Draft Figures and Analyses

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Contents

1. Plot each fishery B/Bmsy versus F/Fsmy

Data used: updated upside data with Corbett's ITQ/no ITQ data

Note:

- Corbett's ITQ data is only until 2012
- Chris's upside data is now updated until 2016 with the more recent RAM data that Dan had.

Issues:

1. Since Corbett's ITQ data is only until 2012, all the fisheries specific data we have past that does not have ITQ data assocaited with them. I made "KOBE" plots with the following data:
   a. fisheries 1950 - 2012
   b. fisheries 1950 - 2016
2. Dealing with fisheries with no data on ITQs: ITQ related analyzes are limited to fisheries that Corbette had data on. I removed the fisheries that have no information on presence or absence of ITQs. I am unsure if this is biasing the data; should we assume that the fisheries with no definate information on ITQs have no ITQs? This seems like it woud be biased as well.
   - Corbette's ITQ data includes 375 different fisheries years 1950-2012 for a total of ~15,000 lines of data

a. "KOBE" plots with ITQs not updated past 2012

All fisheries 1950-2012

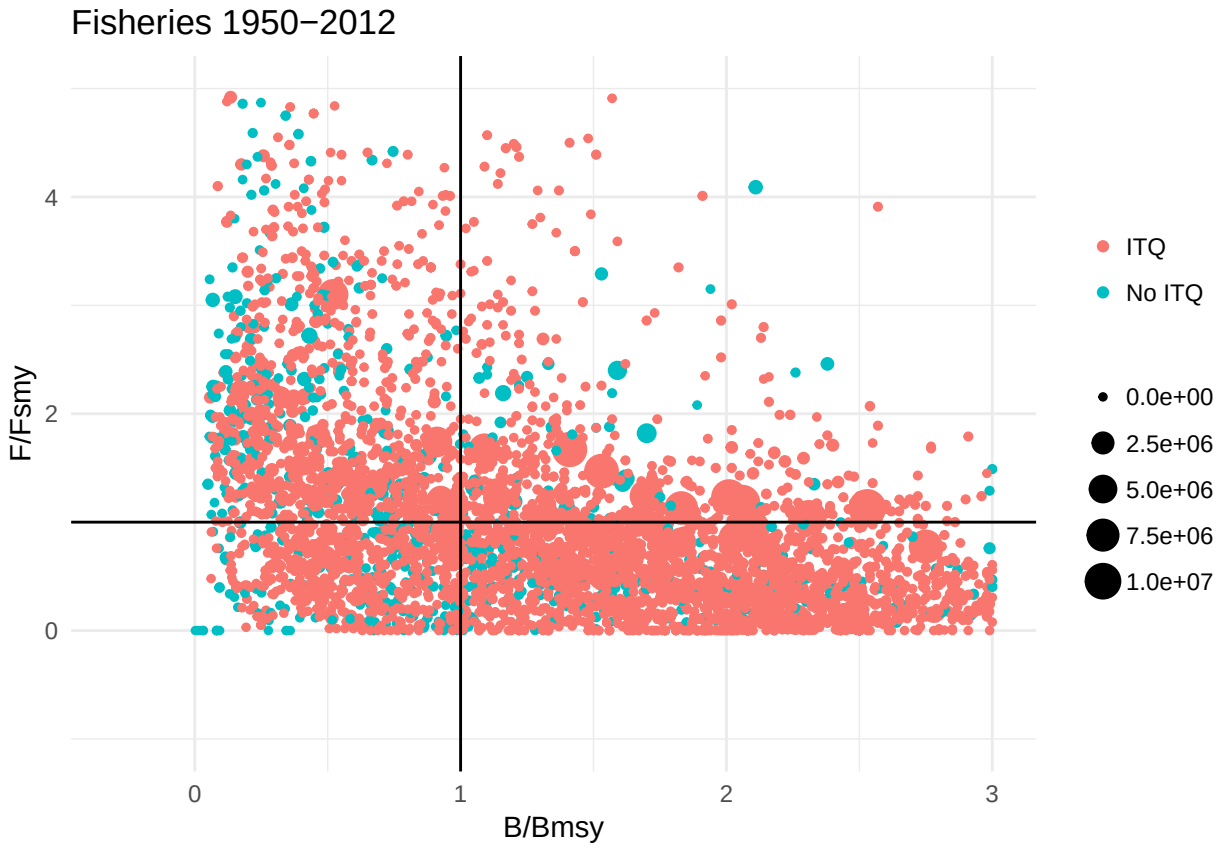
```
ITQ_projection <- readRDS("data/ITQ_projection.rds")

f_b_itq <- ITQ_projection %>%
  select("BvBmsy", "FvFmsy", "itq", "iq", "ivq", "turf", "Catch", "Year") %>%
  filter( itq != "NA", iq != "NA", ivq != "NA") %>%
  mutate(rightsbased = case_when(
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0")) %>%
  filter(Year >= "1950") %>%
  filter(Year <= "2012")

f_b_itq$rightsbased[f_b_itq$rightsbased == "0"]<- "No ITQ"
f_b_itq$rightsbased[f_b_itq$rightsbased == "1"]<- "ITQ"


ggplot(data = f_b_itq, aes( x=BvBmsy, y=FvFmsy, colour= rightsbased, size = Catch ))+
  geom_point()+
  labs(x = "B/Bmsy", y= "F/Fsmy") +
  theme_minimal()+
  theme(legend.title=element_blank())+
  ylim(-1, 5)+
  xlim(-.3, 3)+
  geom_hline(aes(yintercept=1))+
  geom_vline(aes(xintercept=1))+
  ggtitle("Fisheries 1950-2012")
```

```
## Warning: Removed 1160 rows containing missing values (geom_point).
```



b. "KOBE" plots with ITQs updated through 2016

All fisheries 1950-2016

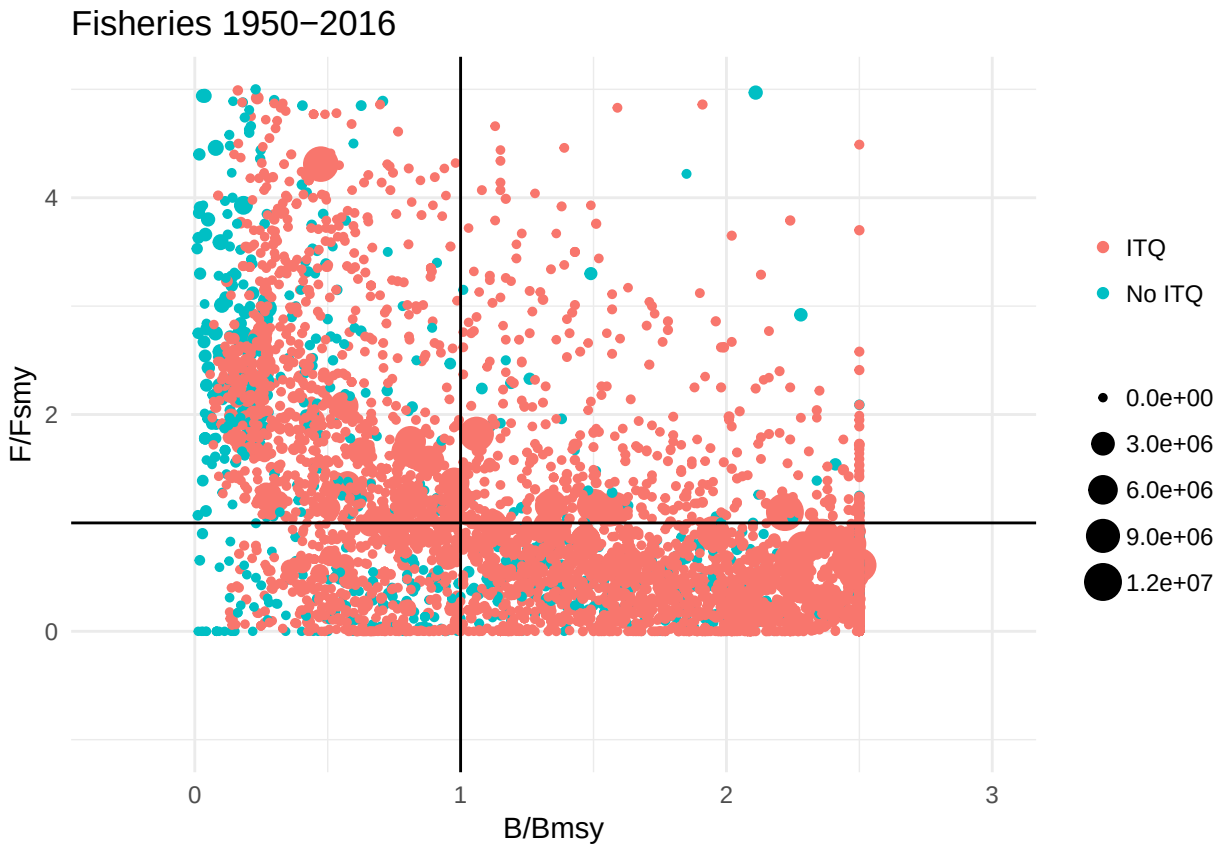
```
ITQ_projection_updated <- readRDS("data/ITQ_projection_updated.rds")

f_b_itq_updated <- ITQ_projection_updated %>%
  select("BvBmsy", "FvFmsy", "itq", "iq", "ivq", "turf", "Catch", "Year") %>%
  filter( itq != "NA", iq != "NA", ivq != "NA") %>%
  mutate(rightsbased = case_when(
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0")) %>%
  filter(Year >= "1950") %>%
  filter(Year <= "2016")

f_b_itq_updated$rightsbased[f_b_itq_updated$rightsbased == "0"]<- "No ITQ"
f_b_itq_updated$rightsbased[f_b_itq_updated$rightsbased == "1"]<- "ITQ"

ggplot(data = f_b_itq_updated, aes( x=BvBmsy, y=FvFmsy, colour= rightsbased, size = Catch ))+
  geom_point()+
  labs(x = "B/Bmsy", y= "F/Fsmy") +
  theme_minimal()+
  theme(legend.title=element_blank())+
  ylim(-1, 5)+
  xlim(-.3, 3)+
  geom_hline(aes(yintercept=1))+
  geom_vline(aes(xintercept=1))+
  ggtitle("Fisheries 1950-2016")
```

```
## Warning: Removed 332 rows containing missing values (geom_point).
```



2. Total Global Catch from ITQ, TURF, or No ITQ fisheries

Data used: updated upside data with Corbett's ITQ/no ITQ data

Notes:

- Same issues as before with Corbett data only until 2012
- For analysis through 2016: extracted information about which fisheries had ITQs in 2012 and applied it to the same fisheries into the future. This doesn't take into account other fisheries implement ITQs past 2012, or if fisheries stop ITQs. Only countries with ITQs in 2012 are : Australia, USA, Canda, Japan, Peru, Argentina, South Africa, New Zealand

The analysis below does not include TURF information from DiscoverTurf GP because that data is not fishery specific enough to merge with the upside/Corbette data

technical note for JV: what units is the catch in the upside/rams data?

a. Total Catch ITQ, No ITQ, TURF in 2012

```
ITQ_projection <- readRDS("data/ITQ_projection.rds")

f_b_itq_countries <- ITQ_projection %>%
  select("BvBmsy", "FvFmsy", "itq", "iq", "ivq", "turf", "Catch", "Year", "Country", "IdOrig") %>%
  filter( itq != "NA" & iq != "NA" & ivq != "NA" & turf != "NA") %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "2",
```

```
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0"))

countries_itq_2012 <- f_b_itq_countries %>%
  select (Country, rightsbased, Year, IdOrig, Catch) %>%
  filter(Year == "2012")

itq_2012_rightsbasedTRUE <- filter(countries_itq_2012, rightsbased == "1")

itq_2012_rightsbasedFALSE <- filter(countries_itq_2012, rightsbased == "0")

itq_2012_rightsbasedTURF <- filter(countries_itq_2012, rightsbased == "2")


sum(itq_2012_rightsbasedTRUE$Catch, na.rm = TRUE)
```

```
## [1] 4350545
```

```
#4,350,545

sum(itq_2012_rightsbasedFALSE$Catch, na.rm = TRUE)
```

```
## [1] 149554
```

```
#149,554

sum(itq_2012_rightsbasedTURF$Catch, na.rm = TRUE)
```

```
## [1] 260000
```

```
#260,000
```

2012 total catch:

ITQs: 4,350,545

No ITQ: 149,554 (all USA)

TURF: 260,000(all Japan)

b. Total Catch ITQ, No ITQ, TURF in 2016

```
ITQ_projection <- readRDS("data/ITQ_projection.rds")

f_b_itq_countries <- ITQ_projection %>%
  select("BvBmsy", "FvFmsy", "itq", "iq", "ivq", "turf", "Catch", "Year", "Country", "IdOrig") %>%
  filter( itq != "NA" & iq != "NA" & ivq != "NA" & turf != "NA") %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "2",
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0"))

countries_itq_2012_2 <- f_b_itq_countries %>%
  select (Country, rightsbased, Year, IdOrig) %>%
  filter(Year == "2012")  %>%
```

```
  select(Country, rightsbased, IdOrig)

ITQ_projection_2016 <- ITQ_projection %>%
  filter(Year == "2016") %>%
  select(IdOrig, Country, Year, Catch)

itq_2016_updated <- join(ITQ_projection_2016, countries_itq_2012_2, by= c("IdOrig", "Country"), type= "

itq_2016_rightsbasedTRUE <- filter(itq_2016_updated, rightsbased == "1")

itq_2016_rightsbasedFALSE <- filter(itq_2016_updated, rightsbased == "0")

itq_2016_rightsbasedTURF <- filter(itq_2016_updated, rightsbased == "2")


sum(itq_2016_rightsbasedTRUE$Catch, na.rm = TRUE)
```

```
## [1] 20217168
```

```
#20,217,168

sum(itq_2016_rightsbasedFALSE$Catch, na.rm = TRUE)
```

```
## [1] 1154957
```

```
#1,154,957

sum(itq_2016_rightsbasedTURF$Catch, na.rm = TRUE)
```

```
## [1] 382370.4
```

```
#382,370.4
```

2016 total catch:

ITQs: 20,217,168

No ITQ: 1,154,957 (all in the USA)

TURF: 382,370.4 (all in Japan)

3. Probability of ITQ

itq or turf: probablity of itq = f(ISSCAPP and GDP)

regression converges

```
turf_itq_isscaap <- read_csv("data/turf_itq_isscaap.csv")
```

```
## Parsed with column specification:
## cols(
##   SciName = col_character(),
##   Country = col_character(),
##   programstart = col_integer(),
##   itq_now = col_integer(),
##   iq = col_logical(),
```

```
##   itq = col_logical(),
##   ivq = col_logical(),
##   turf = col_logical(),
##   SpeciesCat = col_integer()
## )
```

```
gdp_all <- read_csv("/GitHub/global_fisheries_managment/data/gpd.csv")
```

```
## Parsed with column specification:
## cols(
##   Country = col_character(),
##   current_gdp = col_double()
## )
```

```
gdp <- filter(gdp_all, current_gdp != "NA")

turf_itq_isscaap_mutate <- turf_itq_isscaap %>%
  mutate(i_right = case_when(
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0")) %>%
  mutate(TURF = case_when(
    turf == TRUE ~ "1",
    turf = FALSE ~"0"
  )) %>%
  select(SciName, Country, SpeciesCat, i_right, TURF)


turf_itq_isscaap_mutate$TURF[is.na(turf_itq_isscaap_mutate$TURF)] <- "0"


join_gdp_rightsbased <- merge(gdp, turf_itq_isscaap_mutate, by = c("Country"))

gdp_rightsbased <- filter(join_gdp_rightsbased, SpeciesCat != "NA" )

gdp_rightsbased$SpeciesCat <- factor(gdp_rightsbased$SpeciesCat)
gdp_rightsbased$i_right <- as.numeric(gdp_rightsbased$i_right)

itq_glm <- glm(formula = i_right ~ current_gdp + SpeciesCat, family = "binomial", data = gdp_rightsbase
itq_glm
```

```
##
## Call:  glm(formula = i_right ~ current_gdp + SpeciesCat, family = "binomial",
##     data = gdp_rightsbased)
##
## Coefficients:
##  (Intercept)   current_gdp  SpeciesCat22  SpeciesCat23  SpeciesCat24
##   -2.084e+01     3.592e-05    -7.197e-01    -1.867e+00    -2.786e-02
## SpeciesCat31  SpeciesCat32  SpeciesCat33  SpeciesCat34  SpeciesCat35
##   -1.267e+00     2.118e+01     1.784e+01     2.098e+01     1.907e+01
## SpeciesCat37  SpeciesCat42  SpeciesCat43  SpeciesCat44  SpeciesCat45
##    1.825e+01     1.759e+01     1.949e+01    -2.806e-01    -7.347e-01
## SpeciesCat47  SpeciesCat52  SpeciesCat53  SpeciesCat54  SpeciesCat55
##   -8.737e-01    -7.235e-01    -1.352e+00    -7.761e-01    -6.853e-01
## SpeciesCat56  SpeciesCat57  SpeciesCat58  SpeciesCat74  SpeciesCat76
##   -9.480e-01    -8.752e-01    -4.608e-01    -6.131e-01    -6.537e-01
```

```
## SpeciesCat77  SpeciesCat91  SpeciesCat92
##   -6.782e-01    -6.131e-01    -6.131e-01
##
## Degrees of Freedom: 289 Total (i.e. Null);  262 Residual
## Null Deviance:       295.7
## Residual Deviance: 126.1     AIC: 182.1
```

```
summary(itq_glm)
```

```
##
## Call:
## glm(formula = i_right ~ current_gdp + SpeciesCat, family = "binomial",
##     data = gdp_rightsbased)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -2.01691  -0.36072  -0.00005  -0.00003   2.10604
##
## Coefficients:
##                Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -2.084e+01  1.254e+04  -0.002   0.9987
## current_gdp   3.592e-05  1.888e-05   1.902   0.0571 .
## SpeciesCat22 -7.197e-01  2.171e+04   0.000   1.0000
## SpeciesCat23 -1.867e+00  1.448e+04   0.000   0.9999
## SpeciesCat24 -2.786e-02  2.171e+04   0.000   1.0000
## SpeciesCat31 -1.267e+00  1.773e+04   0.000   0.9999
## SpeciesCat32  2.118e+01  1.254e+04   0.002   0.9987
## SpeciesCat33  1.784e+01  1.254e+04   0.001   0.9989
## SpeciesCat34  2.098e+01  1.254e+04   0.002   0.9987
## SpeciesCat35  1.907e+01  1.254e+04   0.002   0.9988
## SpeciesCat37  1.825e+01  1.254e+04   0.001   0.9988
## SpeciesCat42  1.759e+01  1.254e+04   0.001   0.9989
## SpeciesCat43  1.949e+01  1.254e+04   0.002   0.9988
## SpeciesCat44 -2.806e-01  1.764e+04   0.000   1.0000
## SpeciesCat45 -7.347e-01  1.308e+04   0.000   1.0000
## SpeciesCat47 -8.737e-01  1.769e+04   0.000   1.0000
## SpeciesCat52 -7.235e-01  1.333e+04   0.000   1.0000
## SpeciesCat53 -1.352e+00  1.443e+04   0.000   0.9999
## SpeciesCat54 -7.761e-01  1.481e+04   0.000   1.0000
## SpeciesCat55 -6.853e-01  1.445e+04   0.000   1.0000
## SpeciesCat56 -9.480e-01  1.296e+04   0.000   0.9999
## SpeciesCat57 -8.752e-01  1.398e+04   0.000   1.0000
## SpeciesCat58 -4.608e-01  1.307e+04   0.000   1.0000
## SpeciesCat74 -6.131e-01  1.773e+04   0.000   1.0000
## SpeciesCat76 -6.537e-01  1.611e+04   0.000   1.0000
## SpeciesCat77 -6.782e-01  1.527e+04   0.000   1.0000
## SpeciesCat91 -6.131e-01  1.483e+04   0.000   1.0000
## SpeciesCat92 -6.131e-01  1.448e+04   0.000   1.0000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 295.69  on 289  degrees of freedom
## Residual deviance: 126.14  on 262  degrees of freedom
```

```
## AIC: 182.14
##
## Number of Fisher Scoring iterations: 19
```

4. Run Turf versus ITQ probably: prob(ITQ). Turf = 1 and ITQ = 0 with the data set that was the turf/itq only one

regression does not converge

```
turf_itq_isscaap <- read_csv("data/turf_itq_isscaap.csv")
```

```
## Parsed with column specification:
## cols(
##   SciName = col_character(),
##   Country = col_character(),
##   programstart = col_integer(),
##   itq_now = col_integer(),
##   iq = col_logical(),
##   itq = col_logical(),
##   ivq = col_logical(),
##   turf = col_logical(),
##   SpeciesCat = col_integer()
## )
```

```
gdp_all <- read_csv("/GitHub/global_fisheries_managment/data/gpd.csv")
```

```
## Parsed with column specification:
## cols(
##   Country = col_character(),
##   current_gdp = col_double()
## )
```

```
gdp <- filter(gdp_all, current_gdp != "NA")

species_rightsbased_mutate_2 <- turf_itq_isscaap %>%
  mutate(rightbased = case_when(
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "0",
    turf == TRUE ~ "1"))

gdp <- filter(gdp_all, current_gdp != "NA")

join_gdp_rightsbased_2 <- join(gdp, species_rightsbased_mutate_2, by = c("Country"), type = "full")

gdp_rightsbased_2 <- filter(join_gdp_rightsbased_2, SpeciesCat != "NA" )

gdp_rightsbased_2$SpeciesCat <- factor(gdp_rightsbased_2$SpeciesCat)
gdp_rightsbased_2$rightbased <- as.numeric(gdp_rightsbased_2$rightbased)

rightbased_glm <- glm(formula = rightbased ~ current_gdp + SpeciesCat + programstart, family = "binomial
```

```
## Warning: glm.fit: algorithm did not converge
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
rightbased_glm
```

```
##
## Call:  glm(formula = rightbased ~ current_gdp + SpeciesCat + programstart,
##     family = "binomial", data = gdp_rightsbased_2)
##
## Coefficients:
##  (Intercept)   current_gdp  SpeciesCat33  SpeciesCat34  SpeciesCat35
##    1.345e+04    -4.539e-03    -6.105e+01    -6.590e+01    -5.434e+01
## SpeciesCat37  SpeciesCat42  SpeciesCat43  SpeciesCat44  SpeciesCat45
##   -6.054e+01    -5.348e+01    -6.667e+01    -5.529e+01     1.459e+02
## SpeciesCat47  SpeciesCat52  SpeciesCat54  SpeciesCat55  SpeciesCat56
##    1.111e+01    -5.570e+01    -5.529e+01    -5.606e+01     4.379e+01
## SpeciesCat57  SpeciesCat58  SpeciesCat74  SpeciesCat76  SpeciesCat77
##    4.288e+01    -8.010e+00    -5.529e+01    -5.529e+01    -5.529e+01
## SpeciesCat91  SpeciesCat92  programstart
##   -5.529e+01    -5.529e+01    -6.658e+00
##
## Degrees of Freedom: 159 Total (i.e. Null);  137 Residual
##   (235 observations deleted due to missingness)
## Null Deviance:       211.7
## Residual Deviance: 9.275e-09     AIC: 46
```

```
summary(rightbased_glm)
```

```
##
## Call:
## glm(formula = rightbased ~ current_gdp + SpeciesCat + programstart,
##     family = "binomial", data = gdp_rightsbased_2)
##
## Deviance Residuals:
##        Min          1Q      Median          3Q         Max
## -4.559e-05  -2.100e-08   2.100e-08   2.409e-06   4.294e-05
##
## Coefficients:
##                Estimate Std. Error z value Pr(>|z|)
## (Intercept)   1.345e+04  6.084e+06   0.002    0.998
## current_gdp  -4.539e-03  2.318e+00  -0.002    0.998
## SpeciesCat33 -6.105e+01  2.028e+05   0.000    1.000
## SpeciesCat34 -6.590e+01  2.090e+05   0.000    1.000
## SpeciesCat35 -5.434e+01  4.529e+05   0.000    1.000
## SpeciesCat37 -6.054e+01  2.016e+05   0.000    1.000
## SpeciesCat42 -5.348e+01  4.851e+05   0.000    1.000
## SpeciesCat43 -6.667e+01  2.992e+05   0.000    1.000
## SpeciesCat44 -5.529e+01  4.102e+05   0.000    1.000
## SpeciesCat45  1.459e+02  2.678e+05   0.001    1.000
## SpeciesCat47  1.111e+01  3.010e+05   0.000    1.000
## SpeciesCat52 -5.570e+01  2.254e+05   0.000    1.000
## SpeciesCat54 -5.529e+01  2.705e+05   0.000    1.000
## SpeciesCat55 -5.606e+01  2.472e+05   0.000    1.000
## SpeciesCat56  4.379e+01  2.123e+05   0.000    1.000
## SpeciesCat57  4.288e+01  2.299e+05   0.000    1.000
## SpeciesCat58 -8.010e+00  2.070e+05   0.000    1.000
## SpeciesCat74 -5.529e+01  4.102e+05   0.000    1.000
## SpeciesCat76 -5.529e+01  4.102e+05   0.000    1.000
## SpeciesCat77 -5.529e+01  3.238e+05   0.000    1.000
## SpeciesCat91 -5.529e+01  2.585e+05   0.000    1.000
```

```
## SpeciesCat92 -5.529e+01  2.502e+05   0.000    1.000
## programstart -6.658e+00  3.006e+03  -0.002    0.998
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 2.1170e+02  on 159  degrees of freedom
## Residual deviance: 9.2752e-09  on 137  degrees of freedom
##   (235 observations deleted due to missingness)
## AIC: 46
##
## Number of Fisher Scoring iterations: 25
```

5. MPA Area by Country

Note: did not filter out MPAs that did no meet IUCN and/or CBD PA definition

MPA data: from protectedplanet.net

```
mpa_updated <- read_csv("data/mpa_updated.csv")
```

```
## Parsed with column specification:
## cols(
##   Country = col_character(),
##   NAME = col_character(),
##   DESIG_ENG = col_character(),
##   DESIG_TYPE = col_character(),
##   IUCN_CAT = col_character(),
##   MARINE = col_integer(),
##   REP_M_AREA = col_integer(),
##   NO_TAKE = col_character(),
##   STATUS = col_character()
## )
```

MPAs that are completly No Take

The top 10 countries with the largest MPA area (km

^{2}

). These MPAs are 100% no take.

```
##Completly no Take
mpa <- mpa_updated %>%
  select(Country, REP_M_AREA, MARINE, NO_TAKE) %>%
  filter(MARINE == "2" | MARINE == "1") %>%
  filter(NO_TAKE == "All") %>%
  group_by(Country)

mpa_area <- aggregate(mpa$REP_M_AREA, by=list(Country=mpa$Country), FUN=sum)
mpa_area
```

```
##                              Country       x
## 1  Areas Beyond National Jurisdiction 2090027
## 2                            Bahamas       0
## 3                         Bangladesh       0
```

```
## 4                              Brazil       0
## 5                               Chile  451113
## 6                              France  135950
## 7                               India     265
## 8                               Kenya      28
## 9                            Maldives      49
## 10                       New Zealand       5
## 11                   Papua New Guinea       0
## 12                         Seychelles     142
## 13                   Solomon Islands      36
## 14       Tanzania, United Republic of      26
## 15               United Arab Emirates       0
## 16                     United Kingdom  640000
## 17                      United States 1521594
```

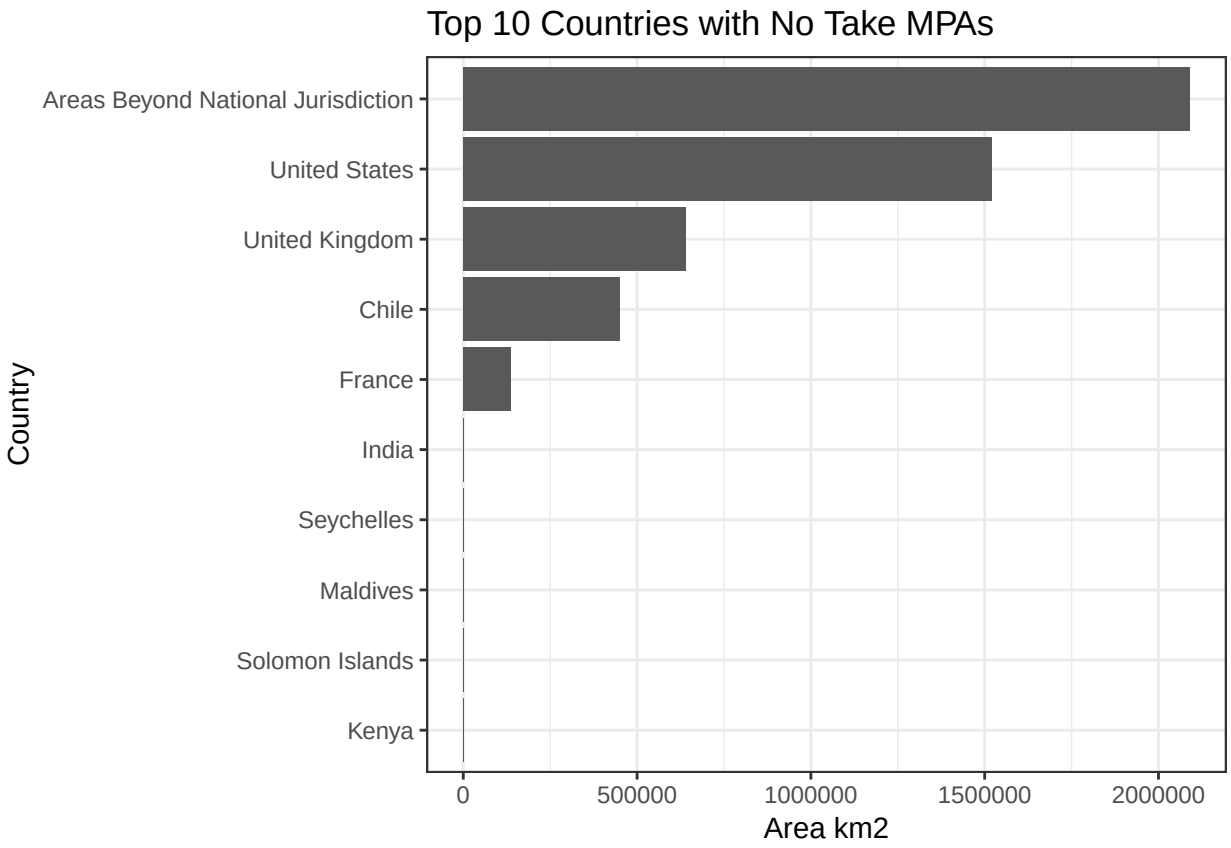
```
names(mpa_area) <-c("Country", "Area")

mpa_area_10 <- top_n(mpa_area, 10, Area)
mpa_area_10
```

```
##                              Country    Area
## 1  Areas Beyond National Jurisdiction 2090027
## 2                               Chile  451113
## 3                              France  135950
## 4                               India     265
## 5                               Kenya      28
## 6                            Maldives      49
## 7                          Seychelles     142
## 8                    Solomon Islands      36
## 9                     United Kingdom  640000
## 10                     United States 1521594
```

```
##all countries
mpa_area_10$Country <- factor(mpa_area_10$Country, levels = mpa_area_10$Country[order(mpa_area_10$Area)]

ggplot(mpa_area_10, aes(x = Country, y = Area)) +
  geom_bar(stat = "identity")+
  ggtitle("Top 10 Countries with No Take MPAs")+
  coord_flip()+
  theme_bw()+
  ylab("Area km2")
```



MPAs that are completly No Take

The top 10 countries (minus areas beyond national jurisdiction) with the largest MPA area (km

2

). These MPAs are 100% no take.

```
##Completly no Take
mpa <- mpa_updated %>%
  select(Country, REP_M_AREA, MARINE, NO_TAKE) %>%
  filter(MARINE == "2" | MARINE == "1") %>%
  filter(NO_TAKE == "All") %>%
  group_by(Country)

mpa_area <- aggregate(mpa$REP_M_AREA, by=list(Country=mpa$Country), FUN=sum)
mpa_area
```

```
##                              Country       x
## 1  Areas Beyond National Jurisdiction 2090027
## 2                            Bahamas       0
## 3                         Bangladesh       0
## 4                             Brazil       0
## 5                              Chile  451113
## 6                             France  135950
## 7                              India     265
## 8                              Kenya      28
```

```
## 9                           Maldives      49
## 10                       New Zealand       5
## 11                   Papua New Guinea       0
## 12                        Seychelles     142
## 13                     Solomon Islands      36
## 14       Tanzania, United Republic of      26
## 15               United Arab Emirates       0
## 16                     United Kingdom  640000
## 17                      United States 1521594
```

```
names(mpa_area) <-c("Country", "Area")

mpa_area_10 <- top_n(mpa_area, 10, Area)
mpa_area_10
```

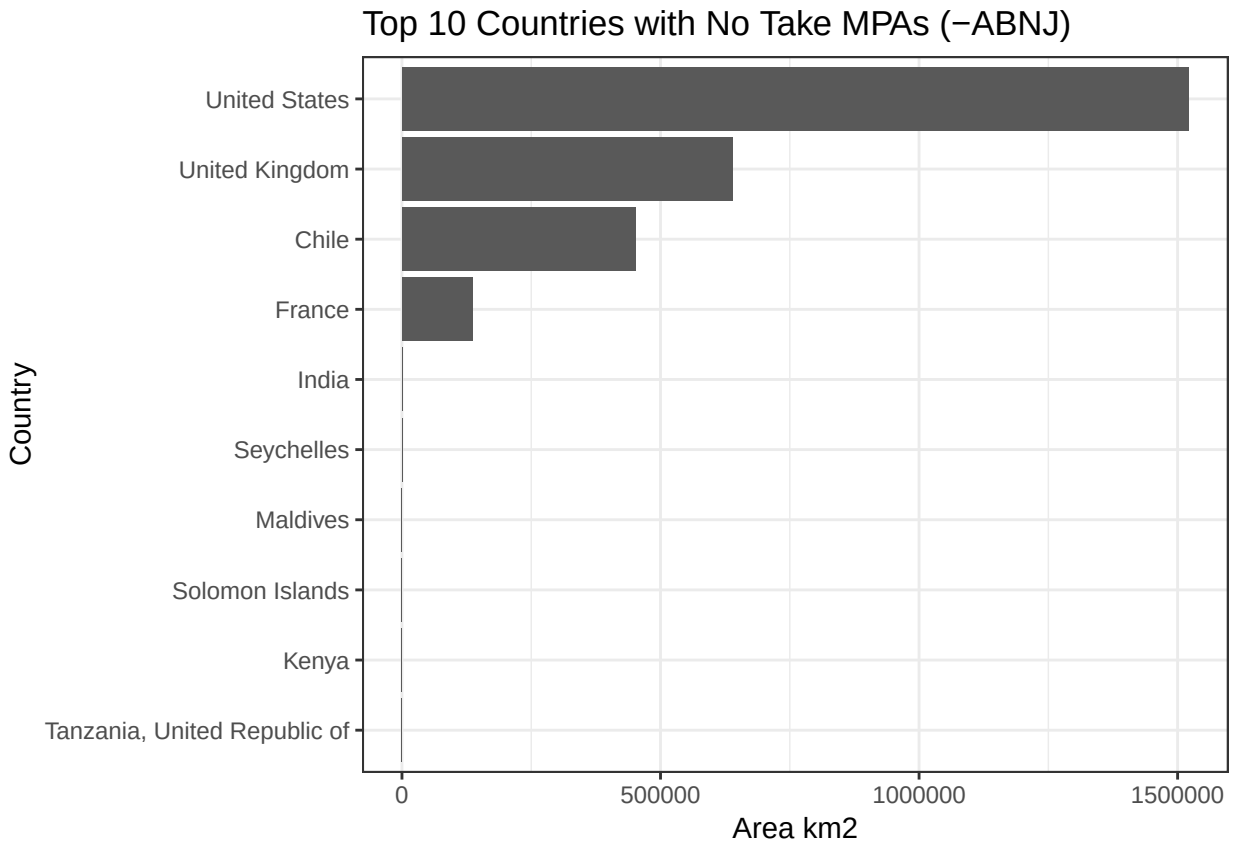
```
##                               Country    Area
## 1  Areas Beyond National Jurisdiction 2090027
## 2                               Chile  451113
## 3                              France  135950
## 4                               India     265
## 5                               Kenya      28
## 6                            Maldives      49
## 7                          Seychelles     142
## 8                       Solomon Islands      36
## 9                        United Kingdom  640000
## 10                        United States 1521594
```

```
#all countries minus areas beyond national jurisdiction
mpa_area_nojurisdiction <-filter(mpa_area, Country != "Areas Beyond National Jurisdiction")
mpa_area_nojurisdiction_10 <- top_n(mpa_area_nojurisdiction, 10, Area)
mpa_area_nojurisdiction_10
```

```
##                          Country    Area
## 1                          Chile  451113
## 2                         France  135950
## 3                          India     265
## 4                          Kenya      28
## 5                       Maldives      49
## 6                     Seychelles     142
## 7                 Solomon Islands      36
## 8  Tanzania, United Republic of      26
## 9                  United Kingdom  640000
## 10                  United States 1521594
```

```
mpa_area_nojurisdiction_10$Country <- factor(mpa_area_nojurisdiction_10$Country, levels = mpa_area_noju

ggplot(mpa_area_nojurisdiction_10, aes(x = Country, y = Area)) +
  geom_bar(stat = "identity")+
  ggtitle("Top 10 Countries with No Take MPAs (-ABNJ)")+
  coord_flip()+
  theme_bw()+
  ylab("Area km2")
```



MPAs that are completly No Take or Partial No Take

```
##No Take and Partial Take

mpa_parttake <- mpa_updated %>%
  select(Country, REP_M_AREA, MARINE, NO_TAKE) %>%
  filter(MARINE == "2" | MARINE == "1") %>%
  filter(NO_TAKE == "All" | NO_TAKE == "Part") %>%
  group_by(Country)


mpa_area_part <- aggregate(mpa_parttake$REP_M_AREA, by=list(Country=mpa_parttake$Country), FUN=sum)
mpa_area_part
```

```
##                              Country       x
## 1  Areas Beyond National Jurisdiction 2090027
## 2                            Bahamas       0
## 3                         Bangladesh       0
## 4                             Brazil       0
## 5                           Cambodia      60
## 6                              Chile 1030481
## 7                           Colombia   65000
## 8                               Fiji    1437
## 9                             France 1429008
## 10                             India     265
## 11                         Indonesia   31078
```

```
## 12                              Kenya      28
## 13                 Korea, Republic of      70
## 14                         Madagascar      10
## 15                           Maldives      49
## 16                    Marshall Islands       0
## 17                         Mozambique    2796
## 18                        Netherlands      57
## 19                        New Zealand       5
## 20                    Papua New Guinea       0
## 21                        Philippines       2
## 22                              Samoa      50
## 23              Sao Tome and Principe       0
## 24                         Seychelles     142
## 25                          Singapore       0
## 26                     Solomon Islands     656
## 27                Syrian Arab Republic      50
## 28       Tanzania, United Republic of    2555
## 29                            Tunisia       0
## 30                United Arab Emirates       0
## 31                      United Kingdom 2544334
## 32                       United States 2789324
```

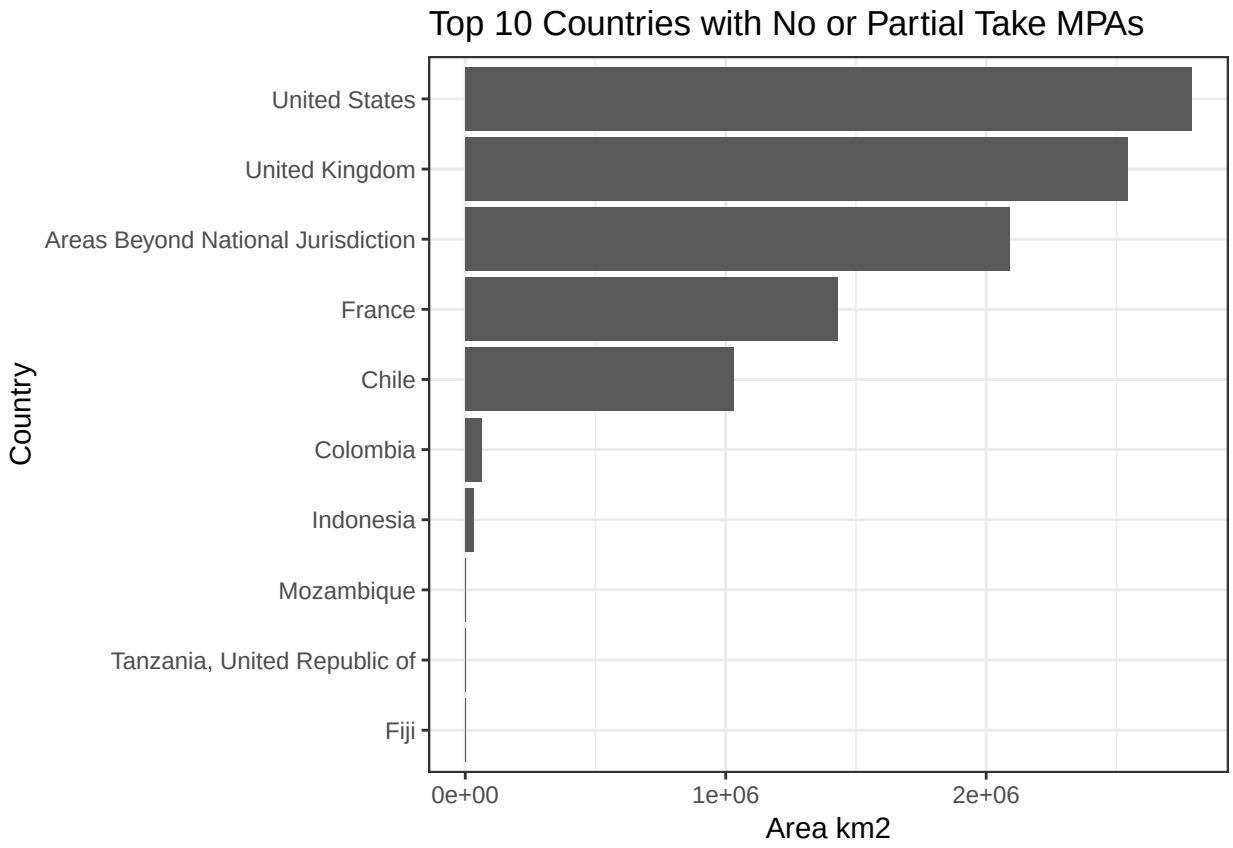
```
names(mpa_area_part) <-c("Country", "Area")

mpa_area_part_10 <- top_n(mpa_area_part, 10, Area)
mpa_area_part_10
```

```
##                               Country    Area
## 1  Areas Beyond National Jurisdiction 2090027
## 2                               Chile 1030481
## 3                            Colombia   65000
## 4                                Fiji    1437
## 5                              France 1429008
## 6                           Indonesia   31078
## 7                          Mozambique    2796
## 8        Tanzania, United Republic of    2555
## 9                       United Kingdom 2544334
## 10                       United States 2789324
```

```
##all countries
mpa_area_part_10$Country <- factor(mpa_area_part_10$Country, levels = mpa_area_part_10$Country[order(mpa

ggplot(mpa_area_part_10, aes(x = Country, y = Area)) +
  geom_bar(stat = "identity")+
  ggtitle("Top 10 Countries with No or Partial Take MPAs")+
  coord_flip()+
  theme_bw()+
  ylab("Area km2")
```


Top 10 Countries with No or Partial Take MPAs
United States
United Kingdom
Areas Beyond National Jurisdiction
France
Chile
Colombia
Indonesia
Mozambique
Tanzania, United Republic of
Fiji
Country
0e+00
1e+06
2e+06
Area km2