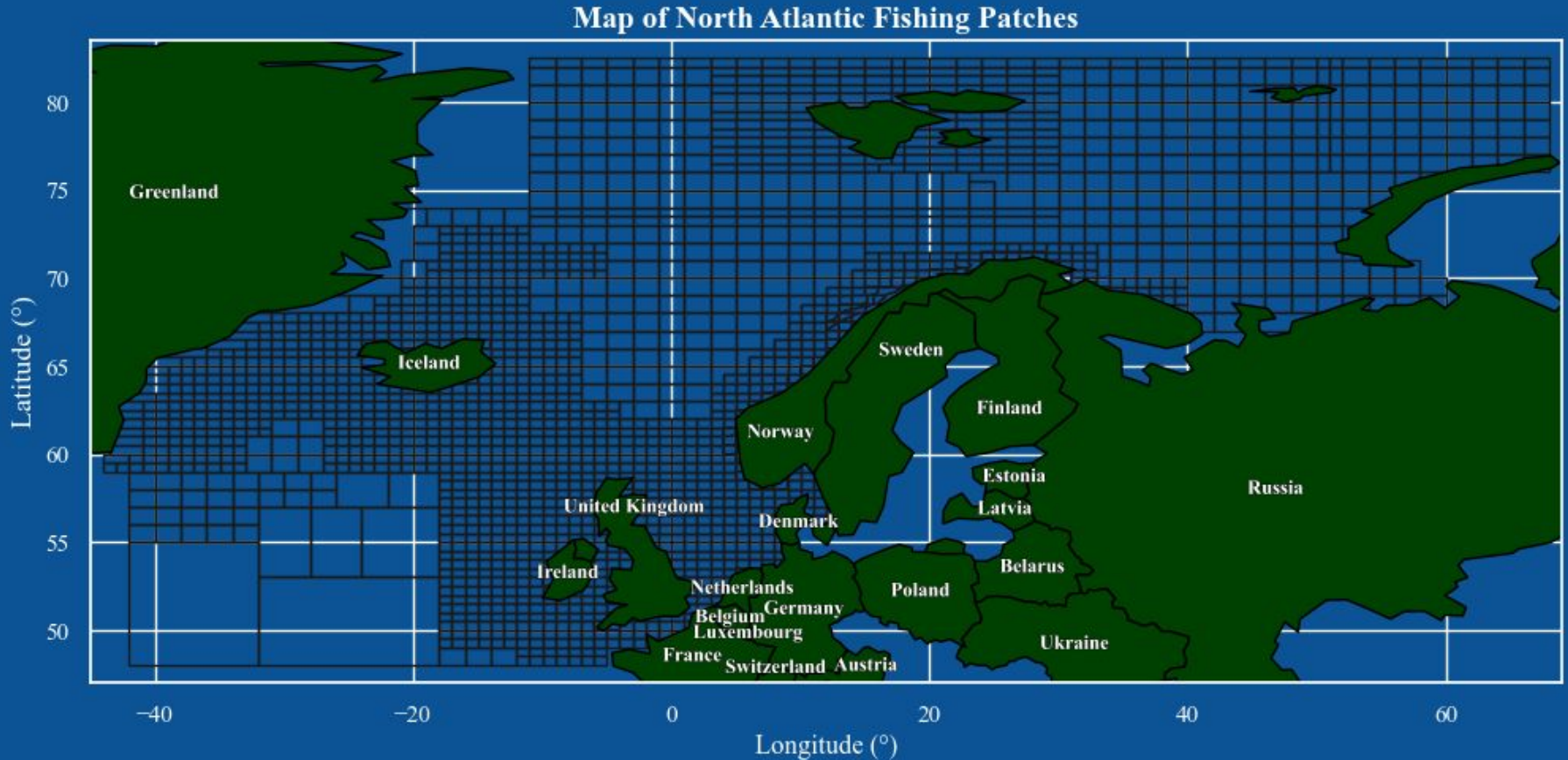
Summary Statistics Table of Fishing Data

This cleaned, inflation-adjusted slice of the dataset shows its sheer spread. For example, the standard deviation shows a nearly $100,000 deviation from the mean catch value.

	Catch Weight (Tons)	Catch Value (USD)	Engine Age (Years)	Hull Length (m)	Metric Horsepower
count	169011.0	169011.0	169011.0	169011.0	169011.0
mean	64.9	37146.2	19.9	28.1	1403.5
std	213.4	94973.8	12.0	19.9	1899.2
min	0.5	0.0	0.0	3.9	0.0
25%	1.0	1940.9	10.0	10.8	205.0
50%	3.9	6029.6	19.0	21.2	540.0
75%	31.6	25167.5	29.0	40.6	1599.0
max	2500.0	2568333.1	49.0	94.3	11000.0

Summary Statistics Table of Ocean Data

Some additional values include distance to a point on the shore, patch area, the North Atlantic Oscillation (NAO) index (measures pressure and therefore wind/water conditions), and the water's surface temperature.

	Distance to Shore (km)	Patch Area (km²)	NAO Index	Surface Temp (°C)
count	1601870.0	1601870.0	1601870.0	1473522.0
mean	402.5	2841.3	-0.0	8.4
std	475.9	1992.0	1.0	2.9
min	1.4	86.0	-3.2	-2.0
25%	33.9	2108.0	-0.9	6.4
50%	155.7	2611.0	0.0	7.9
75%	671.7	3228.0	0.7	10.3
max	3292.5	192838.0	2.5	20.7

With the data in order, we can optimize our fleet according to the performance of existing fishing vessels.

Our Optimization Goals

Using **real-world data** , we must optimize:

1. **Vessel characteristics** like hull size, horsepower, and age

2. **Fishing spot** selection

3. **Timing** of month, season, and temperature

To **net** as many fish, and therefore as much profit, as possible.

1. Which ships should we field?

In order to build the fleet of ships with the most efficient specifications for catching fish using the data, we look at the data's most effective combination of :

1. **Hull length** in meters
2. **Metric horsepower** of the engine
3. **Engine age**

To start, we'll consider the absolute best vessels in the dataset.

1. Which ships should we field?

The top performers are outliers; experienced crews, specific spots, and secretive fishing techniques. For example, the dataset's best crew:

Top 5 Catches By The Most Effective Vessel

Catch Weight (Tons)	Catch Value (USD)	Hull Length (m)	Engine Age (Years)	Metric Horsepower
2500.0	275497.5	74.6	13.0	6000.0
2483.7	351989.5	74.6	15.0	6000.0
2490.3	372891.9	74.6	16.0	6000.0
2470.4	383745.9	74.6	17.0	6000.0
2489.4	602969.3	74.6	18.0	6000.0

This isn't the best combination of hull and engine, but instead the best performing vessel. Having a 13+ year old engine isn't ideal, it just worked well for this crew. So, what is ideal?

Per this 3D plot, longer/stronger vessels catch more, but only up to a point. This is likely due to engine noise and difficulty of fishing from extraordinarily massive ships.
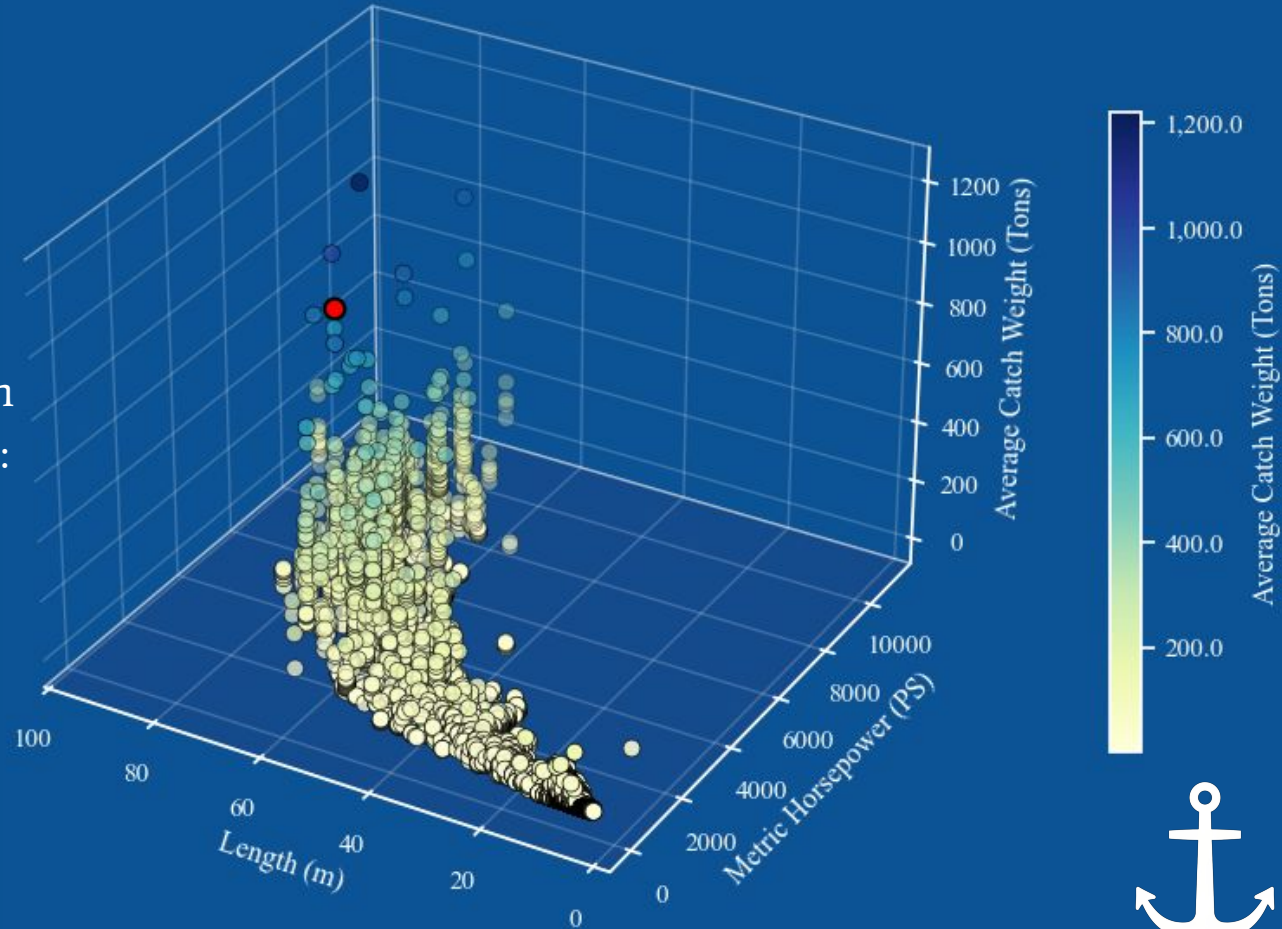
The ideal combination of length and horsepower (shown in red):
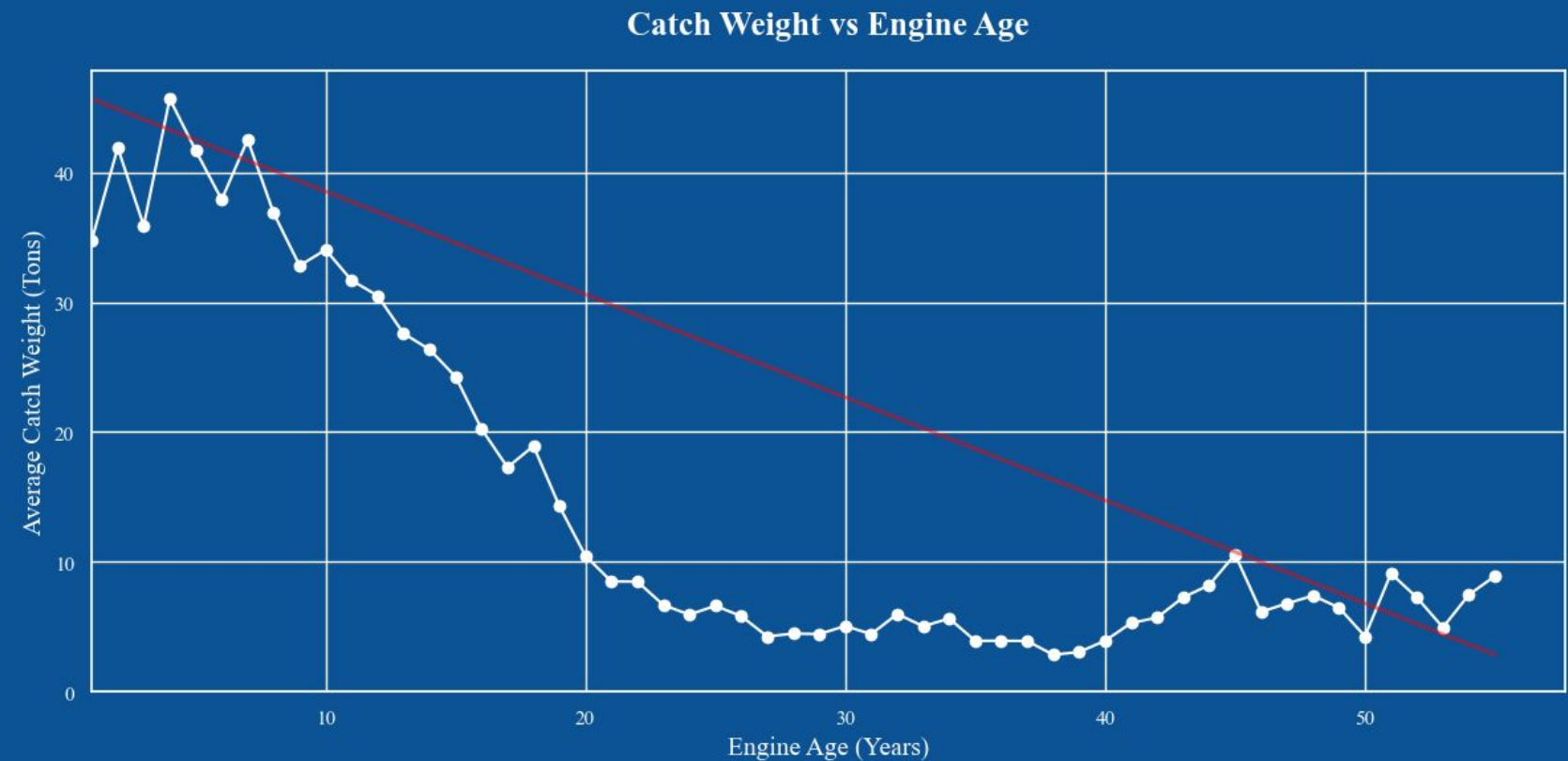
70 m hull length

4000 hp engine power

What about the engine age?

Predictably, newer engines perform better. While some of this is likely due to having new equipment in general, the more advanced, quieter, and faster engines allow the catching of more fish.

Catch Weight vs Engine Age

Thus, the ideal vessel is:
A **70 meter** trawler with a **brand-new 4,000 hp engine**

Fortunately, Norwegian firm Skipstekisk launched a new line of demersal trawlers in 2023 with these exact specifications, of which a 3D rendering is seen below.

2. Where should we fish?

Now that we have the perfect boat, we need to know exactly where to cast our nets and drop our lines. We'll base this on:

1. **Average fish caught per patch**   in Tons
2. **Average catch value per patch**   in USD

To start, we'll consider a raster map of where the most fish are caught, on average.

This map plot shows that the most successful fishing occurs in regions sufficiently far from the coast, but not quite out in the deep sea. To find which coast is best, we'll consider value.

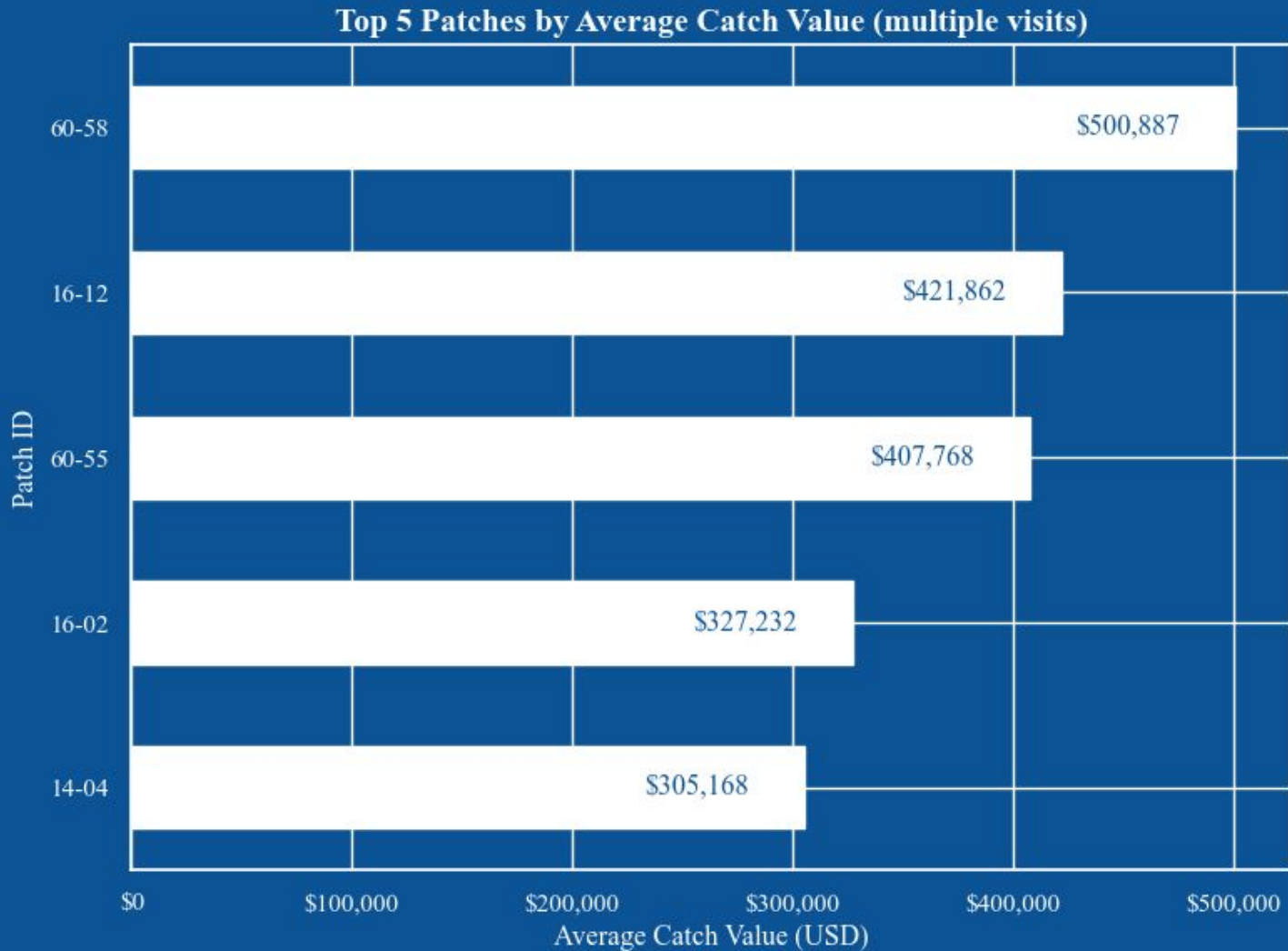Average Catch Weight by Patch (All Dates)
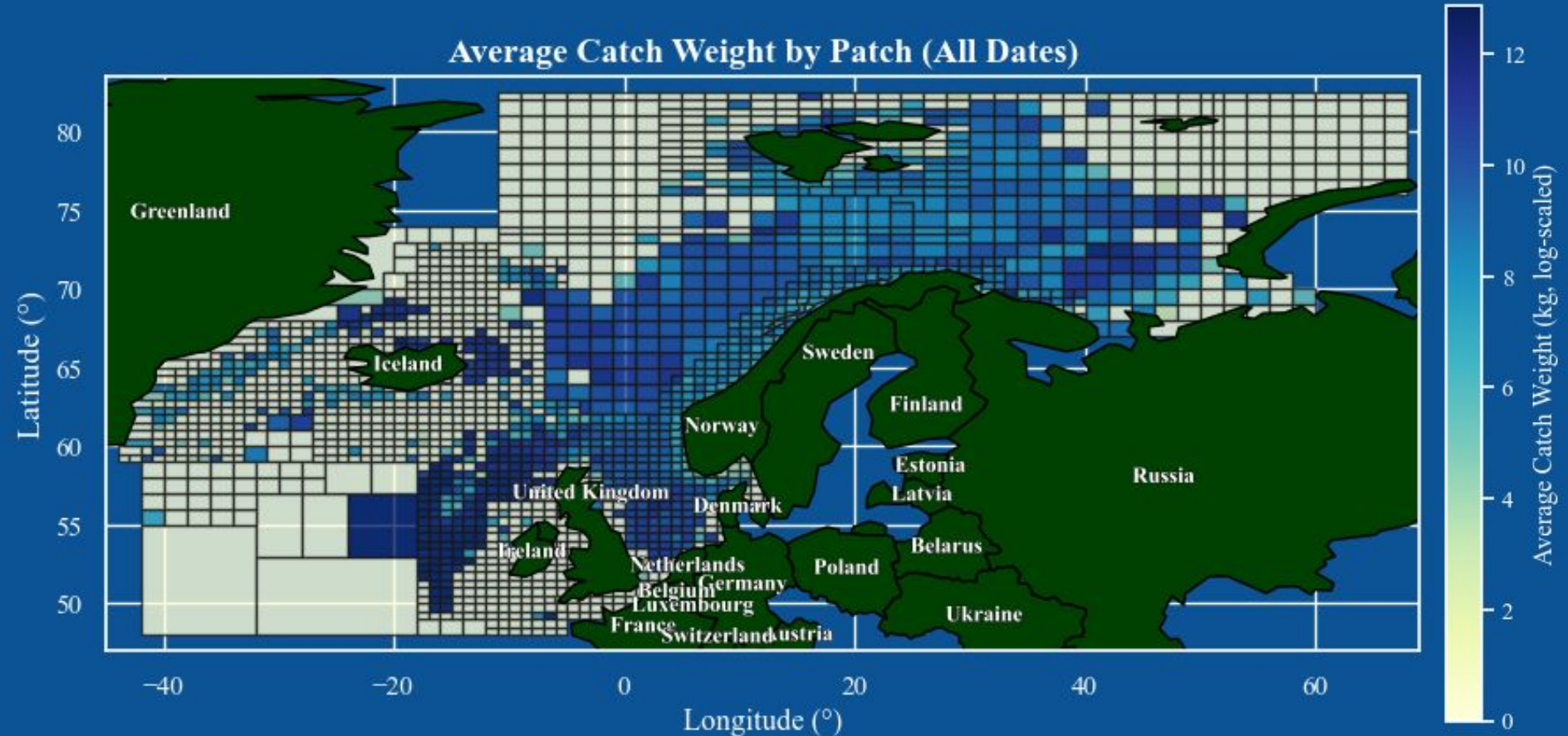
This bar graph shows the most profitable places to fish, but it doesn't consider visit frequency; 4 of these 5 spots have only been visited once, making them one offs.
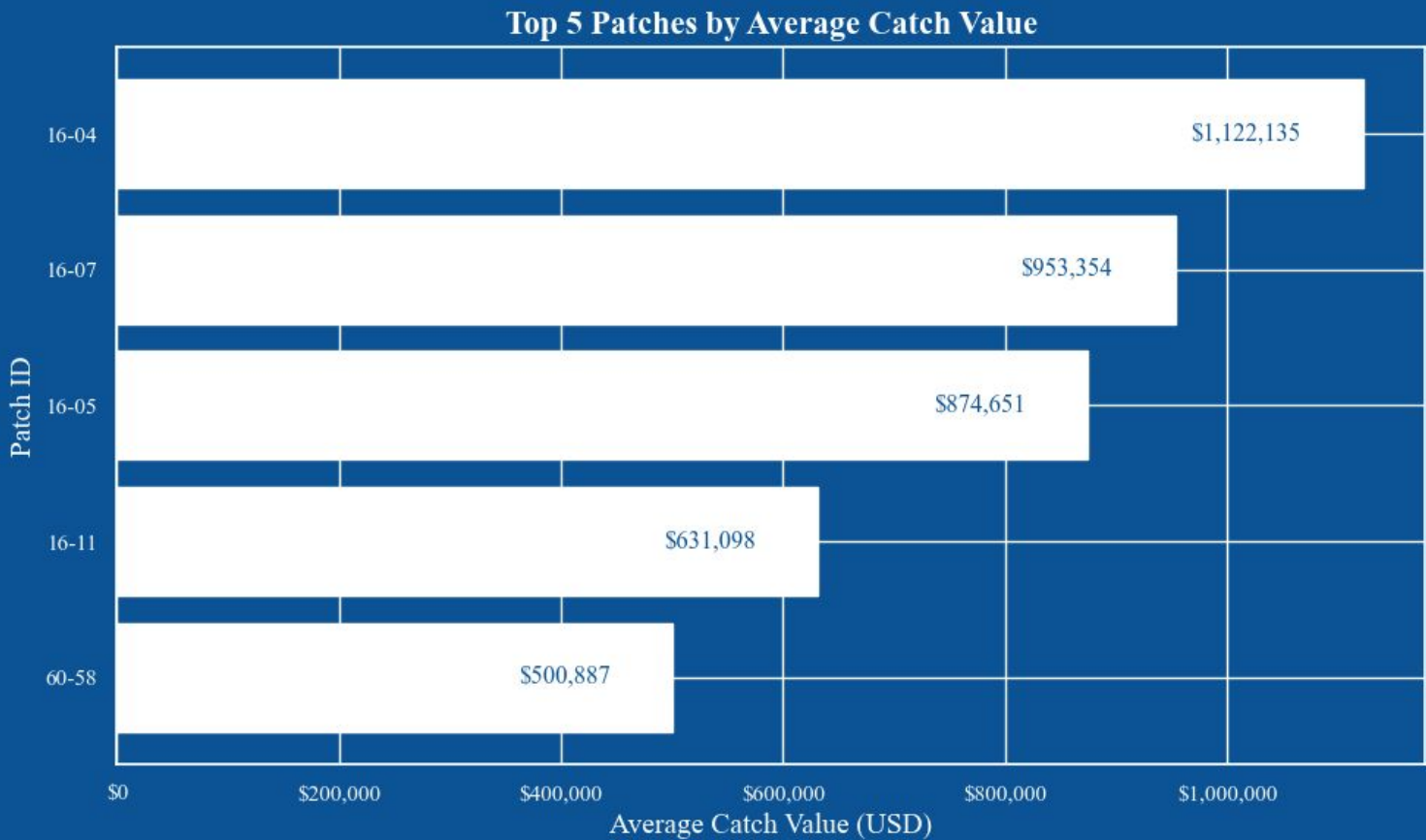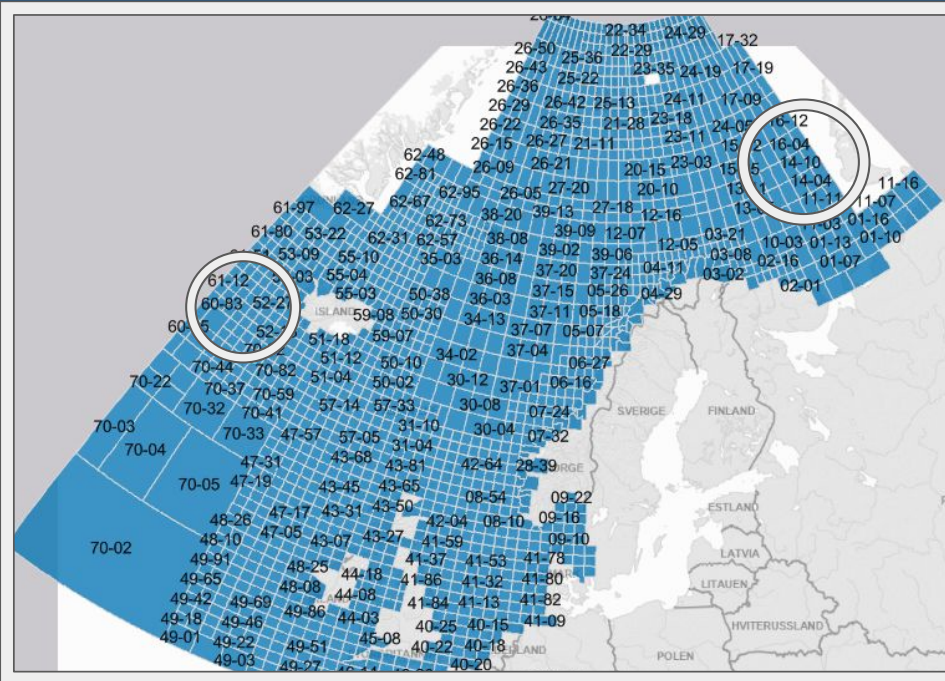
This can be useful if we want to try our luck for a big catch, but we can profit more reliably if we use spots with many high-profiting visits in the data.

Top 5 Patches by Average Catch Value

Patch ID	Average Catch Value (USD)
16-04	$1,122,135
16-07	$953,354
16-05	$874,651
16-11	$631,098
60-58	$500,887

This solves the issue; these spots have been consistently high-earning across nearly 18 years of data.

That means we can come to these regions for consistent, low-risk profit.

Top 5 Patches by Average Catch Value (multiple visits)

Patch ID	Average Catch Value (USD)
60-58	$500,887
16-12	$421,862
60-55	$407,768
16-02	$327,232
14-04	$305,168

So, our ideal reliable fishing spots are:
West of Iceland or Northeast of Finland

3. When should we fish?

With our vessels and fishing spots figured out, all that's left is to know when it's best to go. We'll determine this with:

1. **Average catch weight based on month and temperature**
2. **Average catch weight based on NAO index**

To start, we'll look at a descriptive statistics table of months and see what the data indicates.

This descriptive statistics table shows data according to the month of the catch. Mar-Apr has the highest avg. catches, while Oct-Nov has the highest dollar value.

Thus we can assume North-Atlantic fishing is best in the spring (as hatch and warm waters makes catching easier), but it's ideal to sell fish mid-Autumn (as fewer boats brave the storms and holiday season spikes the market).

Monthly Fishing Performance Summary

	Avg Catch (kg)	Catch Std	Max Catch (kg)	Avg Value (USD)	Value Std	Max Value (USD)
January	2721.2	24931.9	1150914.0	2565.2	21031.8	1137356.4
February	6307.4	53067.9	2118507.0	3688.9	24603.7	1625858.6
March	11265.0	108738.3	2489439.0	4220.4	31488.0	1128602.1
April	13128.3	125243.1	2500011.0	3901.5	30843.2	1226138.7
May	7666.3	91404.0	2450927.0	2553.5	26150.9	2137206.1
June	5319.8	53477.3	1866066.0	2795.8	26667.9	2344467.1
July	6093.6	51612.6	2052837.0	4066.1	29551.4	2271760.8
August	5117.4	57224.8	2098705.0	3265.8	30586.7	2568333.1
September	2607.7	30248.3	1918446.0	2429.8	24087.0	1866342.3
October	5978.9	37988.2	1209140.0	7452.3	51476.9	2030281.6
November	6776.4	40362.3	1280051.0	7260.4	48097.7	1652996.4
December	4814.7	32845.0	1130942.0	4422.7	32185.4	1612884.4

The independent crosstab (right) better visualizes the fact that we can catch more fish in the Spring. The dependent one (left) shows that on warm Spring days in particular, the most catches happen. Thus, our best time to fish is clear; Spring months, on days when the water is warm.

	Cold	Cool	Warm	Hot
January	2.46	3.05	1.86	8.22
February	5.66	7.36	3.68	1.25
March	33.75	11.1	8.93	7.34
April	10.07	10.27	38.66	0.01
May	1.93	6.14	26.38	0.34
June	5.07	3.82	6.53	23.8
July	4.28	4.97	9.08	9.82
August	10.13	2.25	5.27	6.55
September	5.98	1.29	2.01	4.25
October	1.86	7.81	5.8	4.71
November	4.08	6.16	8.44	0.11
December	1.91	5.1	5.75	4.09

	Average Catch Weight (Tons)
January	2.72
February	6.31
March	11.27
April	13.13
May	7.67
June	5.32
July	6.09
August	5.12
September	2.61
October	5.98
November	6.78
December	4.81

This graph shows how spikes in the NAO index (indicating weather changes) have a delayed effect on avg. catch weight. Therefore, **we should fish according to the wake of NAO spikes.**

NAO Index vs Avg Catch Weight (kg)
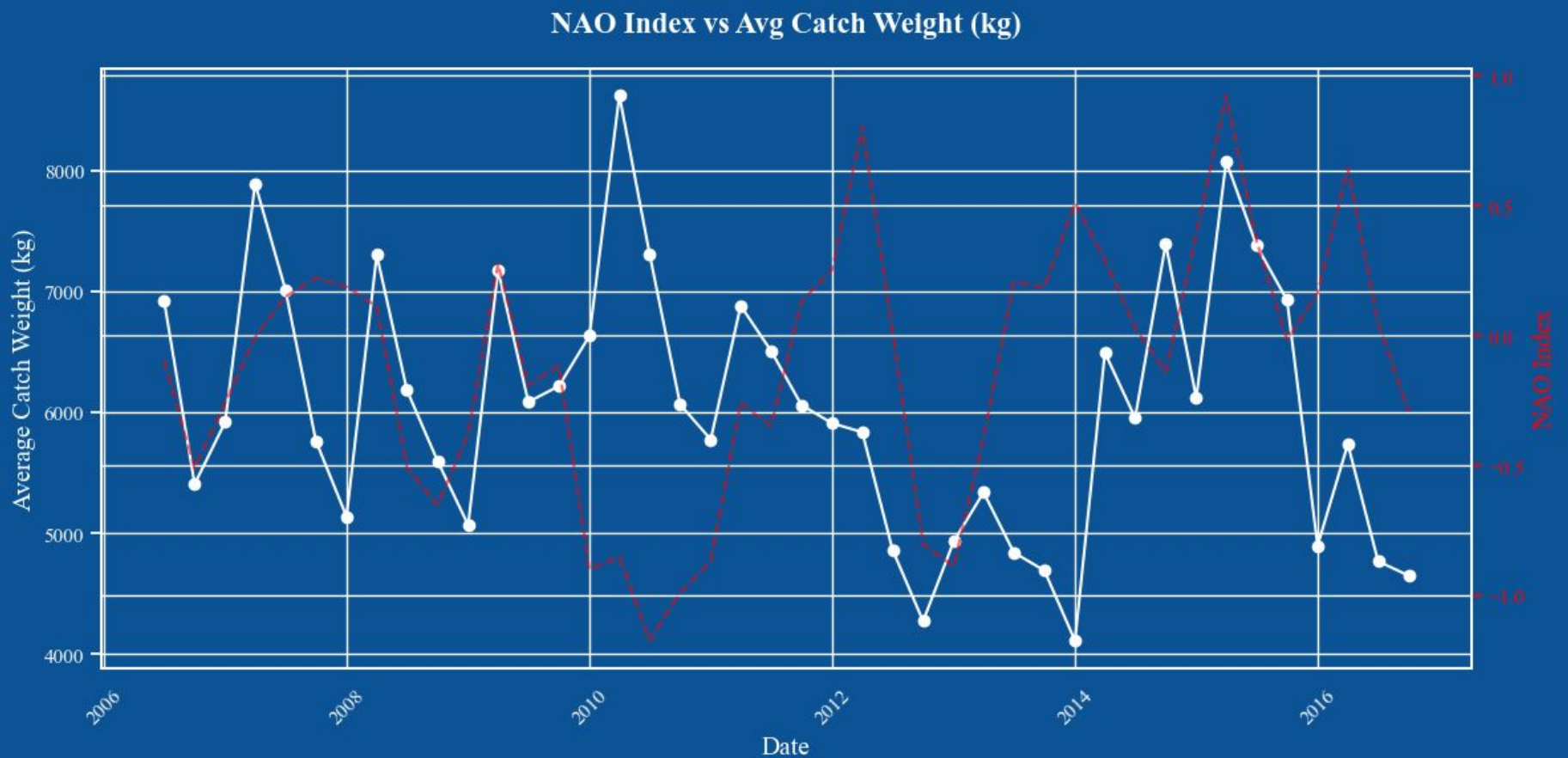
This means our ideal fishing schedule is:

Fish around warm Spring days - Sell more in mid-August
Operate according to NAO data

Conclusion: Our Data-Driven Fleet

Our fleet is an armada of **70-meter long** deep-sea trawlers with **brand-new 4,000 hp engines** ,

Primarily following fishing routes **West of Iceland** and **Northeast of Finland** ,

With **fishing focused the most on Spring days** with **warm water surface temperatures** in accordance with **NAO data** , and **selling focused around the mid-August season** .

Sources Cited

USD to NOK historic conversion rates

Raster geographic map of fishing zones

Norwegian Directory of Fisheries

The trawler image I used

Info on the new Norwegian trawler

Google Earth map of Norwegian ocean

Original Kaggle data