

longboats

April 7, 2021

```
[1]: from scipy.constants import nautical_mile
import numpy as np
```

0.1 Longboat speeds

Assumptions based on studies:

1. Favourable wind conditions, in downwind run, the square sail could give 15kt sustained speed over ground (SOG).
2. In unfavourable wind conditions (not enough or headwind in a narrow fjord, for example) the boat was probably rowed giving 5kt sustained SOG. Big waves could have been a problem in this case.
3. Combined by using wind and rowing a longboat could travel more than 200km in 24 hours. This corresponds to 108nm/day with 4.5kt average speed.

Let's see what max VMG could have been when beating in moderate winds.

```
[2]: # assume SOG of 8kt and TWD 30deg
8*np.sin(np.deg2rad(30))
```

```
[2]: 3.9999999999999996
```

```
[3]: # assume boat speed of 8kt and TWD 30deg
8*np.sin(np.deg2rad(40))
```

```
[3]: 5.142300877492314
```

Hence, maybe velocity made good (VMG) could have been around 5kt. Let's use these:

```
[10]: # assumed max speeds in wind range 10-40kt
windward_sails=5
downwind_sails=15
rowing=5
# average speed resulting from 200km per day expert estimate
combined=4.5

def estimates(distance):
    print("Route: %.2f nm" % distance)
```

```
slowest=distance/windward_sails
print("Naive slowest time: %.2f hours" % slowest)
fastest=distance/downwind_sails
print("Naive fastest time: %.2f hours" % fastest)

expert=distance/combined
print("200km/day estimate 100%: {:.2f} hours".format(expert))
print("200km/day estimate 80%: {:.2f} hours".format(expert/.8))
print("200km/day estimate 120%: {:.2f} hours".format(expert/1.2))
```

0.2 Probable legs in Baltic Sea

Time assumptions do not take account possible landings on the route. Slowest and fastest times naively assume max speeds in given conditions (wind direction or rowing). Slowest assumes beating or rowing all the time and fastest surfing downwind all the time. Therefore it is advised to use the average to get more realistic estimate.

0.2.1 Tukholma-Pori



```
[11]: estimates(382e3/nautical_mile)
```

```
Route: 206.26 nm  
Naive slowest time: 41.25 hours  
Naive fastest time: 13.75 hours  
200km/day estimate 100%: 45.84 hours  
200km/day estimate 80%: 57.30 hours  
200km/day estimate 120%: 38.20 hours
```

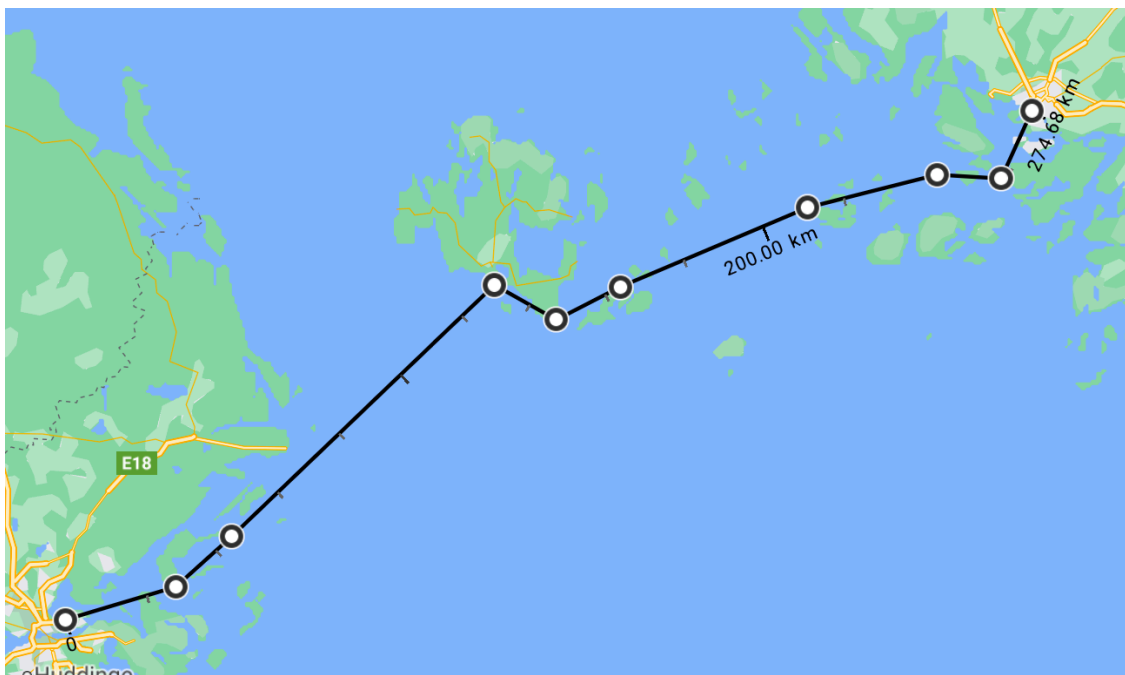
0.2.2 Pori-Pietari



```
[12]: estimates(672e3/nautical_mile)
```

Route: 362.85 nm
Naive slowest time: 72.57 hours
Naive fastest time: 24.19 hours
200km/day estimate 100%: 80.63 hours
200km/day estimate 80%: 100.79 hours
200km/day estimate 120%: 67.19 hours

0.2.3 Tukholma-Turku



```
[13]: estimates(275e3/nautical_mile)
```

```
Route: 148.49 nm  
Naive slowest time: 29.70 hours  
Naive fastest time: 9.90 hours  
200km/day estimate 100%: 33.00 hours  
200km/day estimate 80%: 41.25 hours  
200km/day estimate 120%: 27.50 hours
```