slinky_synthesis

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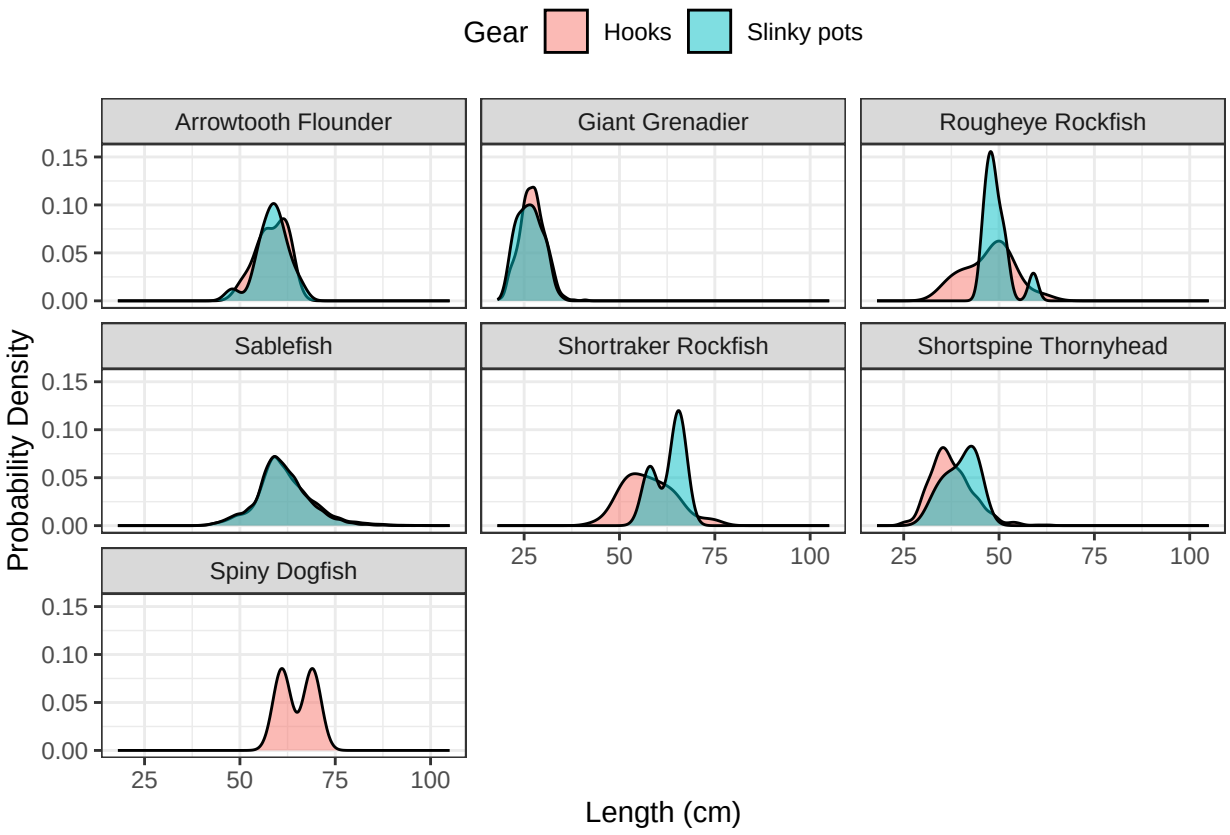
Length distributions (Aggregate)

Key Takeaways: When aggregating among years, the median fork lengths are the same. Looking at length distributions, the HAL appears to marginally select for larger fish. In 2021, when aggregated across stations, slinky pots appear to select larger fish. in 2022, slinky pots appear to select the same size of fish wrt median, but the distributions suggest that slinky pots select smaller fish (interesting the medians line up so well, especially given that the escape rings were closed). This is most likely a consequence of the escape rings. When looking at FL across stations and years, we see similar patterns across years. Also, it's fairly apparent that for station 202 in 2022, slinky pots selects for smaller fish. Nonetheless, I would argue that the length distributions between gears coincide with each other fairly well.

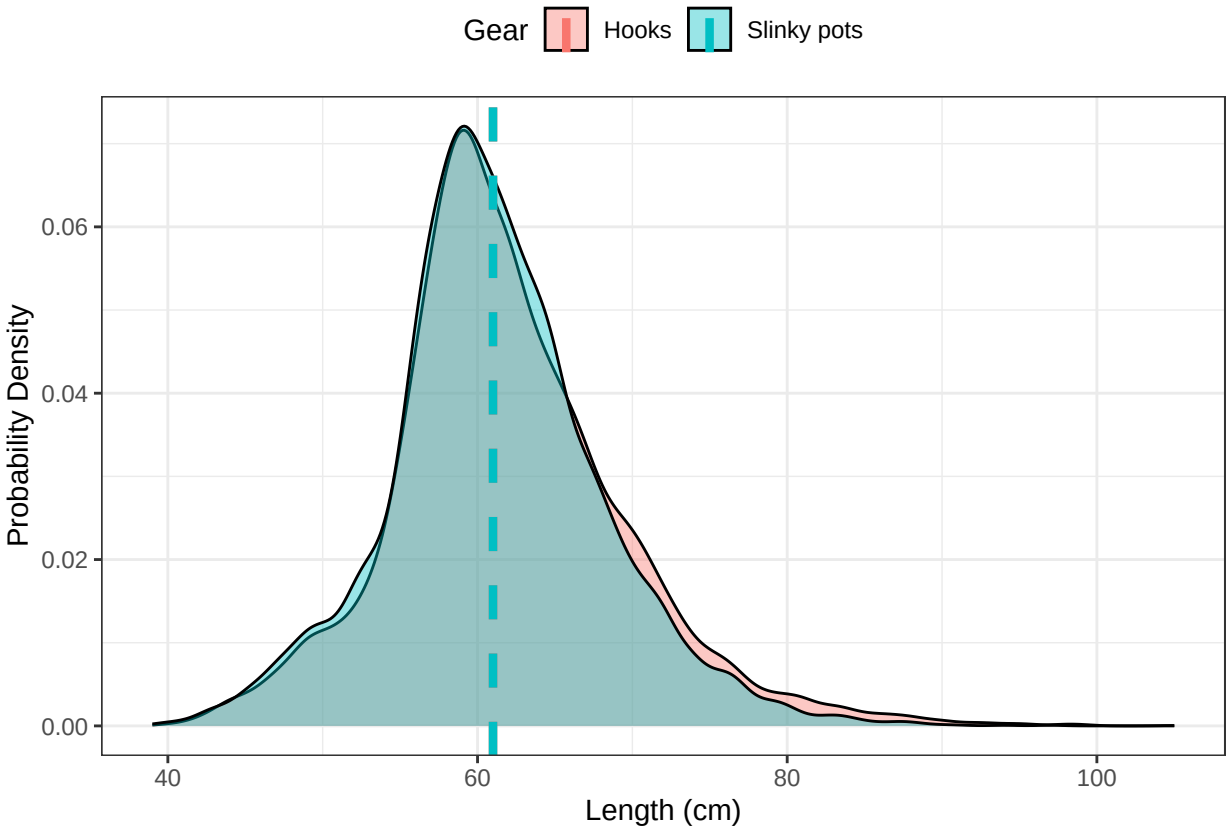
```
# Length distributions aggregated across stations, years, and species
lens %>%
  ggplot(aes(x = length, fill = gear)) +
  geom_density(alpha = 0.5)  +
  labs(x = "Length (cm)", y = "Probability Density",
       fill = "Gear") +
  facet_wrap(~species) +
  theme_bw() +
  theme(legend.position = "top")
```




```
# Sablefish lengths aggregated
median_sab_lens <- lens %>%
  filter(species == "Sablefish") %>%
  group_by(gear) %>%
  summarize(median = median(length))

# lengths across gear types
lens %>%
  filter(species == "Sablefish") %>%
  ggplot(aes(x = length, fill = gear)) +
  geom_density(alpha = 0.4)  +
  geom_vline(median_sab_lens, mapping = aes(xintercept = median,
                                            color = gear), lty = 2, size = 1.5) +
  labs(x = "Length (cm)", y = "Probability Density",
       fill = "Gear", color = "Gear") +
  theme_bw() +
  theme(legend.position = "top")
```

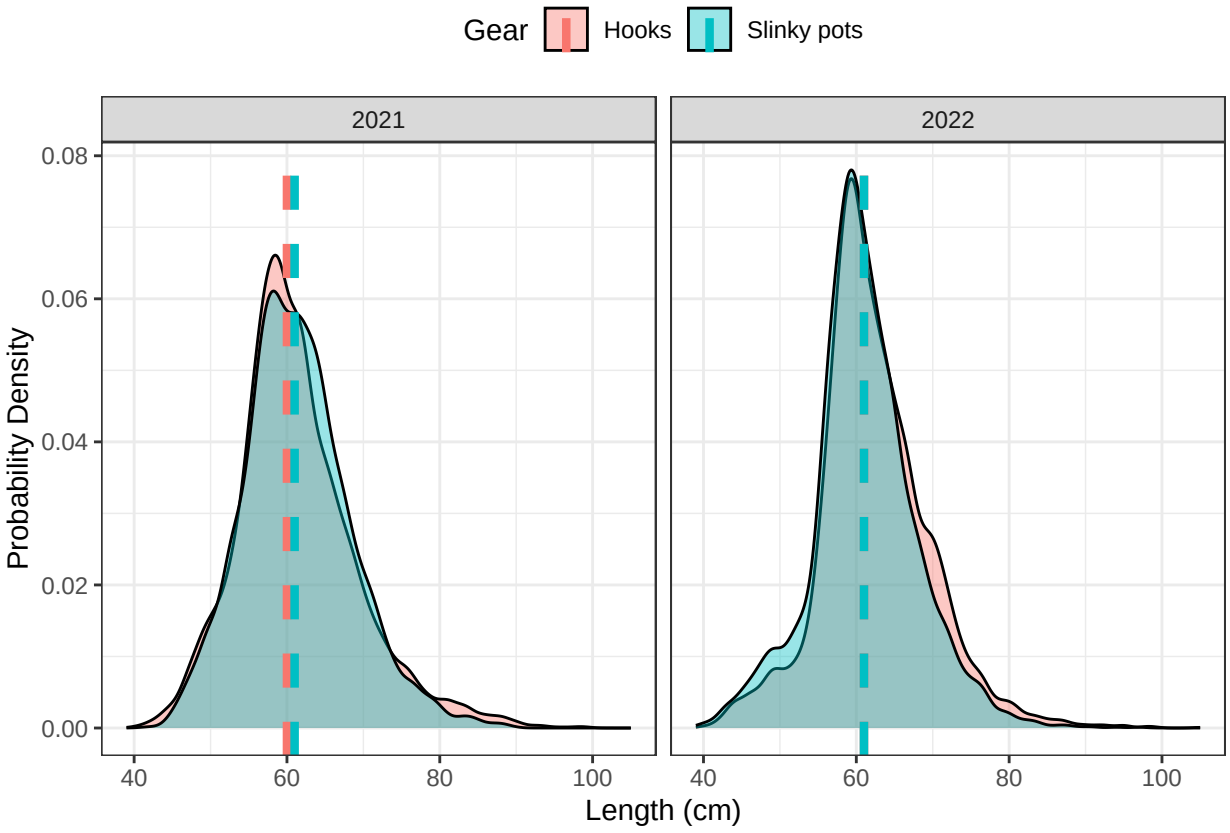
```
## Warning: Using ‘size‘ aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use ‘linewidth‘ instead.
## This warning is displayed once every 8 hours.
## Call ‘lifecycle::last_lifecycle_warnings()‘ to see where this warning was
## generated.
```




```
# Sablefish lengths aggregated and across years
median_sab_lens <- lens %>%
  filter(species == "Sablefish") %>%
  group_by(gear, year) %>%
  summarize(median = median(length))
```

```
## `summarise()` has grouped output by 'gear'. You can override using the
## `.groups` argument.
```

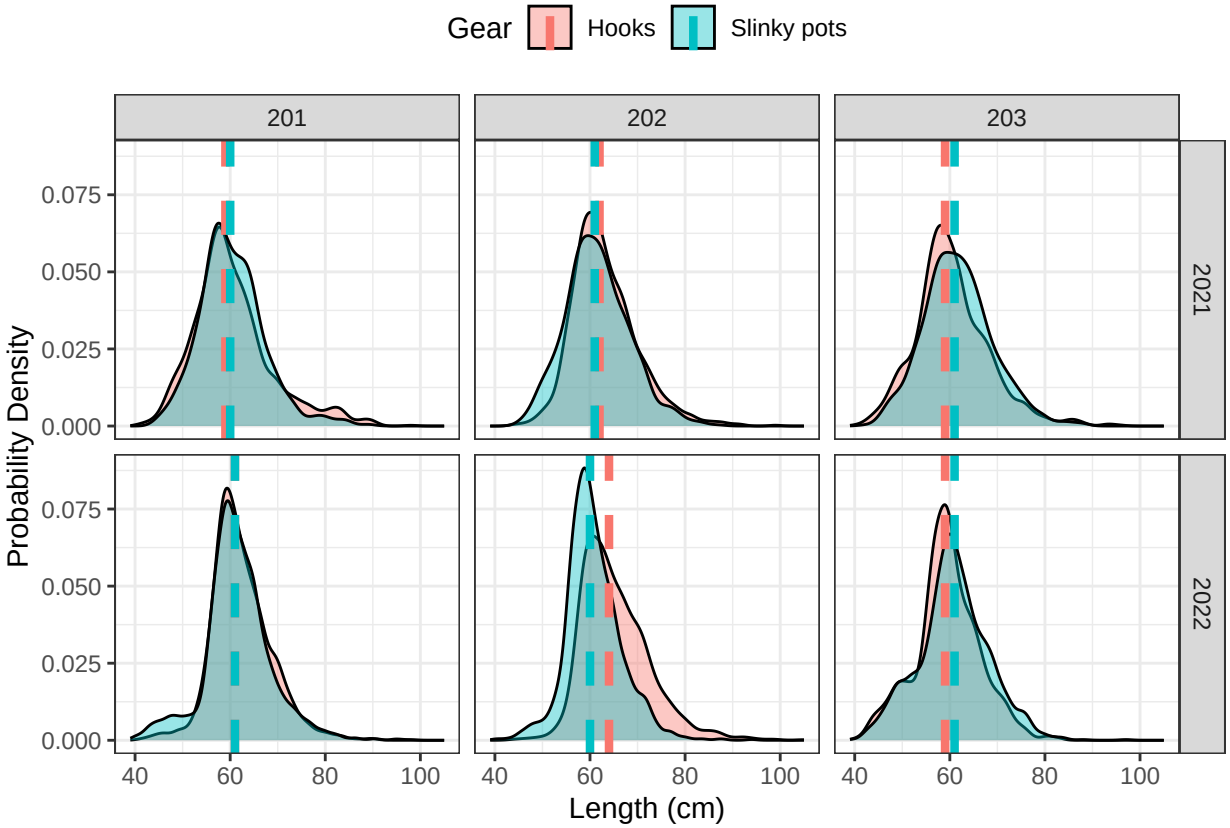
```
# lengths across years
lens %>%
  filter(species == "Sablefish") %>%
  ggplot(aes(x = length, fill = gear)) +
  geom_density(alpha = 0.4)  +
  geom_vline(median_sab_lens, mapping = aes(xintercept = median,
                                            color = gear), lty = 2, size = 1.5) +
  labs(x = "Length (cm)", y = "Probability Density",
       fill = "Gear", color = "Gear") +
  facet_wrap(~year) +
  theme_bw() +
  theme(legend.position = "top")
```




```
# Sablefish lengths aggregated stations
median_sab_lens <- lens %>%
  filter(species == "Sablefish") %>%
  group_by(gear, year, station) %>%
  summarize(median = median(length))
```

```
## `summarise()` has grouped output by 'gear', 'year'. You can override using the
## `.groups` argument.
```

```
# Sablefish lengths by years and station
lens %>%
  filter(species == "Sablefish") %>%
  ggplot(aes(x = length, fill = gear)) +
  geom_density(alpha = 0.4)  +
  geom_vline(median_sab_lens, mapping = aes(xintercept = median,
                                            color = gear), lty = 2, size = 1.5) +
  labs(x = "Length (cm)", y = "Probability Density",
       fill = "Gear", color = "Gear") +
  facet_grid(year~station) +
  theme_bw() +
  theme(legend.position = "top")
```



Length Distributions (by depth)

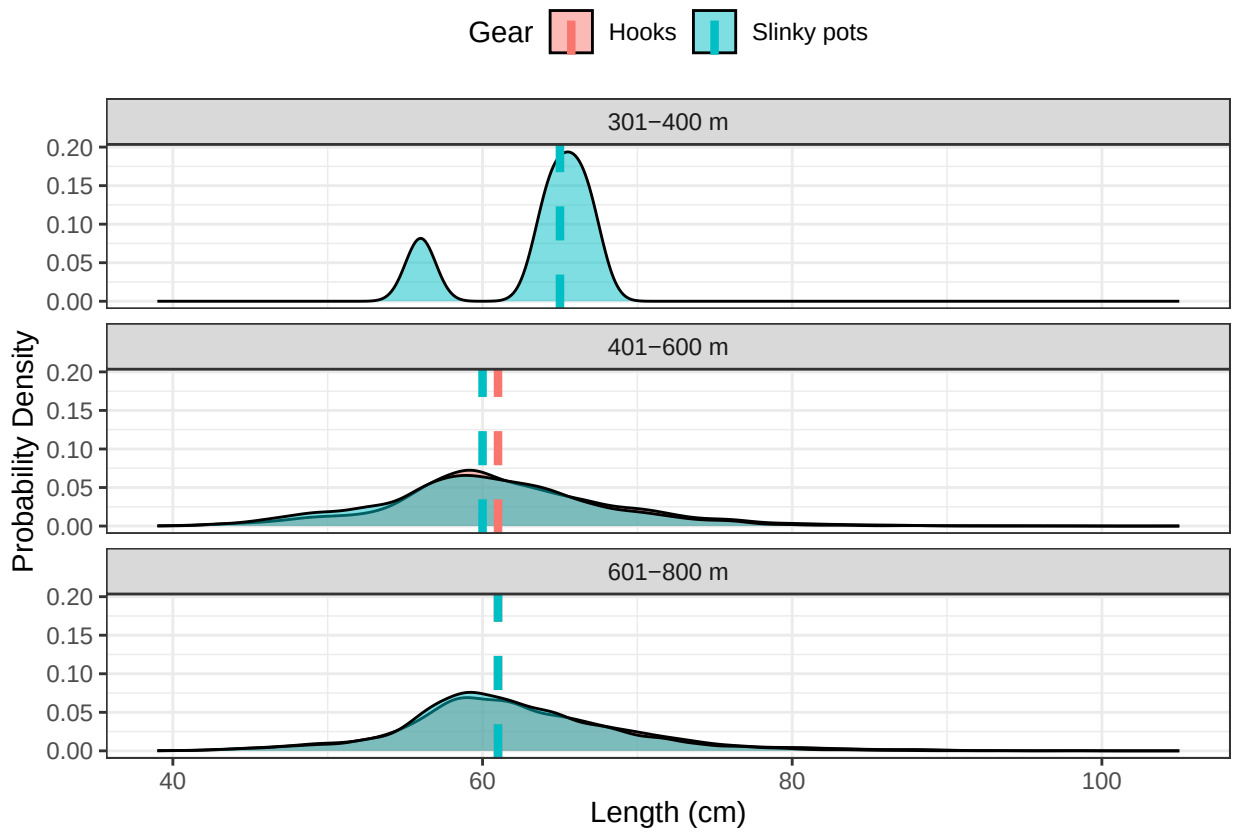
Similar to plots explored above, length distributions follow simlar patterns. Length distributions are fairly similar, irrespective of depth strata. Additionally, station 202 shows the same pattern of slinky pots selecting smaller fish across all strata sampled.

```
# Median lengths by gear and strata
median_sab_lens <- lens %>%
  filter(species == "Sablefish") %>%
  group_by(gear, stratum) %>%
  summarize(median = median(length))
```

```
## `summarise()` has grouped output by 'gear'. You can override using the
## `.groups` argument.
```

```
# Gear and stratum
lens %>%
  filter(species == "Sablefish") %>%
  ggplot(aes(x = length, fill = gear)) +
  geom_density(alpha = 0.5)  +
  geom_vline(median_sab_lens, mapping = aes(xintercept = median,
                                            color = gear), lty = 2, size = 1.5) +
  labs(x = "Length (cm)", y = "Probability Density",
```

```
       fill = "Gear", color = "Gear") +
  facet_wrap(~stratum, ncol = 1) +
  theme_bw() +
  theme(legend.position = "top")
```

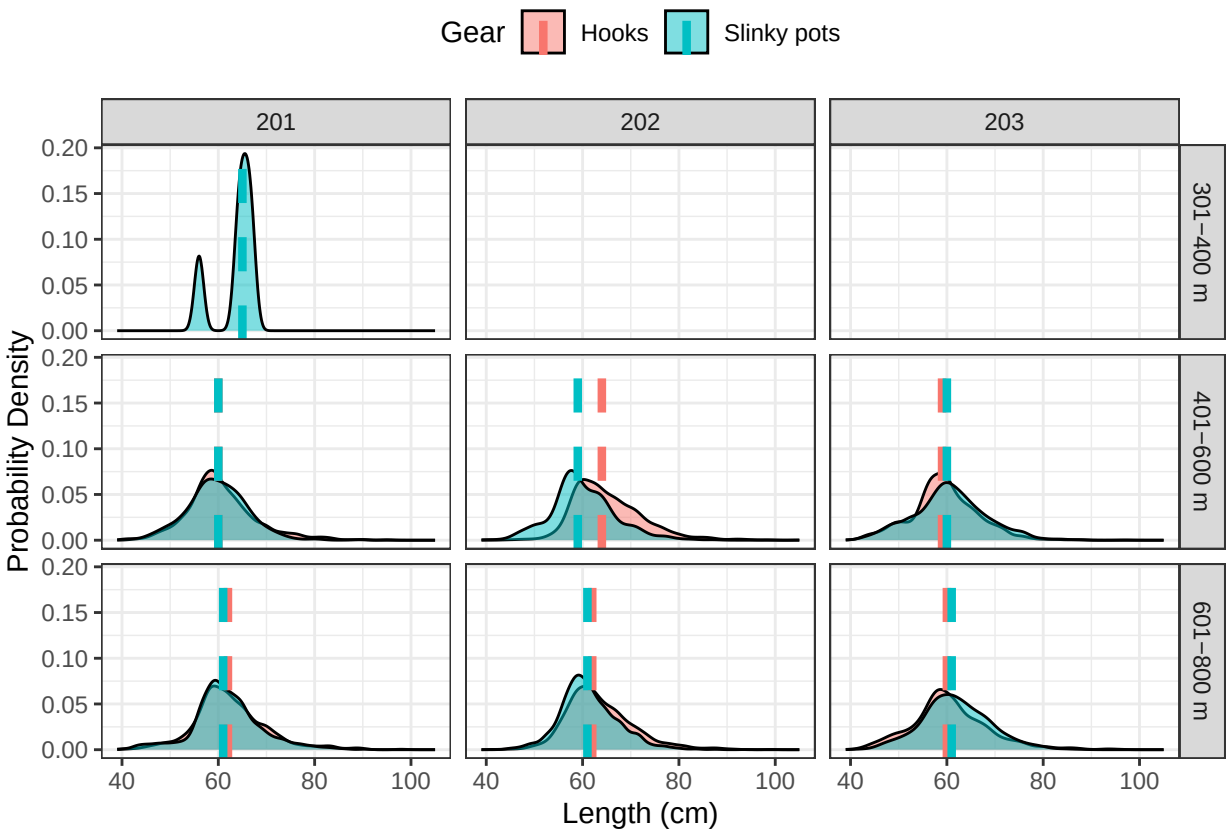



```
# Sablefish lengths aggregated stations and stratum
median_sab_lens <- lens %>%
  filter(species == "Sablefish") %>%
  group_by(gear, stratum, station) %>%
  summarize(median = median(length))
```

```
## `summarise()` has grouped output by 'gear', 'stratum'. You can override using
## the `.groups` argument.
```

```
# lengths across strata and station
lens %>%
  filter(species == "Sablefish") %>%
  ggplot(aes(x = length, fill = gear)) +
  geom_density(alpha = 0.5)  +
  geom_vline(median_sab_lens, mapping = aes(xintercept = median,
                                            color = gear), lty = 2, size = 1.5) +
  labs(x = "Length (cm)", y = "Probability Density",
       fill = "Gear", color = "Gear") +
  facet_grid(stratum~station) +
```

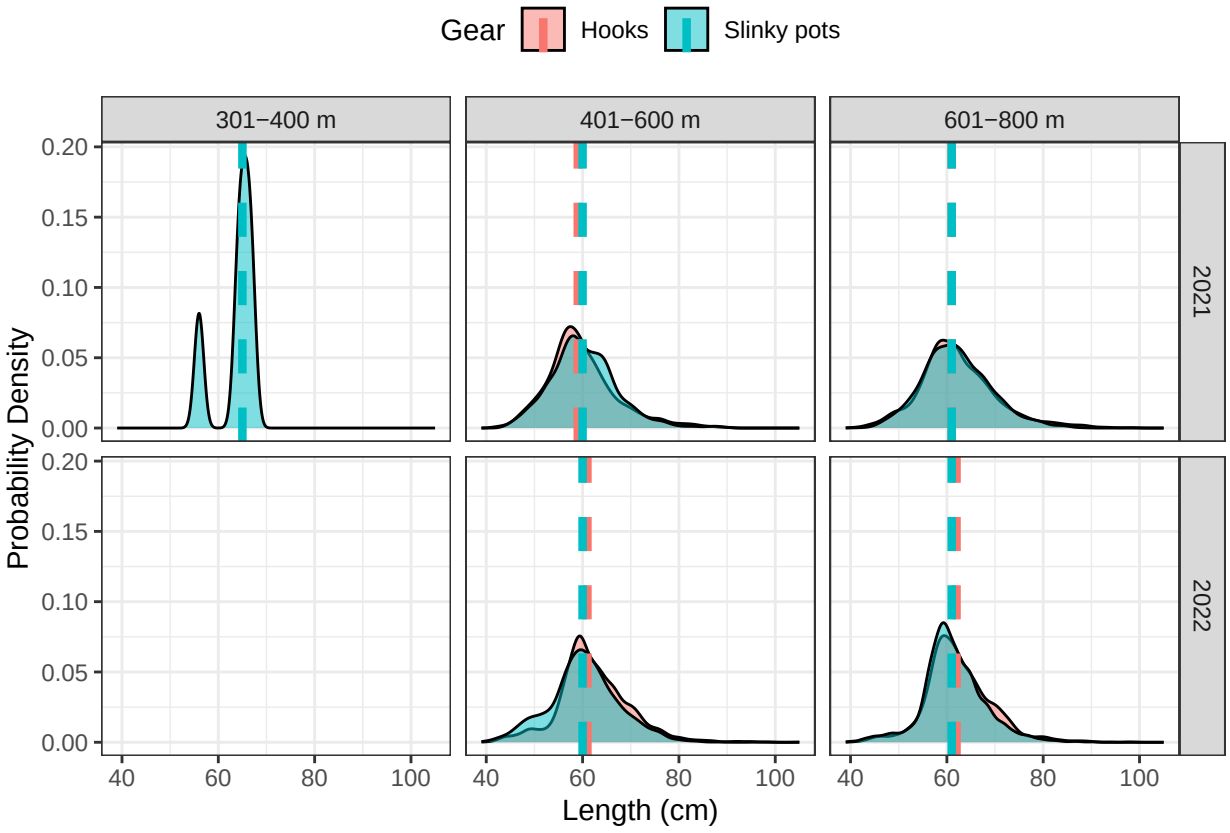
```
  theme_bw() +
  theme(legend.position = "top")
```




```
# Sablefish lengths aggregated stations and stratum
median_sab_lens <- lens %>%
  filter(species == "Sablefish") %>%
  group_by(gear, stratum, year) %>%
  summarize(median = median(length))
```

```
## `summarise()` has grouped output by 'gear', 'stratum'. You can override using
## the `.groups` argument.
```

```
# lengths across stratum and year
lens %>%
  filter(species == "Sablefish") %>%
  ggplot(aes(x = length, fill = gear)) +
  geom_density(alpha = 0.5)  +
  geom_vline(median_sab_lens, mapping = aes(xintercept = median,
                                            color = gear), lty = 2, size = 1.5) +
  labs(x = "Length (cm)", y = "Probability Density",
       fill = "Gear", color = "Gear") +
  facet_grid(year~stratum) +
  theme_bw() +
  theme(legend.position = "top")
```



Length Distribution (Sexes)

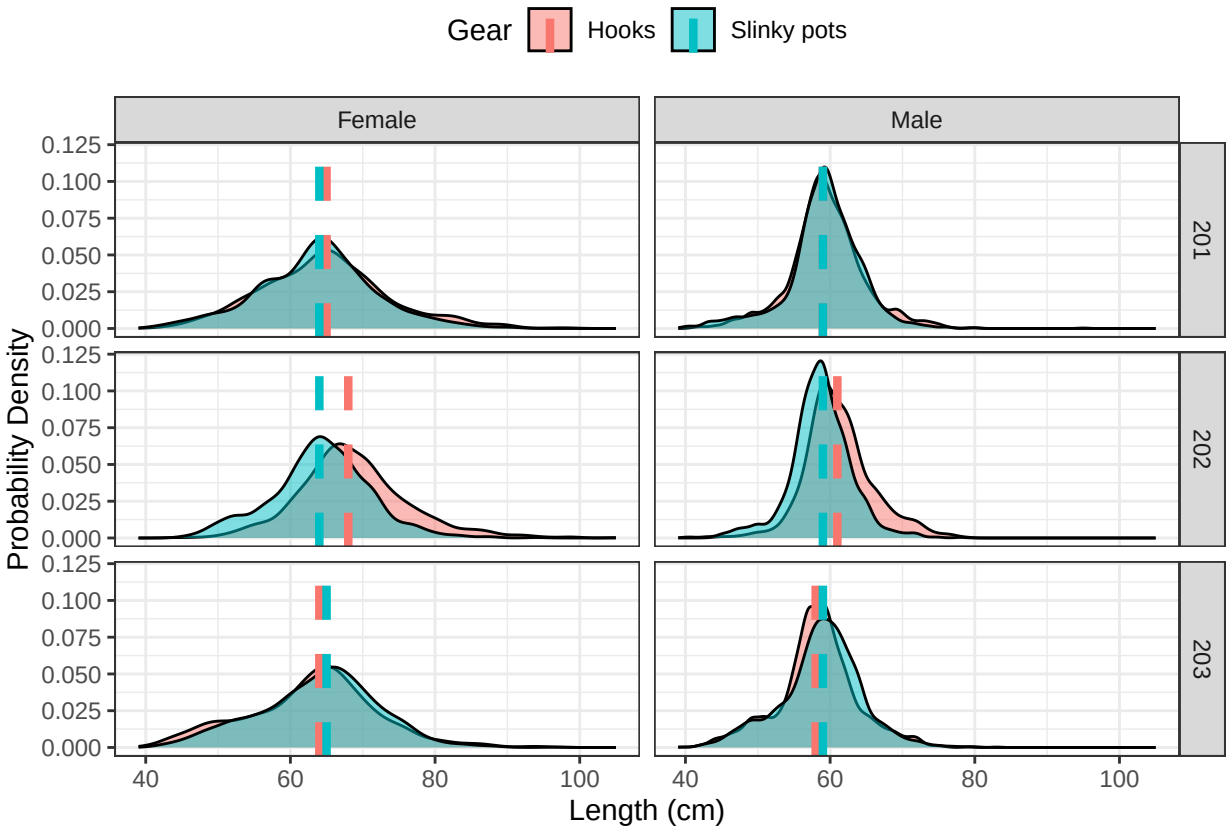
Looking at length distributions by sexes, it seems like males are selected at smaller sizes relative to females across all gear types. Nonetheless, these distributions are once again fairly similar with each other - except for station 202.

```
# Sablefish lengths aggregated stations and stratum
median_sab_lens <- lens %>%
  filter(species == "Sablefish") %>%
  group_by(gear, station, sex) %>%
  summarize(median = median(length))
```

```
## `summarise()` has grouped output by 'gear', 'station'. You can override using
## the `.groups` argument.
```

```
lens %>%
  filter(species == "Sablefish") %>%
  ggplot(aes(x = length, fill = gear)) +
  geom_density(alpha = 0.5)  +
  geom_vline(median_sab_lens, mapping = aes(xintercept = median,
                                            color = gear), lty = 2, size = 1.5) +
  labs(x = "Length (cm)", y = "Probability Density",
       fill = "Gear", color = "Gear") +
```

```
  facet_grid(station~sex) +
  theme_bw() +
  theme(legend.position = "top")
```

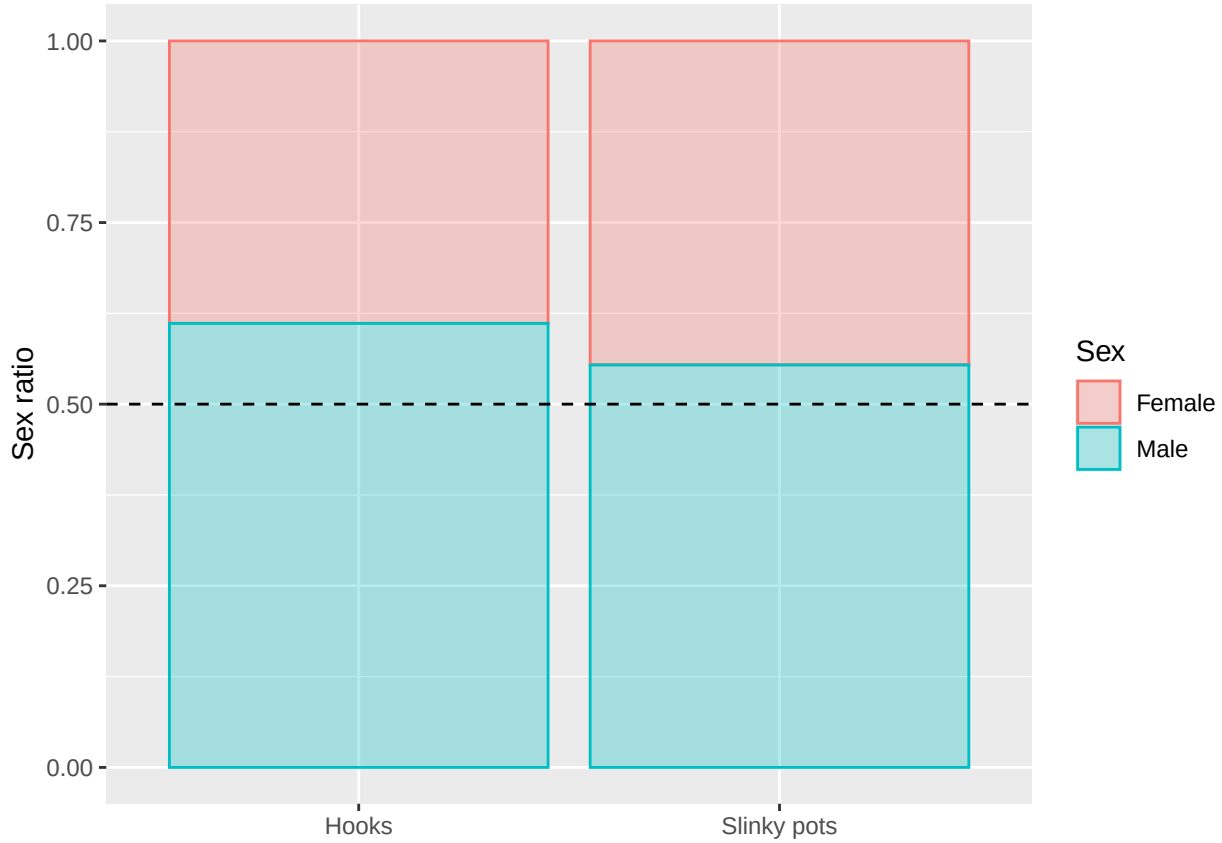


Sex-Ratios

Across all gear types, it seems like the survey selects for more males (or could be a skewed population sex-ratio). In general, it also appears that slinky pots select for more females, although they're pretty close and these data come from a limited sample size - can't really say much about this.

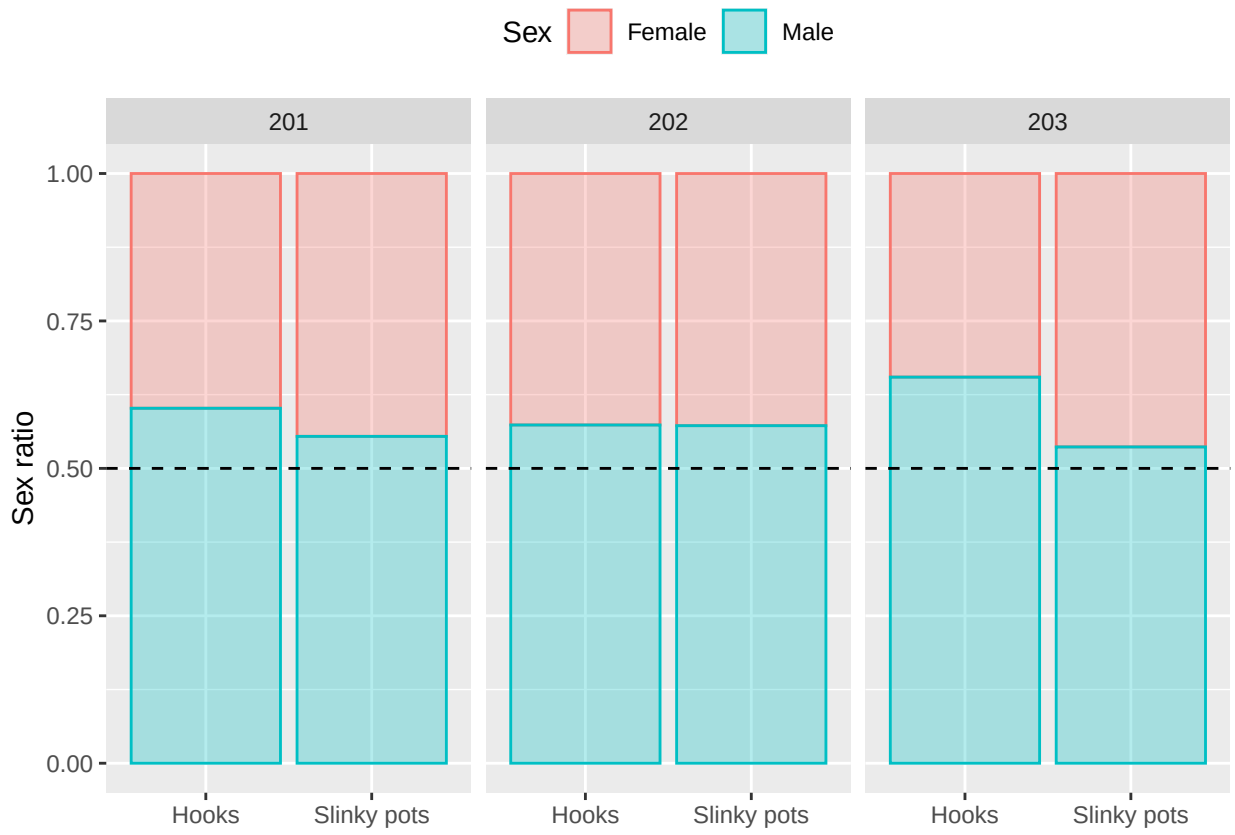
```
# Sex-ratios aggregated
lens %>%
  filter(species == 'Sablefish') %>%
  group_by(gear, sex) %>%
  summarize(n = n()) %>%
  mutate(sex_ratio = n / sum(n)) %>%
  ggplot(aes(x = gear, y = sex_ratio, col = sex, fill = sex)) +
  geom_bar(stat = 'identity', alpha = 0.3) +
  geom_hline(aes(yintercept = 0.5), lty = 2) +
  labs(x = NULL, y = "Sex ratio", col = "Sex", fill = "Sex")
```

```
## `summarise()` has grouped output by 'gear'. You can override using the
## `.groups` argument.
```



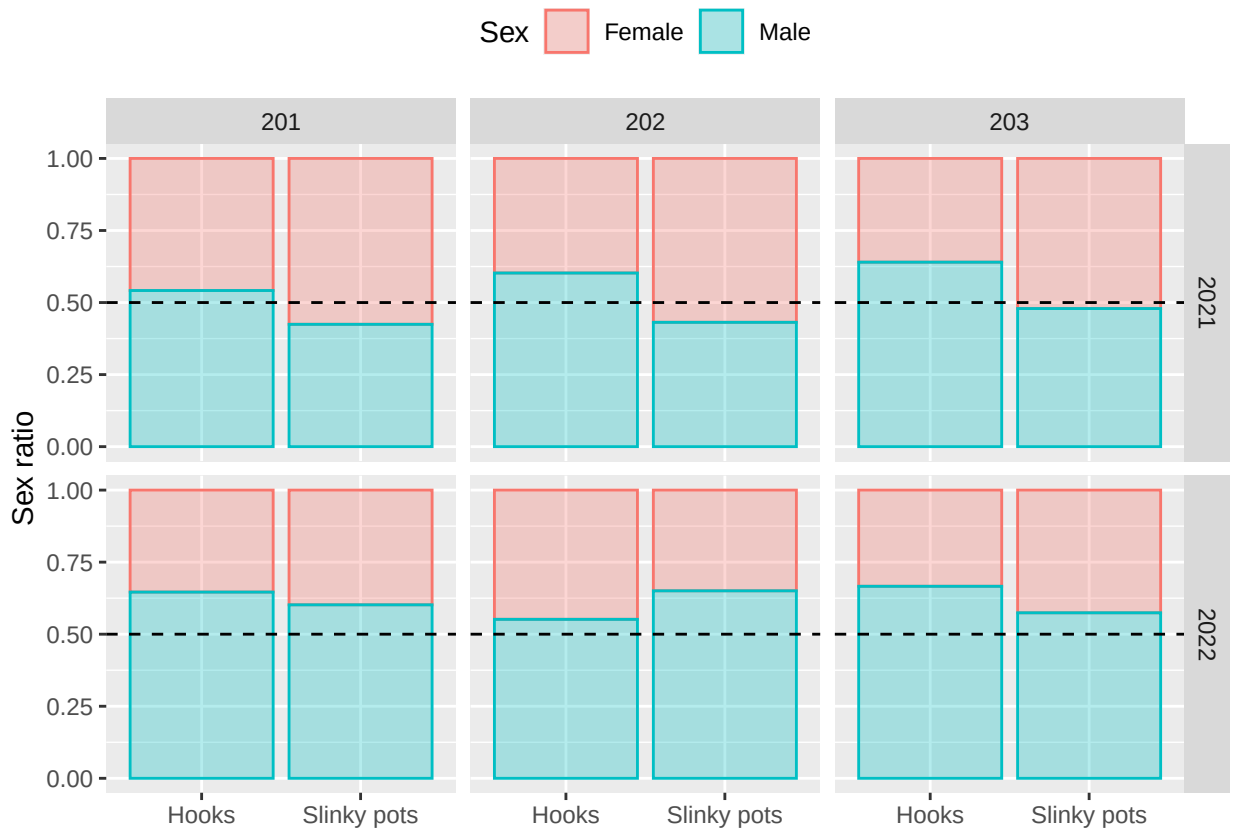

```
# Sex-ratios by station
lens %>%
  filter(species == 'Sablefish') %>%
  group_by(station, gear, sex) %>%
  summarize(n = n()) %>%
  group_by(station, gear) %>%
  mutate(sex_ratio = n / sum(n)) %>%
  ggplot(aes(x = gear, y = sex_ratio, col = sex, fill = sex)) +
  geom_bar(stat = 'identity', alpha = 0.3) +
  geom_hline(aes(yintercept = 0.5), lty = 2) +
  facet_wrap(~ station) +
  labs(x = NULL, y = "Sex ratio", col = "Sex", fill = "Sex") +
  theme(legend.position = "top")
```

```
## `summarise()` has grouped output by 'station', 'gear'. You can override using
## the `.groups` argument.
```




```
# Sex-ratios by station and year
lens %>%
  filter(species == 'Sablefish') %>%
  group_by(station, gear, sex, year) %>%
  summarize(n = n()) %>%
  group_by(station, gear, year) %>%
  mutate(sex_ratio = n / sum(n)) %>%
  ggplot(aes(x = gear, y = sex_ratio, col = sex, fill = sex)) +
  geom_bar(stat = 'identity', alpha = 0.3) +
  geom_hline(aes(yintercept = 0.5), lty = 2) +
  facet_grid(year~ station) +
  labs(x = NULL, y = "Sex ratio", col = "Sex", fill = "Sex") +
  theme(legend.position = "top")
```

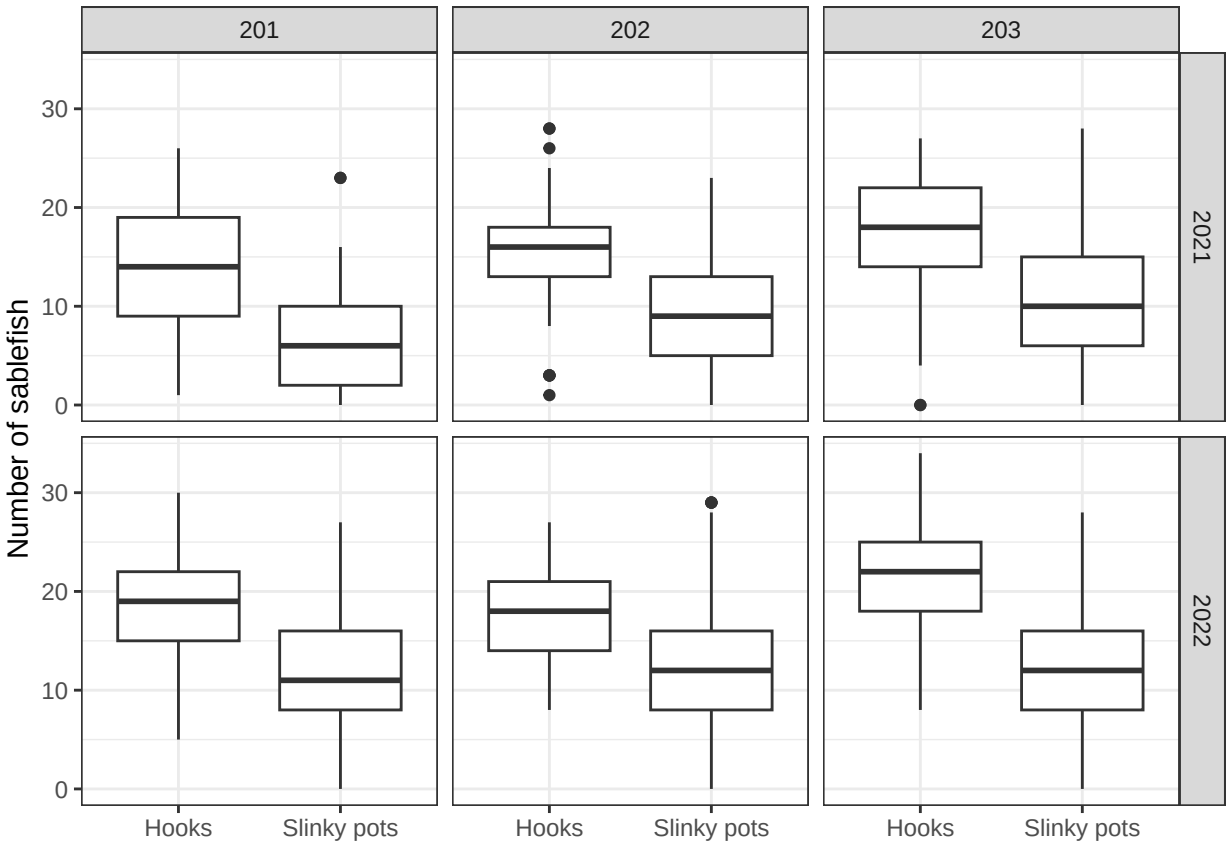
```
## `summarise()` has grouped output by 'station', 'gear', 'sex'. You can override
## using the `.groups` argument.
```



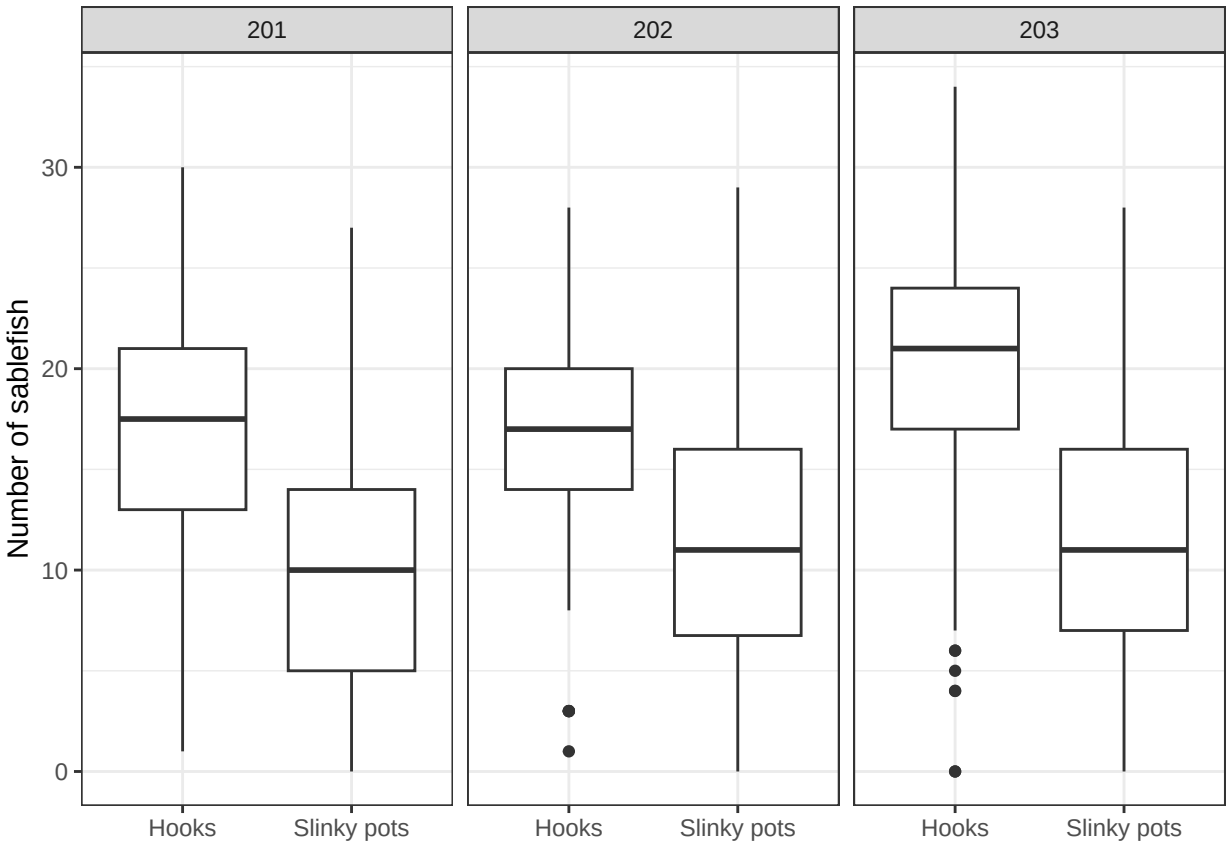
General Catch Rate Trends

Key Takeaways: In general, one skate =/ one pot. We consistently catch less per pot relative to per skate across all years (i.e., catch-per-skate is always larger than catch-per-hook). Additionally, there appears to be more fish caught in general during 2022 across all gears.

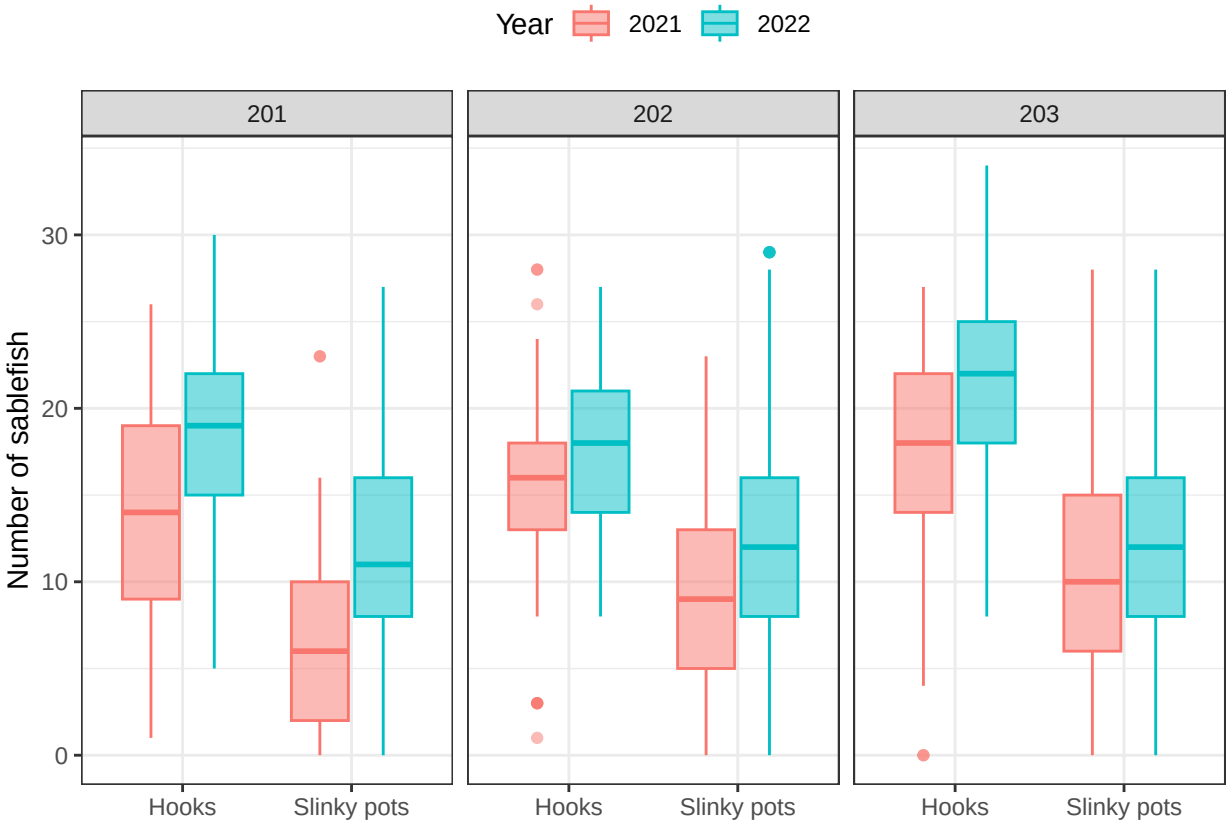
```
# aggregated across years - sabcatch per skate/pot across all gear types
sabcatch_rates %>%
  ggplot(aes(x = gear, y = n_sablefish)) +
  geom_boxplot() +
  labs(x = NULL, y = "Number of sablefish") +
  facet_grid(year~station) +
  theme_bw()
```




```
# now, plot slinky pots aggregated together
sabcatch_rates %>%
  ggplot(aes(x = gear, y = n_sablefish)) +
  geom_boxplot() +
  labs(x = NULL, y = "Number of sablefish") +
  facet_wrap(~station) +
  theme_bw()
```




```
# slinky aggregated together broken up by years
sabcatch_rates %>%
  ggplot(aes(x = gear, y = n_sablefish, fill = factor(year), color = factor(year))) +
  geom_boxplot(alpha = 0.5) +
  labs(x = NULL, y = "Number of sablefish", fill = "Year", color = "Year") +
  facet_grid(~station) +
  theme_bw() +
  theme(legend.position = "top")
```



Correlations for catch-rates

Key Takeaways: In general, correlations of standardized catch-rates (z-scaled) are well correlated. These correlations appears to more correlated in year 2022 relative to 2021. For stations 201 and 203, the correlations appear to be much lower during 2021 when compared to 2022. I'm not really sure why, but it could be due to the fact that this was the first year conducting the experiment? Could also be a function of closing escape rings for 2022? Nonetheless, when aggregating data across all years, the correlations align extremely well.

```
# get correaltions by year and station
std_sta_dep <- sabcatch_rates %>%
  group_by(gear, station, depth, year) %>%
  summarize(n_sablefish = sum(n_sablefish)) %>%
  group_by(gear, station, year) %>%
  mutate(std = (n_sablefish - mean(n_sablefish)) / sd(n_sablefish))
```

```
## `summarise()` has grouped output by 'gear', 'station', 'depth'. You can
## override using the `.groups` argument.
```

```
cor_sta_dep <- std_sta_dep %>%
  ungroup() %>%
  arrange(gear, station, depth, year) %>%
  select(-n_sablefish) %>%
```

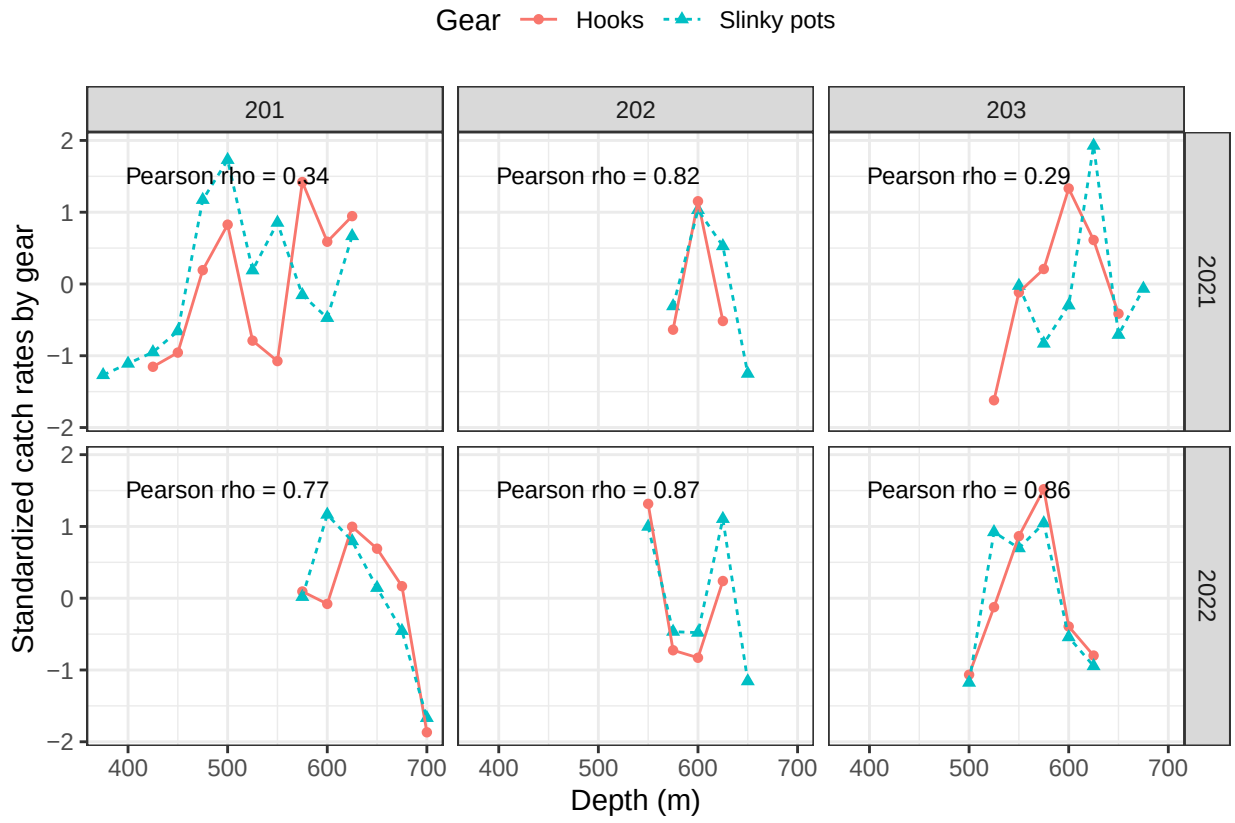
```
  pivot_wider(names_from = gear, values_from = std) %>%
  drop_na() %>%
  group_by(year, station) %>%
  summarize(cor = cor(Hooks, `Slinky pots`, method = "pearson"))
```

```
## `summarise()` has grouped output by 'year'. You can override using the
## `.groups` argument.
```

```
# Catch-rates across depths, stations, and years
ggplot() +
  geom_point(data = std_sta_dep,
             aes(x = depth, y = std, col = gear, shape = gear, lty = gear)) +
  geom_line(data = std_sta_dep,
            aes(x = depth, y = std, col = gear, shape = gear, lty = gear)) +
  geom_text(data = cor_sta_dep, aes(x = 500, y = Inf,
                                    label = paste("Pearson rho =", round(cor ,2))),
            size = 3, vjust = 3) +
  facet_grid(year~ station) +
  labs(x = "Depth (m)", y = "Standardized catch rates by gear",
       col = "Gear", lty = "Gear", shape = "Gear") +
  theme_bw() +
  theme(legend.position = "top")
```

```
## Warning in geom_point(data = std_sta_dep, aes(x = depth, y = std, col = gear, :
## Ignoring unknown aesthetics: linetype
```

```
## Warning in geom_line(data = std_sta_dep, aes(x = depth, y = std, col = gear, :
## Ignoring unknown aesthetics: shape
```



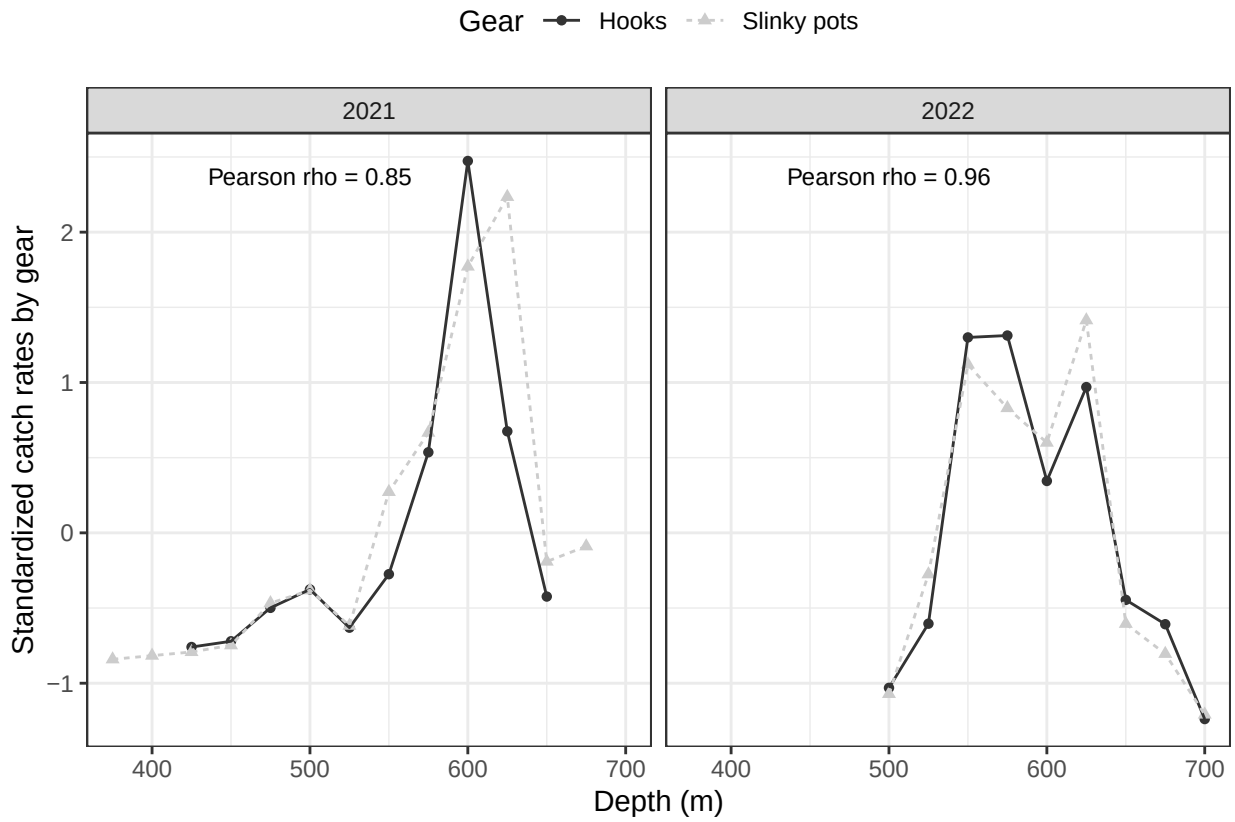

```
# Get correlations by year and depth
std_dep <- sabcatch_rates %>%
  group_by(gear,  depth, year) %>%
  summarize(n_sablefish = sum(n_sablefish)) %>%
  group_by(gear, year) %>%
  mutate(std = (n_sablefish - mean(n_sablefish)) / sd(n_sablefish))# %>%
```

```
## `summarise()` has grouped output by 'gear', 'depth'. You can override using the
## `.groups` argument.
```

```
# correlation by depth acorss years
cor_dep <- std_dep %>%
  arrange(gear, depth, year) %>%
  select(-n_sablefish) %>%
  pivot_wider(names_from = gear, values_from = std) %>%
  drop_na() %>%
  summarize(cor = cor(Hooks, `Slinky pots`, method = "pearson"))

# comparison of standardized catch rates between years
std_dep %>%
  ggplot(aes(x = depth, y = std)) +
  geom_point(aes(col = gear, shape = gear)) +
  geom_line(aes(col = gear, lty = gear)) +
  facet_wrap(~year) +
  scale_color_grey() +
```

```
    geom_text(data = cor_dep, aes(x = 500, y = Inf,
                                  label = paste("Pearson rho =", round(cor ,2))),
              size = 3, vjust = 3) +
  labs(x = "Depth (m)", y = "Standardized catch rates by gear",
       col = "Gear", lty = "Gear", lty = "Gear", shape = "Gear") +
  theme_bw() +
  theme(legend.position = "top")
```




```
# now look at aggregated catch rates (aggregated acrss yrs)
std_yrs <- sabcatch_rates %>%
  group_by(gear,  depth) %>%
  summarize(n_sablefish = sum(n_sablefish)) %>%
  group_by(gear) %>%
  mutate(std = (n_sablefish - mean(n_sablefish)) / sd(n_sablefish))# %>%
```

```
## `summarise()` has grouped output by 'gear'. You can override using the
## `.groups` argument.
```

```
# correlation by depth acorss years
cor_yrs <- std_yrs %>%
  arrange(gear, depth) %>%
  select(-n_sablefish) %>%
  pivot_wider(names_from = gear, values_from = std) %>%
  drop_na() %>%
```

```
  summarize(cor = cor(Hooks, `Slinky pots`, method = "pearson"))

# standardized catch rates across years
std_yrs %>%
  ggplot(aes(x = depth, y = std)) +
  geom_point(aes(col = gear, shape = gear)) +
  geom_line(aes(col = gear, lty = gear)) +
  scale_color_grey() +
  geom_text(data = cor_yrs, aes(x = 500, y = Inf,
                                label = paste("Pearson rho =", round(cor ,2))),
            size = 3, vjust = 3) +
  labs(x = "Depth (m)", y = "Standardized catch rates by gear",
       col = "Gear", lty = "Gear", lty = "Gear", shape = "Gear") +
  theme_bw() +
  theme(legend.position = "top")
```