

# Exploring MHW effects on fish abundance in trawl surveys

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## Exploring marine heatwaves

### North America

#### Characterizing MHWs in North America

How frequent and severe have heatwaves been in North America since 1982 (the start of the MHW data)?

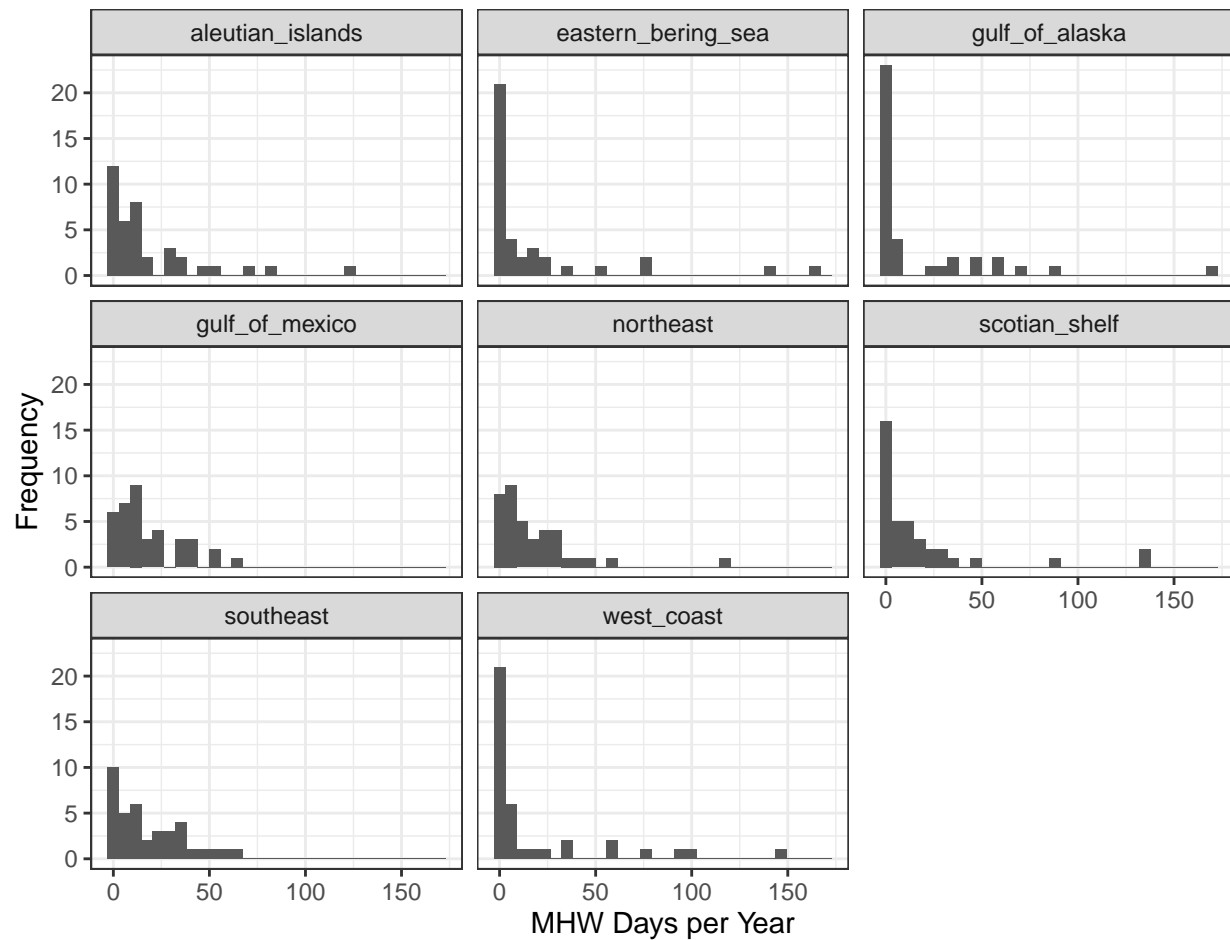


Figure 1: Frequency of MHW Events in North America

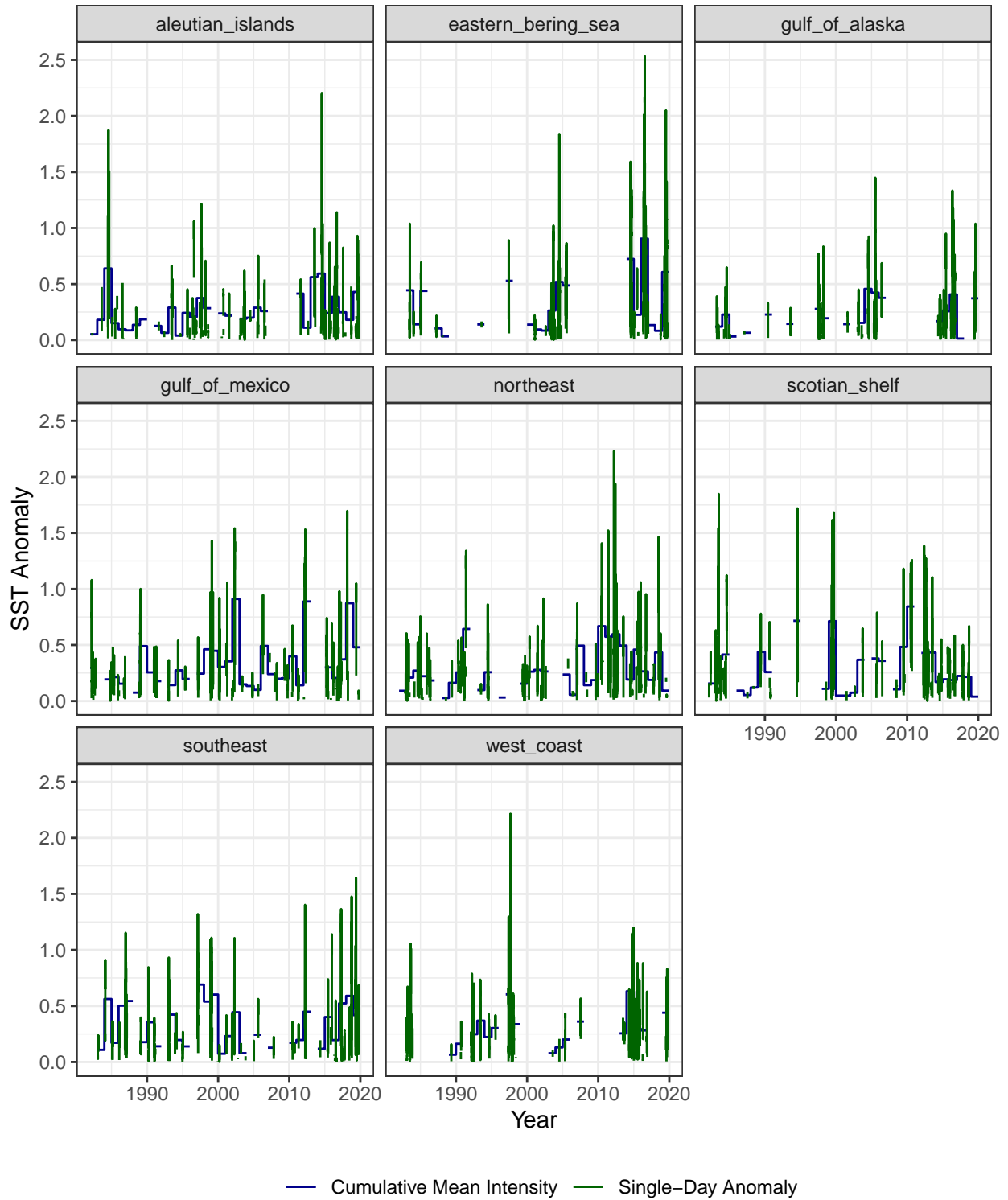


Figure 2: Anomaly of MHW Events in North America

### MHWs vs. CPUE

Lets look at annual cumulative mean intensity (sum of SST anomalies in the calendar year / number of MHW-days in the calendar year) vs. trends in aggregate abundance (total CPUE across all species) for the

whole region. The two metrics of CPUE change used are proportion change CPUE vs. last year  $((\text{cpueThisYear} - \text{cpueLastYear})/\text{cpueLastYear})$ , and proportion change CPUE relative to the long-term mean  $((\text{cpueThisYear} - \text{cpueSeriesMean})/\text{cpueSeriesMean})$ .

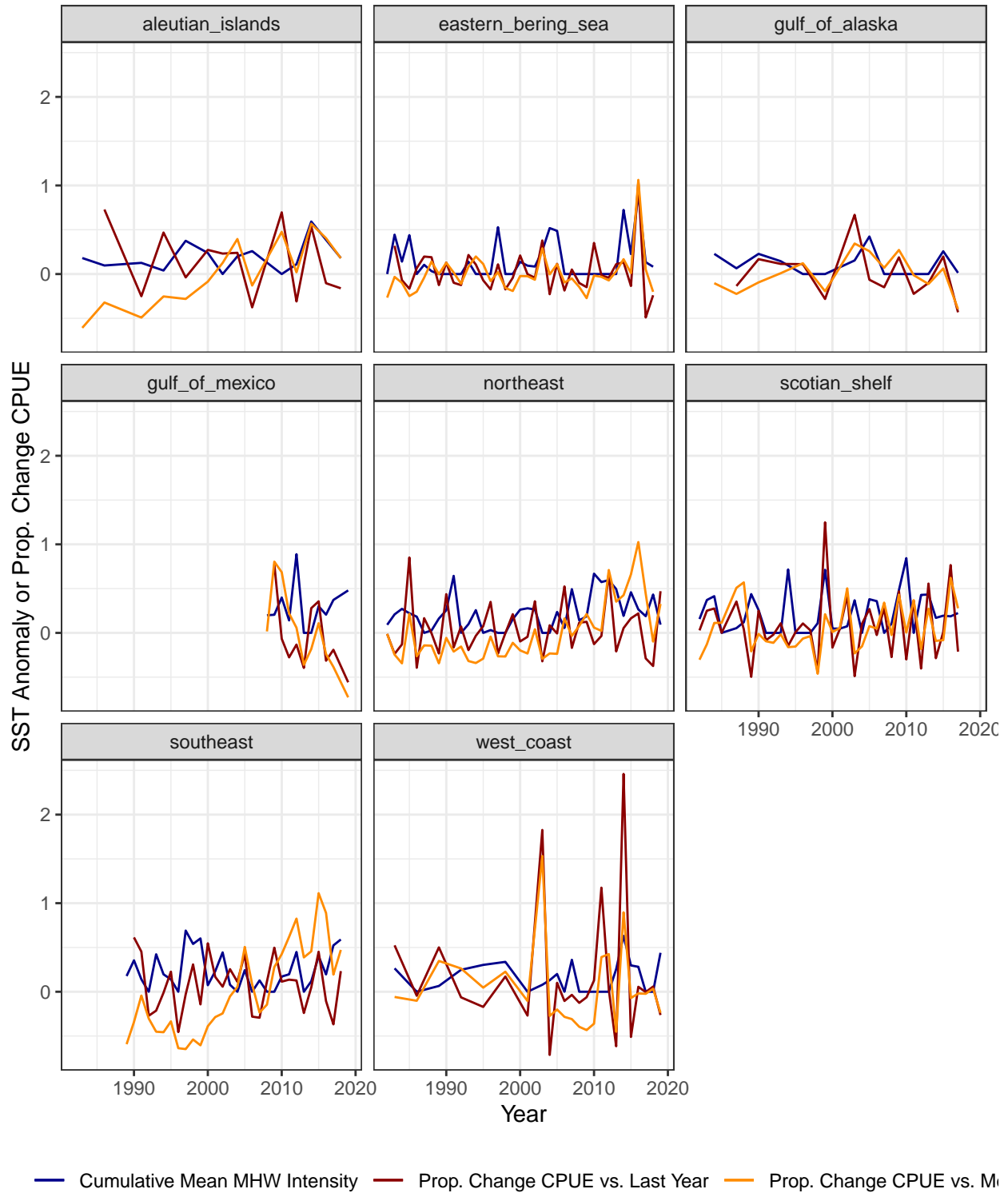


Figure 3: MHW Cumulative Mean Intensity and Change in Total CPUE Over Time

Rather than comparing both MHW intensity and CPUE trends over time, we can just plot cumulative mean intensity against the CPUE trend in that year:

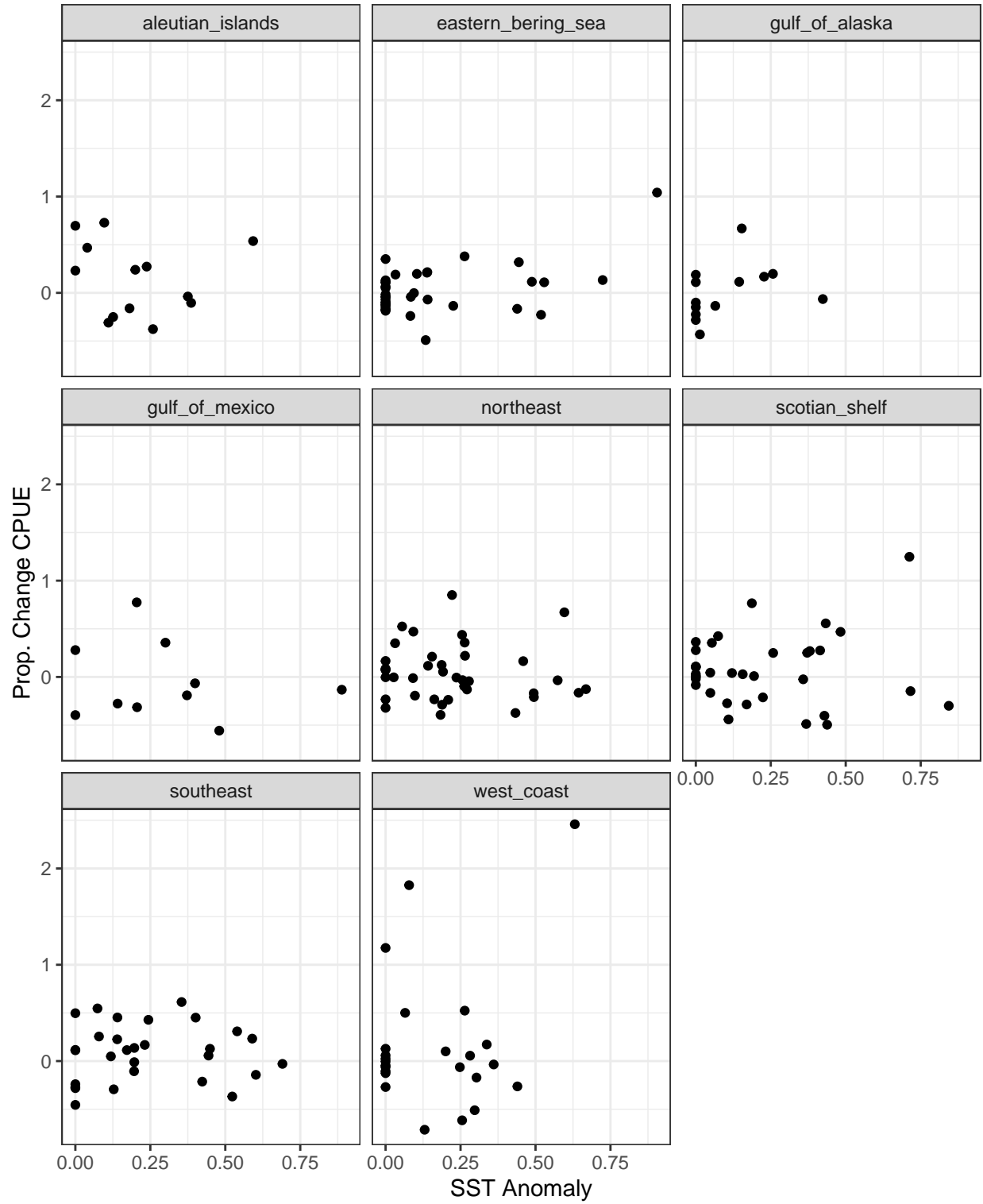


Figure 4: MHW Cumulative Mean Intensity vs. Change in Total CPUE

Let's look at the five species with the most biomass in each region. For plotting purposes, I omitted points with more than a 5x change in CPUE, which happened occasionally (up to 50x change, which is unlikely to be real).



Figure 5: MHW Cumulative Mean Intensity vs. Single-Species Change in Total CPUE

## Evaluating a yearly MHW index

At Thomas's suggestion, let's try using a yearly definition of MHWs rather than a daily one, to match the time scale of the trawl data. In the histograms below I've imputed zeros for NA values (no MHW) just to see the data distribution.

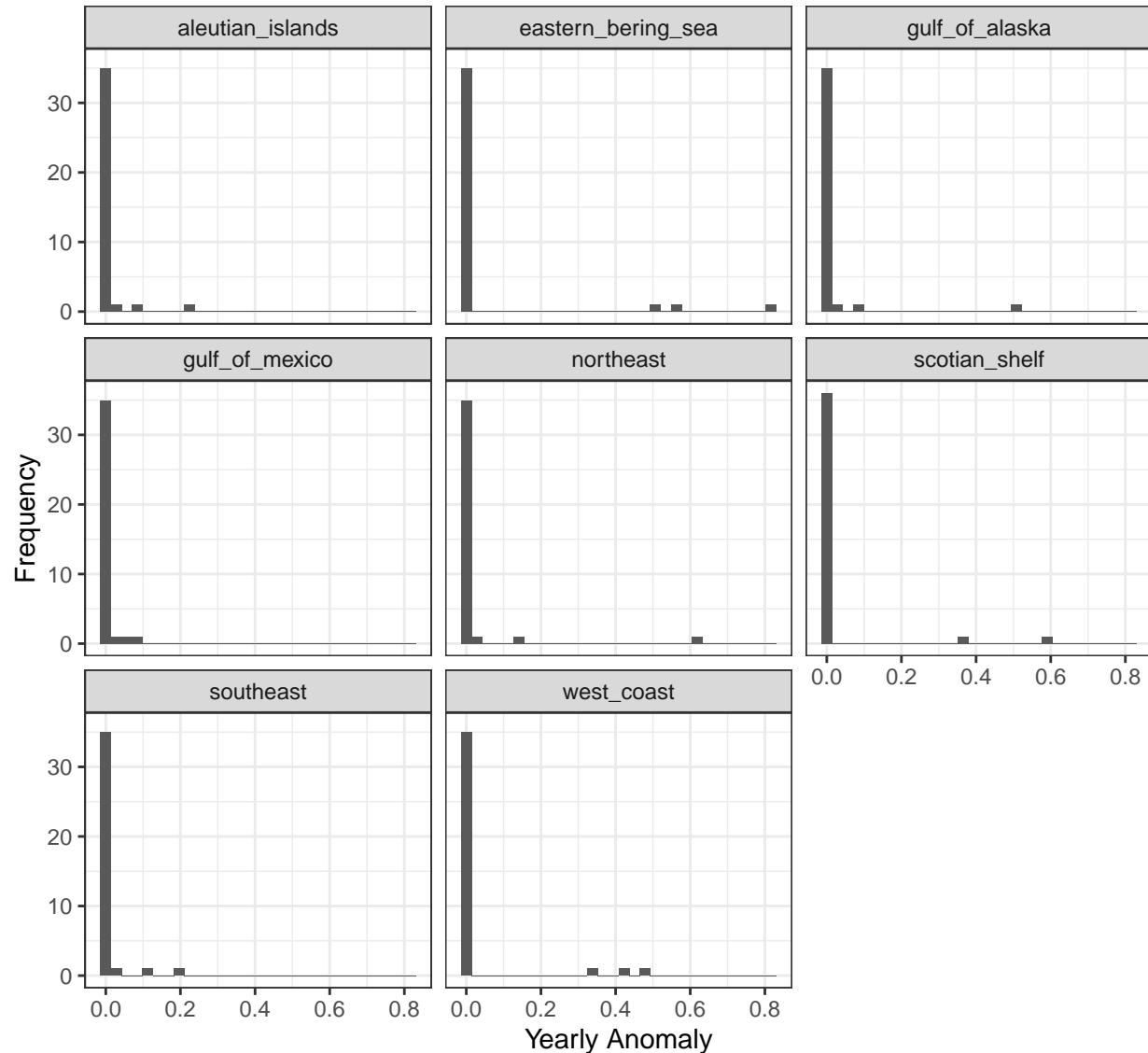


Figure 6: Distributions of Yearly MHW Estimates Across Regions

This approach calculated exactly 3 MHW-years per region, I think because we took the 90th percentile of the same number of years:

```
## # A tibble: 18 x 2
##   region      mhw_years
##   <chr>      <int>
## 1 aleutian_islands      3
## 2 bits                  3
## 3 eastern_bering_sea    3
## 4 evhoe                  3
```

## 5	fr_cgfs	3
## 6	gulf_of_alaska	3
## 7	gulf_of_mexico	3
## 8	ie_igfs	3
## 9	nigfs	3
## 10	norbts	3
## 11	northeast	3
## 12	ns_ibts	3
## 13	pt_ibts	3
## 14	rockall	3
## 15	scotian_shelf	3
## 16	southeast	3
## 17	swc_ibts	3
## 18	west_coast	3

Let's see what happened to CPUE in those regions in those years; these are the same plots as above but now MHW years are indicated with an asterisk. In plots with fewer than three asterisks, there aren't trawl data available in the MHW year.

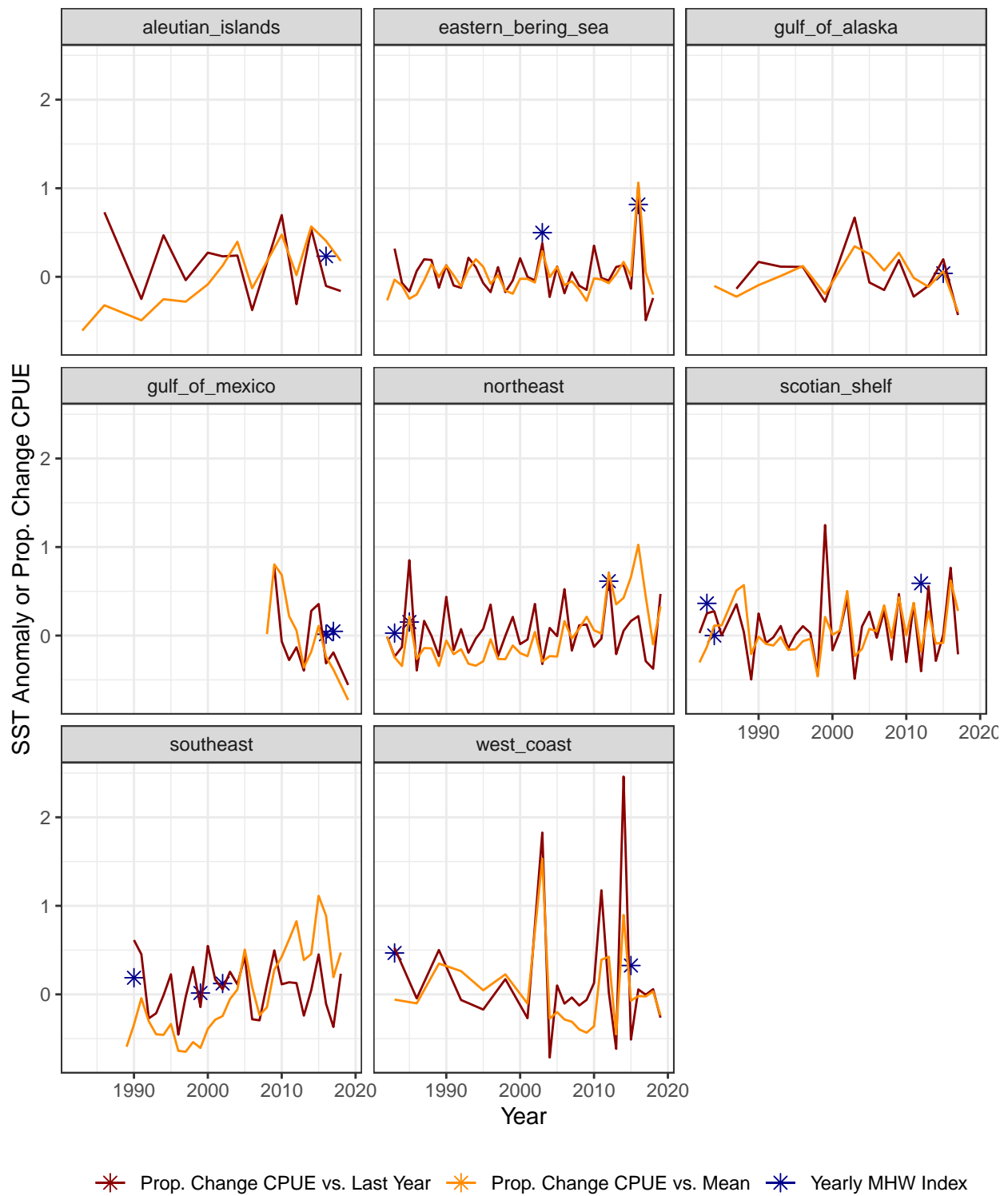


Figure 7: Yearly MHWs and Change in Total CPUE Over Time

How does catch vary in MHW years vs. non-MHW years?



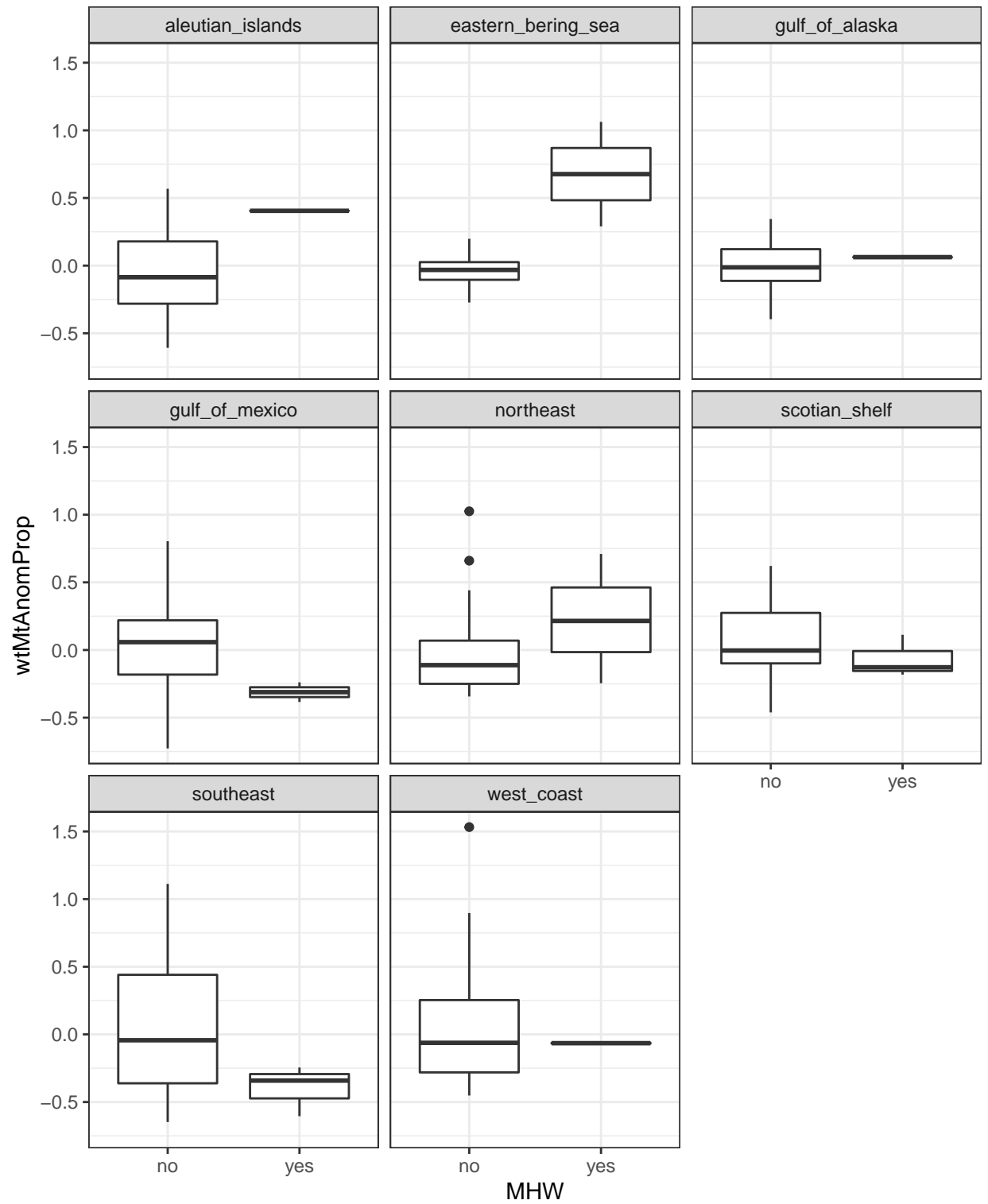


Figure 8: CPUE Proportional Anomaly in MHW vs. non-MHW years

Here are the same plots using proportional difference from the last year instead of CPUE anomaly.

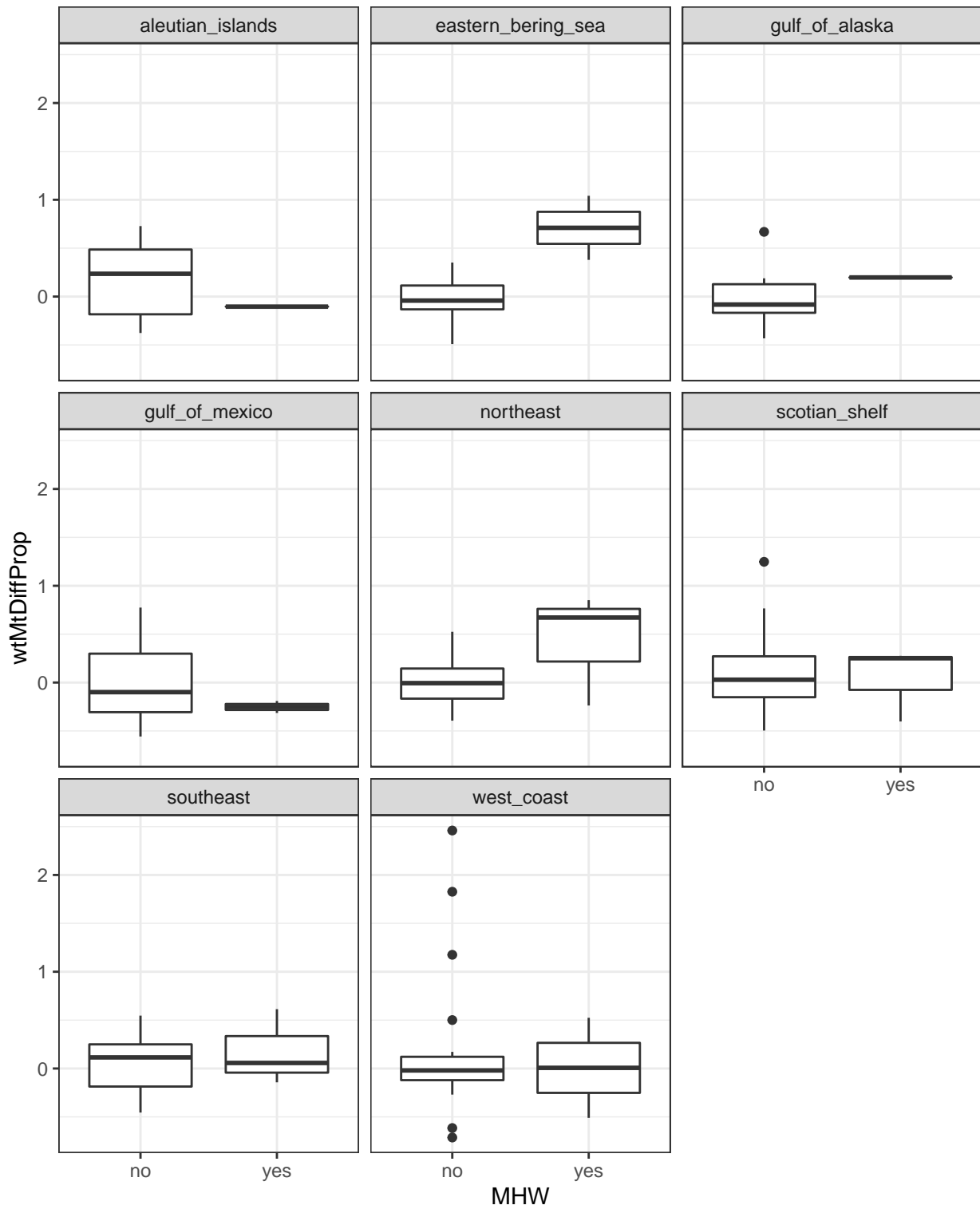


Figure 9: CPUE Proportional Year-Over-Year Difference in MHW vs. non-MHW years