

Draft Figures: 12.23.18

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KOBE Plots with only most recent year of fisheries

RAM only

No data: ITQ = FALSE

#read in data: this is updated projection data (updated using RAMs) and Corbett's ITQ/Turf data applied

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

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
## Warning in rbind(names(probs), probs_f): number of columns of result is not  
## a multiple of vector length (arg 1)
```

```
## Warning: 11 parsing failures.
```

```
## row # A tibble: 5 x 5 col      row      col      expected actual      file exp
```

```
## ...  
## See problems(...) for more details.
```

#assuming that when no data is available on the fishery inregardes to ITQ or Turfs that means there are

```
fisheries_recent$itq[is.na(fisheries_recent$itq)] <- "FALSE"  
fisheries_recent$ivq[is.na(fisheries_recent$ivq)] <- "FALSE"  
fisheries_recent$iq[is.na(fisheries_recent$iq)] <- "FALSE"  
fisheries_recent$turf[is.na(fisheries_recent$turf)] <- "FALSE"
```

```
a = fisheries_recent %>%  
  filter(Dbase == "RAM") %>%  
  ggplot(aes(BvBmsy, FvFmsy, color =Dbase )) +
```

```

geom_point() +
coord_cartesian(xlim = c(0,4), ylim = c(0,4))

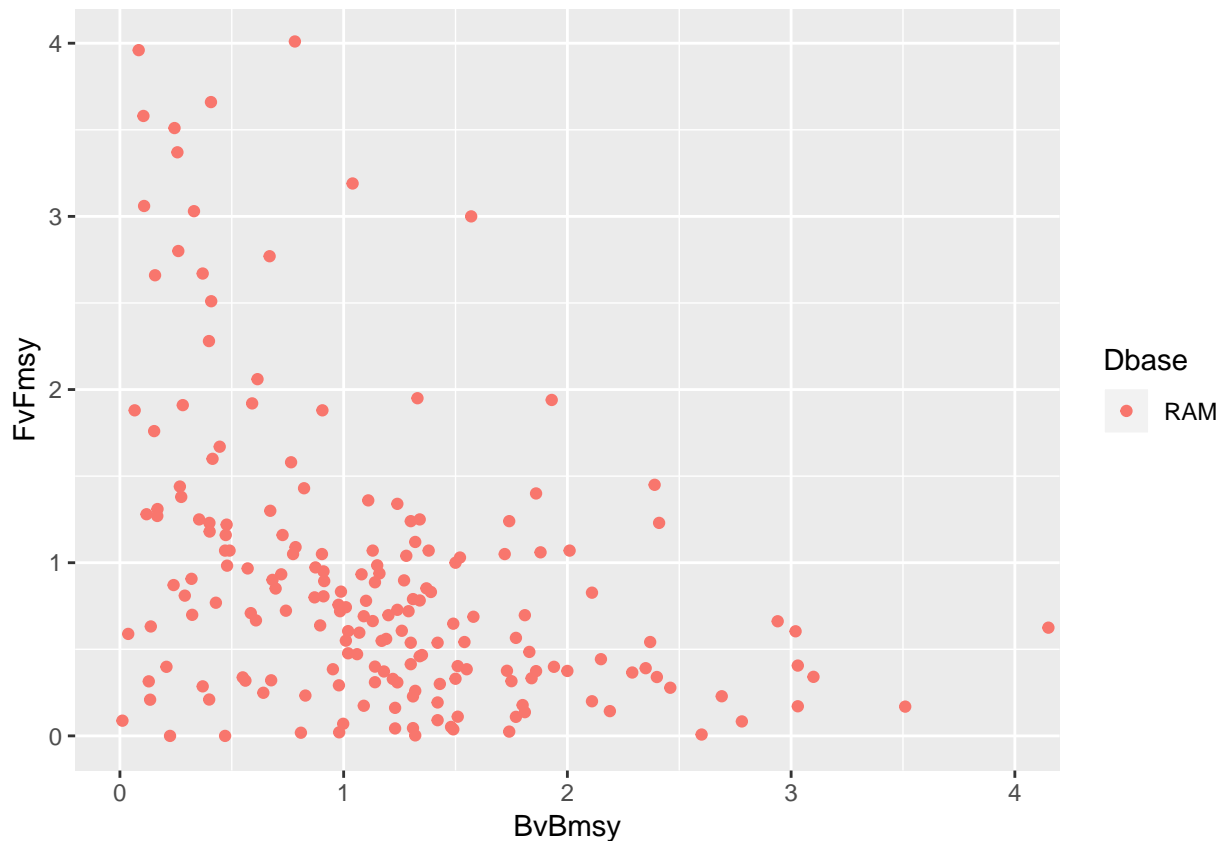
b = fisheries_recent %>%
  ggplot(aes(BvBmsy, FvFmsy, color =Dbase )) +
  geom_point() +
  coord_cartesian(xlim = c(0,4), ylim = c(0,4))

#timeseries_values_views%>%
# filter(year == 2016) %>%
# select(BdivBmsypref,UdivUmsypref) %>%
# na.omit() %>%
# nrow()
# ggplot(aes(BdivBmsypref,UdivUmsypref)) +
# geom_point()

a

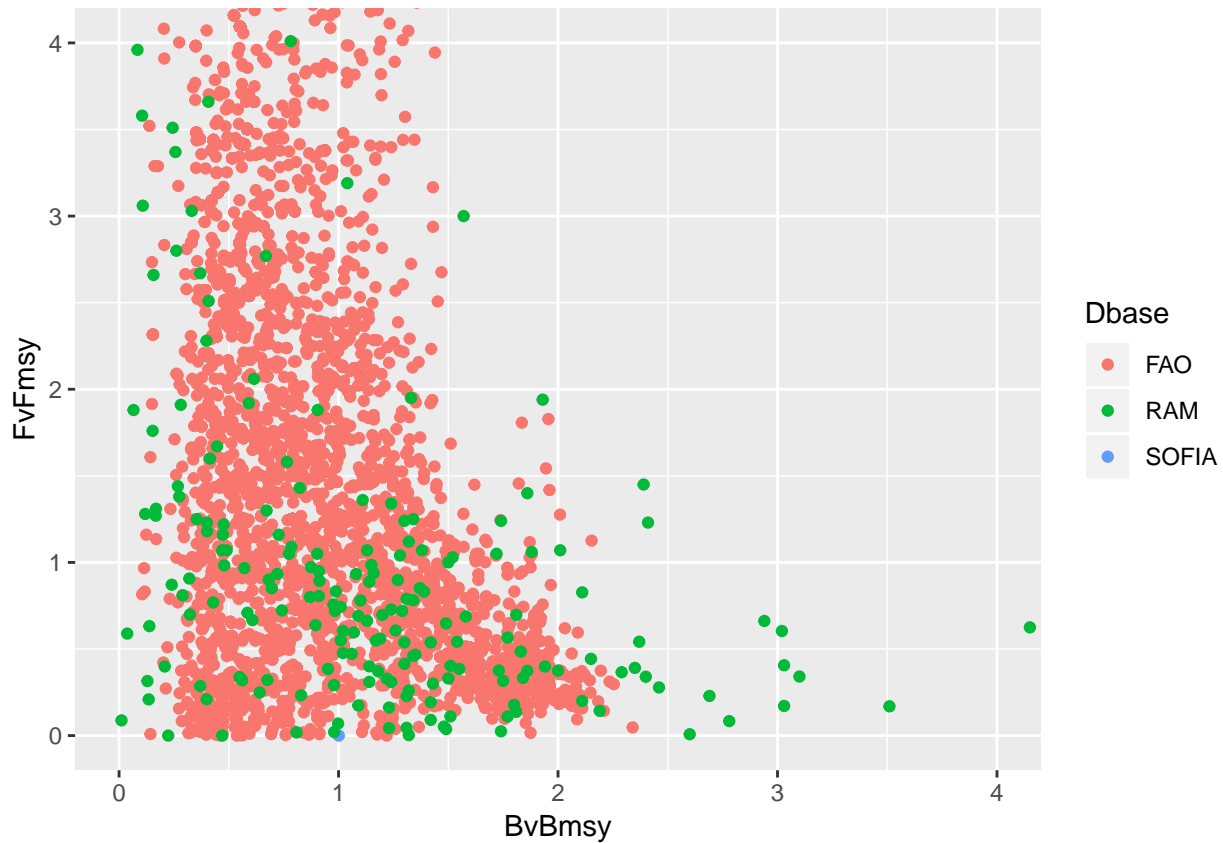
```

Warning: Removed 62 rows containing missing values (geom_point).



b

Warning: Removed 62 rows containing missing values (geom_point).



```
#median F and B values
dbase_median <- fisheries_recent %>%
  select(BvBmsy,FvFmsy, Dbase) %>%
  group_by(Dbase) %>%
  na.omit() %>%
  summarise_each(funs(median)) %>%
  ggplot()+
  geom_point(aes(x=BvBmsy, y=FvFmsy, colour=Dbase))
```

```
fisheries_median <-fisheries_recent %>%
  select(BvBmsy,FvFmsy) %>%
  na.omit() %>%
  summarise_each(funs(median)) %>%
  ggplot()+
  geom_point(aes(x=BvBmsy, y=FvFmsy))
```

```
#only looking at fisheries data that come from RAMS database
# creating new column called "rightsbased" where 1 = ITQ and 0 = No ITQ
fisheries_KOBE_ram <- fisheries_recent %>%
  filter(Dbase == "RAM") %>%
  mutate(rightsbased = case_when(
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0"))
```

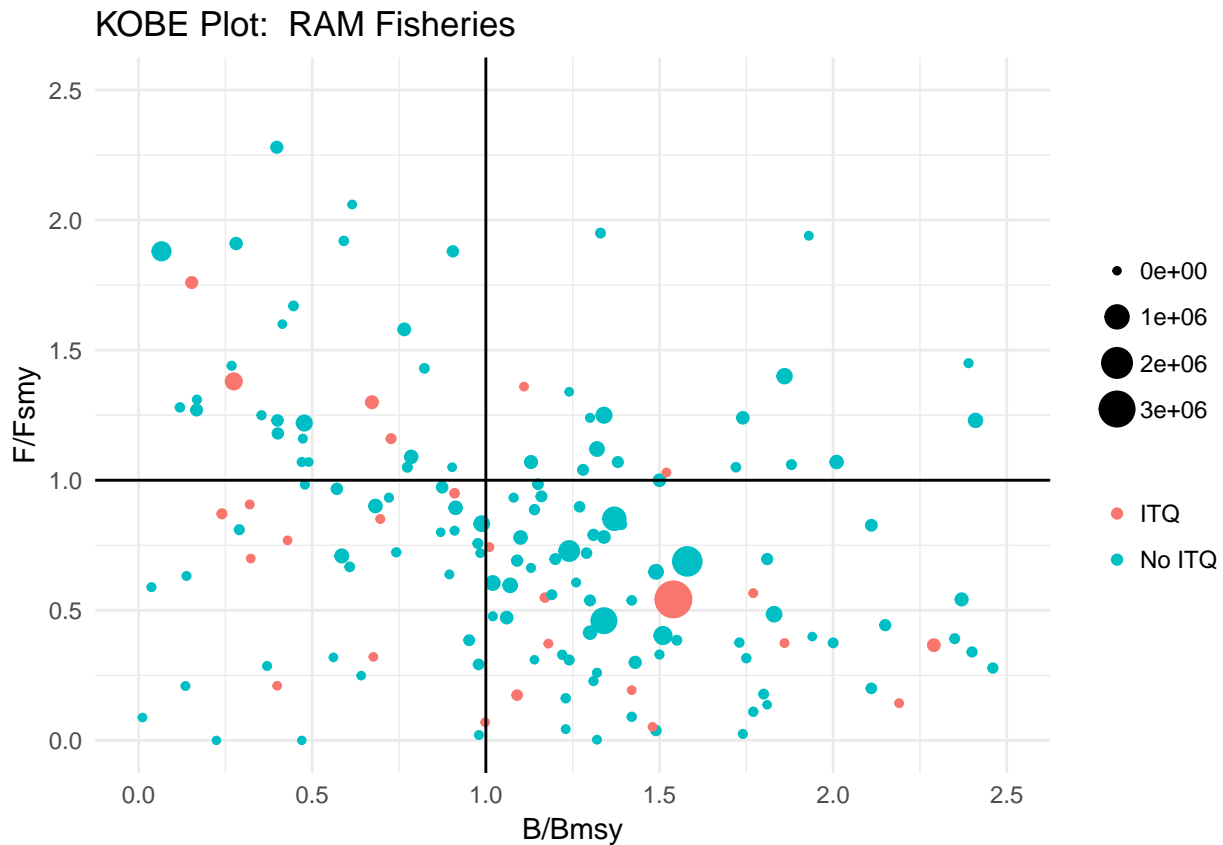
```
#graphing
fisheries_KOBE_ram$rightsbased[fisheries_KOBE_ram$rightsbased == "0"]<- "No ITQ"
```

```
fisheries_KOBE_ram$rightsbased[fisheries_KOBE_ram$rightsbased == "1"]<- "ITQ"
```

```
F_B_graph_ram <- ggplot(data = fisheries_KOBE_ram, aes( x=BvBmsy, y=FvFmsy, colour= rightsbased, size =  
  geom_point()+  
  labs(x = "B/Bmsy", y= "F/Fmsy") +  
  theme_minimal()+  
  theme(legend.title=element_blank()))+  
  ylim(0, 2.5)+  
  xlim(0, 2.5)+  
  geom_hline(aes(yintercept=1))+  
  geom_vline(aes(xintercept=1))+  
  ggtitle("KOBE Plot: RAM Fisheries")
```

```
F_B_graph_ram
```

```
## Warning: Removed 108 rows containing missing values (geom_point).
```



KOBE Plots with only most recent year of fisheries

All Data Sources

No data: ITQ = FALSE

```
fisheries_KOBE <- fisheries_recent %>%  
  mutate(rightsbased = case_when(  
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
```

```

    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0"))

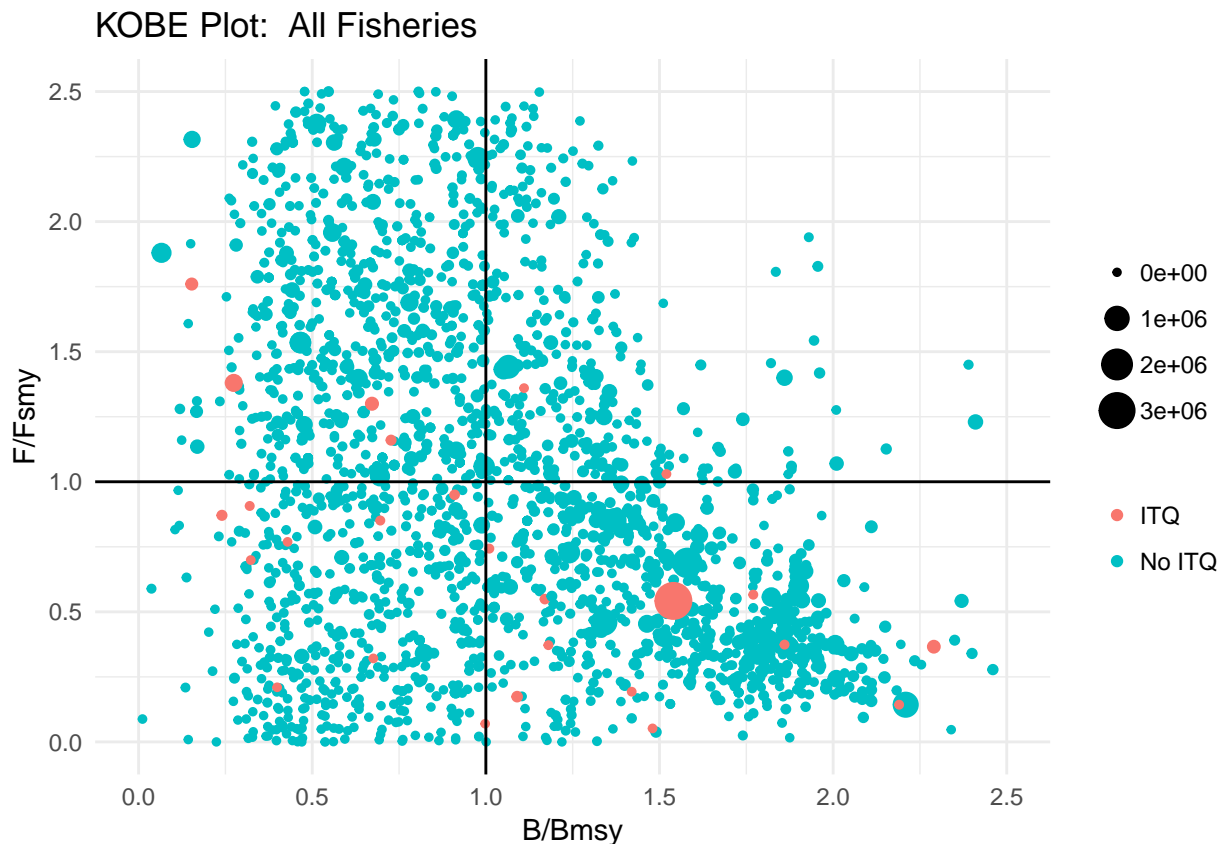
fisheries_KOBE$rightsbased[fisheries_KOBE$rightsbased == "0"]<- "No ITQ"
fisheries_KOBE$rightsbased[fisheries_KOBE$rightsbased == "1"]<- "ITQ"

#graphing
F_B_graph <- ggplot(data = fisheries_KOBE, aes( x=BvBmsy, y=FvFmsy, colour= rightsbased, size = Catch ))
  geom_point()+
  labs(x = "B/Bmsy", y = "F/Fmsy") +
  theme_minimal()+
  theme(legend.title=element_blank())+
  ylim(0, 2.5)+
  xlim(0, 2.5)+
  geom_hline(aes(yintercept=1))+
  geom_vline(aes(xintercept=1))+
  ggtitle("KOBE Plot: All Fisheries")

F_B_graph

```

Warning: Removed 1603 rows containing missing values (geom_point).



```

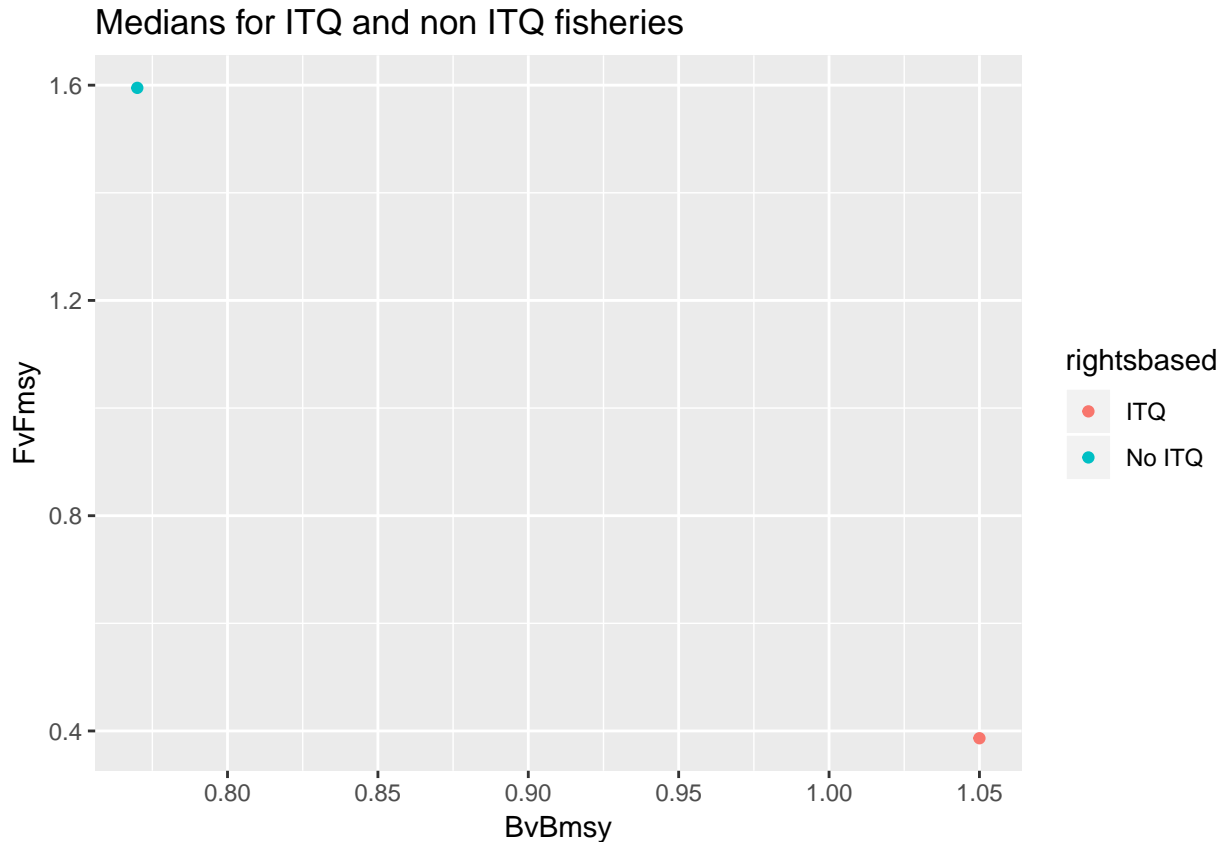
itq_median <- fisheries_KOBE %>%
  select(BvBmsy, FvFmsy, rightsbased) %>%
  group_by(rightsbased) %>%
  na.omit() %>%
  summarise_each(funs(median)) %>%
  ggplot()+

```

```
geom_point(aes(x=BvBmsy, y=FvFmsy, colour = rightsbased))+
ggtitle("Medians for ITQ and non ITQ fisheries")
```

```
## `summarise_each()` is deprecated.
## Use `summarise_all()`, `summarise_at()` or `summarise_if()` instead.
## To map `funs` over all variables, use `summarise_all()`
```

```
itq_median
```



Total Catch: Most recent year for each fishery

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

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
## Parsed with column specification:
```

```
## cols(
```

```
##   .default = col_character(),
```

```
##   X1 = col_integer(),
```

```
##   Year = col_integer(),
```

```
##   Biomass = col_double(),
```

```
##   Catch = col_integer(),
```

```
##   BvBmsy = col_double(),
```

```
##   FvFmsy = col_double(),
```

```
##   SpeciesCat.x = col_integer(),
```

```
##   Profits = col_double(),
```

```
##   MSY = col_double(),
```

```
## Price = col_double(),
## g = col_double(),
## k = col_double(),
## c = col_double(),
## phi = col_double()
## )

## See spec(...) for full column specifications.

## Warning in rbind(names(probs), probs_f): number of columns of result is not
## a multiple of vector length (arg 1)

## Warning: 11 parsing failures.
## row # A tibble: 5 x 5 col      row      col      expected actual      file exp
## ... .....
## See problems(...) for more details.
```

```
#assuming that when no data is present for itqs/turf that means there are none
fisheries_recent$turf[is.na(fisheries_recent$turf)] <- "FALSE"
fisheries_recent$itq[is.na(fisheries_recent$itq)] <- "FALSE"
fisheries_recent$ivq[is.na(fisheries_recent$ivq)] <- "FALSE"
fisheries_recent$iq[is.na(fisheries_recent$iq)] <- "FALSE"
```

```
fisheries_turf_itqs <- fisheries_recent %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "2",
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0"
  ))

turfs_catch <- filter(fisheries_turf_itqs, rightsbased == "2")
itq_catch <- filter(fisheries_turf_itqs, rightsbased == "1")
no_itq_catch <- filter(fisheries_turf_itqs, rightsbased == "0")

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

```
## [1] 234000
```

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

```
## [1] 4093520
```

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

```
## [1] 47569594
```

turf = 234000 = 0.29% of total catch itq = 4093520 = 5.1% of total catch

Global Catch Estimate = 80 million

Percent Catch ITQ over last 5 Years

```
# by assess id
fisheries_recent_5years <- read_csv("data/fisheries_recent_5years.csv")
```

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
## Warning: Duplicated column names deduplicated: 'X1' => 'X1_2' [2]
```

```

## Parsed with column specification:
## cols(
##   .default = col_double(),
##   X1 = col_integer(),
##   X1_2 = col_integer(),
##   X1_1 = col_integer(),
##   Country = col_character(),
##   assess_id_short = col_character(),
##   Year = col_integer(),
##   CommName = col_character(),
##   Catch = col_integer(),
##   Dbase = col_character(),
##   SciName = col_character(),
##   IdLevel = col_character(),
##   SpeciesCat.x = col_integer(),
##   itq = col_logical(),
##   ivq = col_logical(),
##   iq = col_logical(),
##   turf = col_logical()
## )

## See spec(...) for full column specifications.

#assuming that when no data is present for itqs/turf that means there are none
fisheries_recent_5years$turf[is.na(fisheries_recent_5years$turf)] <- "FALSE"
fisheries_recent_5years$itq[is.na(fisheries_recent_5years$itq)] <- "FALSE"
fisheries_recent_5years$ivq[is.na(fisheries_recent_5years$ivq)] <- "FALSE"
fisheries_recent_5years$iq[is.na(fisheries_recent_5years$iq)] <- "FALSE"

###creating new column for management; also merging country and the name of species in order to have a v
fisheries_turf_itqs_5years_1 <- fisheries_recent_5years %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "2",
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0"
  ))

##get average catch over last 5 years for each fishery
mean_5years <- aggregate(fisheries_turf_itqs_5years_1[, 7], list(fisheries_turf_itqs_5years_1$assess_id,

```

```

## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
## returning NA

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## Warning in mean.default(X[[i]], ...): argument is not numeric or logical:
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```
colnames(mean_5years) <- c("assess_id_short", "FiveYearCatchAvg")
```

```
fisheries_turf_itqs_5years_2 <- select(fisheries_turf_itqs_5years_1, "assess_id_short", "rightsbased",
```

```
fisheries_turf_itqs_5years <- merge(fisheries_turf_itqs_5years_2, mean_5years, by.x = "assess_id_short"
```

```
turfs_catch <- filter(fisheries_turf_itqs_5years, rightsbased == "2")
```

```
itq_catch <- filter(fisheries_turf_itqs_5years, rightsbased == "1")
```

```
no_itq_catch <- filter(fisheries_turf_itqs_5years, rightsbased == "0")
```

```
sum(turfs_catch$FiveYearCatchAvg, na.rm = TRUE)
```

```
## [1] 0
```

```
sum(itq_catch$FiveYearCatchAvg, na.rm = TRUE)
```

```
## [1] 0
```

```
sum(no_itq_catch$FiveYearCatchAvg, na.rm = TRUE)
```

```
## [1] 0
```

```
#####
```

```
#by common name
```

```
# end up with same number by common name becuae the fisheries without more infor (just common name, an
```

```
fisheries_recent_5years <- read_csv("data/fisheries_recent_5years.csv")
```

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
## Warning: Duplicated column names deduplicated: 'X1' => 'X1_2' [2]
```

```
## Parsed with column specification:
```

```
## cols(
```

```
##   .default = col_double(),
```

```
##   X1 = col_integer(),
```

```
##   X1_2 = col_integer(),
```

```

## X1_1 = col_integer(),
## Country = col_character(),
## assess_id_short = col_character(),
## Year = col_integer(),
## CommName = col_character(),
## Catch = col_integer(),
## Dbase = col_character(),
## SciName = col_character(),
## IdLevel = col_character(),
## SpeciesCat.x = col_integer(),
## itq = col_logical(),
## ivq = col_logical(),
## iq = col_logical(),
## turf = col_logical()
## )
## See spec(...) for full column specifications.

#assuming that when no data is present for itqs/turf that means there are none
fisheries_recent_5years$turf[is.na(fisheries_recent_5years$turf)] <- "FALSE"
fisheries_recent_5years$itq[is.na(fisheries_recent_5years$itq)] <- "FALSE"
fisheries_recent_5years$ivq[is.na(fisheries_recent_5years$ivq)] <- "FALSE"
fisheries_recent_5years$iq[is.na(fisheries_recent_5years$iq)] <- "FALSE"

###creating new column for management; also merging country and the name of species in order to have a v
fisheries_turf_itqs_5years_1 <- fisheries_recent_5years %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "2",
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0"
  ))

##get average catch over last 5 years for each fishery
mean_5years <- aggregate(fisheries_turf_itqs_5years_1[, 9], list(fisheries_turf_itqs_5years_1$CommName),
  FUN = function(x) {
    sum(x)
  })

colnames(mean_5years) <- c("CommName", "FiveYearCatchAvg")

fisheries_turf_itqs_5years_2 <- select(fisheries_turf_itqs_5years_1, "assess_id_short", "rightsbased", "CommName")

fisheries_turf_itqs_5years <- merge(fisheries_turf_itqs_5years_2, mean_5years, by.x = "CommName")

turfs_catch <- filter(fisheries_turf_itqs_5years, rightsbased == "2")
itq_catch <- filter(fisheries_turf_itqs_5years, rightsbased == "1")
no_itq_catch <- filter(fisheries_turf_itqs_5years, rightsbased == "0")

sum(turfs_catch$FiveYearCatchAvg, na.rm = TRUE)

## [1] 234000

sum(itq_catch$FiveYearCatchAvg, na.rm = TRUE)

## [1] 4093520

sum(no_itq_catch$FiveYearCatchAvg, na.rm = TRUE)

## [1] 47569594

```

Turf: 234,000 ITQ: 4,093,520 = 5.1% 3,200,000 peru anchovies

Percent Catch ITQ over last 10 Years

```
fisheries_recent_10years <- read_csv("data/fisheries_recent_10years.csv")

## Warning: Missing column names filled in: 'X1' [1]

## Parsed with column specification:
## cols(
##   .default = col_character(),
##   X1 = col_integer(),
##   Year = col_integer(),
##   Biomass = col_double(),
##   Catch = col_integer(),
##   BvBmsy = col_double(),
##   FvFmsy = col_double(),
##   SpeciesCat.x = col_integer(),
##   Profits = col_double(),
##   MSY = col_double(),
##   Price = col_double(),
##   g = col_double(),
##   k = col_double(),
##   c = col_double(),
##   phi = col_double()
## )

## See spec(...) for full column specifications.

## Warning in rbind(names(probs), probs_f): number of columns of result is not
## a multiple of vector length (arg 1)

## Warning: 17 parsing failures.
## row # A tibble: 5 x 5 col      row      col      expected actual expected   <int> <chr>
## ... .....
## See problems(...) for more details.

#assuming that when no data is present for itqs/turf that means there are none
fisheries_recent_10years$turf[is.na(fisheries_recent_10years$turf)] <- "FALSE"
fisheries_recent_10years$itq[is.na(fisheries_recent_10years$itq)] <- "FALSE"
fisheries_recent_10years$ivq[is.na(fisheries_recent_10years$ivq)] <- "FALSE"
fisheries_recent_10years$iq[is.na(fisheries_recent_10years$iq)] <- "FALSE"

###creating new column for management; also merging country and the name of species in order to have a v
fisheries_turf_itqs_10years_1 <- fisheries_recent_10years %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "2",
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0"
  ))

##get average catch over last 5 years for each fishery
mean_10years <- aggregate(fisheries_turf_itqs_10years_1[, 7], list(fisheries_turf_itqs_10years_1$assess,
colnames(mean_10years) <- c("assess_id_short", "TenYearCatchAvg")
```

```

fisheries_turf_itqs_10years_2 <- select(fisheries_turf_itqs_10years_1, "assess_id_short", "rightsbased")

fisheries_turf_itqs_10years <- merge(fisheries_turf_itqs_10years_2, mean_10years, by.x = "assess_id_sh

turfs_catch <- filter(fisheries_turf_itqs_10years, rightsbased == "2")
itq_catch <- filter(fisheries_turf_itqs_10years, rightsbased == "1")
no_itq_catch <- filter(fisheries_turf_itqs_10years, rightsbased == "0")

sum(turfs_catch$TenYearCatchAvg, na.rm = TRUE)

## [1] 234000
sum(itq_catch$TenYearCatchAvg, na.rm = TRUE)

## [1] 4115210
sum(no_itq_catch$TenYearCatchAvg, na.rm = TRUE)

## [1] 50457755
##by common name instead of assess_id ; get same numbers
##get average catch over last 5 years for each fishery
mean_10years <- aggregate(fisheries_turf_itqs_10years_1[, 7], list(fisheries_turf_itqs_10years_1$CommName),
colnames(mean_10years) <- c("CommName", "TenYearCatchAvg")

fisheries_turf_itqs_10years_2 <- select(fisheries_turf_itqs_10years_1, "assess_id_short", "rightsbased")

fisheries_turf_itqs_10years <- merge(fisheries_turf_itqs_10years_2, mean_10years, by.x = "CommName")

turfs_catch <- filter(fisheries_turf_itqs_10years, rightsbased == "2")
itq_catch <- filter(fisheries_turf_itqs_10years, rightsbased == "1")
no_itq_catch <- filter(fisheries_turf_itqs_10years, rightsbased == "0")

sum(turfs_catch$TenYearCatchAvg, na.rm = TRUE)

## [1] 234000
sum(itq_catch$TenYearCatchAvg, na.rm = TRUE)

## [1] 4115210
sum(no_itq_catch$TenYearCatchAvg, na.rm = TRUE)

## [1] 50495965
Turf: 234,000 ITQ: 4,115,210 = 5.1%

```

Total Catch: A more generous estimation of Turf catch

```

#load data with info only on most recent year for each fishery (includes upside, updated with RAMs, cor
fisheries_recent <- read_csv("data/fisheries_recent.csv")

## Warning: Missing column names filled in: 'X1' [1]

## Warning in rbind(names(probs), probs_f): number of columns of result is not
## a multiple of vector length (arg 1)

```

```
## Warning: 11 parsing failures.
## row # A tibble: 5 x 5 col      row      col      expected actual      file exp
## ... .....
## See problems(...) for more details.

#turf data from edf and discover turfs
turfs_edf_dt <- read_csv("data/turfs_edf_dt.csv")

## Warning: Missing column names filled in: 'X1' [1]

fisheries_recent_generousturf_1 <- select(fisheries_recent, Country, assess_id_short, Year, SciName, Cat

#merge the most recent data on each fishery with turf data
fisheries_recent_generousturf <- merge(fisheries_recent_generousturf_1, turfs_edf_dt, by = c("Country",

#assuming that when no data is present for itqs/turf that means there are none
fisheries_recent_generousturf$turf[is.na(fisheries_recent_generousturf$turf)] <- "FALSE"
fisheries_recent_generousturf$itq[is.na(fisheries_recent_generousturf$itq)] <- "FALSE"
fisheries_recent_generousturf$ivq[is.na(fisheries_recent_generousturf$ivq)] <- "FALSE"
fisheries_recent_generousturf$iq[is.na(fisheries_recent_generousturf$iq)] <- "FALSE"

fisheries_recent_generousturf_rightsbased <- fisheries_recent_generousturf %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "2",
    itq == FALSE & iq == FALSE & ivq == FALSE ~ "0",
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1"
  ))

#create dfs for turf, itq, and no itq fisheries to calculate the sum of each
#NOTE to rememeber: the data from these fisheries are the most recent numbers we have. they are not all

turfs_generous <- filter(fisheries_recent_generousturf_rightsbased, rightsbased == "2")
itq_generous <- filter(fisheries_recent_generousturf_rightsbased, rightsbased == "1")
no_itq_generous <- filter(fisheries_recent_generousturf_rightsbased, rightsbased == "0")

sum(turfs_generous$Catch, na.rm = TRUE)

## [1] 1246549

sum(itq_generous$Catch, na.rm = TRUE)

## [1] 4093520

sum(no_itq_generous$Catch, na.rm = TRUE)

## [1] 46557045
```

Generous Turf Catch Estimates:

turf = 1246549 -> 1.5% global catch itq= 4093520 -> 5.1% global catch

Global Estimate = 80,000,000

Logit regressions

- new UN GDP data, 2016 only
- Scaled GDPs

Probability of itq = f(ISSCAPP and GDP)

```

fisheries_recent$itq[is.na(fisheries_recent$itq)] <- "FALSE"
fisheries_recent$ivq[is.na(fisheries_recent$ivq)] <- "FALSE"
fisheries_recent$iq[is.na(fisheries_recent$iq)] <- "FALSE"
fisheries_recent$turf[is.na(fisheries_recent$turf)] <- "FALSE"

fisheries_recent_generousturf_1 <- fisheries_recent %>%
  select(Country, assess_id_short, Year, CommName, Biomass, Catch, BvBmsy, FvFmsy, Dbase, SciName, IdLev)

colnames(fisheries_recent_generousturf_1) <- c("Country", "assess_id_short", "Year", "CommName", "Biomass", "Catch", "BvBmsy", "FvFmsy", "Dbase", "SciName", "IdLev")
fisheries_recent_generousturf <- merge(fisheries_recent_generousturf_1, turfs_edf_dt, by = c("Country", "assess_id_short", "Year", "CommName", "Biomass", "Catch", "BvBmsy", "FvFmsy", "Dbase", "SciName", "IdLev"))

fisheries_recent_generousturf$turf[is.na(fisheries_recent_generousturf$turf)] <- "FALSE"
fisheries_recent_generousturf$itq[is.na(fisheries_recent_generousturf$itq)] <- "FALSE"
fisheries_recent_generousturf$ivq[is.na(fisheries_recent_generousturf$ivq)] <- "FALSE"
fisheries_recent_generousturf$iq[is.na(fisheries_recent_generousturf$iq)] <- "FALSE"

fisheries_recent_generousturf_rightsbased <- fisheries_recent_generousturf %>%
  mutate(rightsbased = case_when(
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE | iq == FALSE | ivq == FALSE ~ "0"
  ))

gdp_all <- read_excel("data/un_gdp_2016.xls")

gdp <- gdp_all %>%
  select(Country, gdp_center) %>%
  filter(gdp_center != "NA")

merge_gdp_rightsbased <- merge(gdp, fisheries_recent_generousturf_rightsbased, by = c("Country"))

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

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

itq_glm <- glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial", data = gdp_rightsbased)
itq_glm

##
## Call:  glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##        data = gdp_rightsbased)
##
## Coefficients:
## (Intercept)      gdp_center  SpeciesCat24  SpeciesCat25  SpeciesCat31
##   -23.25301      0.65372      0.72199      0.57817      0.23871
## SpeciesCat32  SpeciesCat33  SpeciesCat34  SpeciesCat35  SpeciesCat36
##   21.62558     16.66962     18.37206     18.52555     0.05396
## SpeciesCat37  SpeciesCat38  SpeciesCat42  SpeciesCat43  SpeciesCat44
##   21.11106      0.41897      0.44894     19.86649      0.27557
## SpeciesCat45  SpeciesCat47  SpeciesCat52  SpeciesCat53  SpeciesCat54
##    0.56464      0.58032      0.20064      0.46886      0.48184

```



```
## SpeciesCat55 SpeciesCat56 SpeciesCat57 SpeciesCat76 SpeciesCat77
##      0.09233      0.30466      0.52054      0.59030      0.73787
##
## Degrees of Freedom: 3287 Total (i.e. Null); 3263 Residual
## Null Deviance:      233.7
## Residual Deviance: 160 AIC: 210

summary(itq_glm)

##
## Call:
## glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##      data = gdp_rightsbased)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.8267 -0.0629 -0.0442  0.0000  3.3261
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -2.325e+01  7.285e+03  -0.003  0.9975
## gdp_center    6.537e-01  2.701e-01   2.420  0.0155 *
## SpeciesCat24  7.220e-01  1.037e+04  0.000  0.9999
## SpeciesCat25  5.782e-01  1.311e+04  0.000  1.0000
## SpeciesCat31  2.387e-01  8.022e+03  0.000  1.0000
## SpeciesCat32  2.163e+01  7.285e+03  0.003  0.9976
## SpeciesCat33  1.667e+01  7.285e+03  0.002  0.9982
## SpeciesCat34  1.837e+01  7.285e+03  0.003  0.9980
## SpeciesCat35  1.853e+01  7.285e+03  0.003  0.9980
## SpeciesCat36  5.396e-02  4.874e+04  0.000  1.0000
## SpeciesCat37  2.111e+01  7.285e+03  0.003  0.9977
## SpeciesCat38  4.190e-01  7.799e+03  0.000  1.0000
## SpeciesCat42  4.489e-01  8.342e+03  0.000  1.0000
## SpeciesCat43  1.987e+01  7.285e+03  0.003  0.9978
## SpeciesCat44  2.756e-01  1.663e+04  0.000  1.0000
## SpeciesCat45  5.646e-01  7.975e+03  0.000  0.9999
## SpeciesCat47  5.803e-01  1.619e+04  0.000  1.0000
## SpeciesCat52  2.006e-01  1.041e+04  0.000  1.0000
## SpeciesCat53  4.689e-01  1.290e+04  0.000  1.0000
## SpeciesCat54  4.818e-01  1.250e+04  0.000  1.0000
## SpeciesCat55  9.233e-02  1.144e+04  0.000  1.0000
## SpeciesCat56  3.047e-01  8.929e+03  0.000  1.0000
## SpeciesCat57  5.205e-01  8.188e+03  0.000  0.9999
## SpeciesCat76  5.903e-01  1.134e+04  0.000  1.0000
## SpeciesCat77  7.379e-01  4.874e+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: 233.73  on 3287  degrees of freedom
## Residual deviance: 160.02  on 3263  degrees of freedom
## AIC: 210.02
##
## Number of Fisher Scoring iterations: 21
```

The intercepts for the species categories are not coming up as significant at all. Recategorized fish according to the next level up for the ISSCAAP codes. Reclassifications are below:

Larger Categories for ISSCAAP Codes 22-24 = diadromous fishes = 2 31-35, 37 = marine fishes = 3 42-45,47 = crustaceans = 4 52-58 = molluscs = 5 74,76,77 = miscellaneous aquatic animals = 7

Rerun Logits with higher up species categories

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

## Warning: Missing column names filled in: 'X1' [1]
## Parsed with column specification:
## cols(
##   .default = col_character(),
##   X1 = col_integer(),
##   Year = col_integer(),
##   Biomass = col_double(),
##   Catch = col_integer(),
##   BvBmsy = col_double(),
##   FvFmsy = col_double(),
##   SpeciesCat.x = col_integer(),
##   Profits = col_double(),
##   MSY = col_double(),
##   Price = col_double(),
##   g = col_double(),
##   k = col_double(),
##   c = col_double(),
##   phi = col_double()
## )

## See spec(...) for full column specifications.

## Warning in rbind(names(probs), probs_f): number of columns of result is not
## a multiple of vector length (arg 1)

## Warning: 11 parsing failures.
## row # A tibble: 5 x 5 col      row    col      expected actual      file exp
## ... .....
## See problems(...) for more details.

fisheries_recent$itq[is.na(fisheries_recent$itq)] <- "FALSE"
fisheries_recent$ivq[is.na(fisheries_recent$ivq)] <- "FALSE"
fisheries_recent$iq[is.na(fisheries_recent$iq)] <- "FALSE"
fisheries_recent$turf[is.na(fisheries_recent$turf)] <- "FALSE"

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()
## )

fisheries_recent_generousturf_1 <- fisheries_recent %>%
  select(Country, assess_id_short, Year, CommName, Biomass, Catch, BvBmsy, FvFmsy, Dbase, SciName, IdLev)

colnames(fisheries_recent_generousturf_1) <- c("Country", "assess_id_short", "Year", "CommName", "Biomass", "Catch", "BvBmsy", "FvFmsy", "Dbase", "SciName", "IdLev")

fisheries_recent_generousturf <- merge(fisheries_recent_generousturf_1, turfs_edf_dt, by = c("Country", "assess_id_short"))

fisheries_recent_generousturf$turf[is.na(fisheries_recent_generousturf$turf)] <- "FALSE"
fisheries_recent_generousturf$itq[is.na(fisheries_recent_generousturf$itq)] <- "FALSE"
fisheries_recent_generousturf$ivq[is.na(fisheries_recent_generousturf$ivq)] <- "FALSE"
fisheries_recent_generousturf$iq[is.na(fisheries_recent_generousturf$iq)] <- "FALSE"

fisheries_recent_regression_1 <- fisheries_recent_generousturf %>%
  mutate(rightsbased = case_when(
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "1",
    itq == FALSE | iq == FALSE | ivq == FALSE ~ "0"
  )) %>%
  mutate(MainCat = case_when(
    SpeciesCat == 22 | SpeciesCat == 23 | SpeciesCat == 24 ~ "2",
    SpeciesCat == 31 | SpeciesCat == 32 | SpeciesCat == 33 | SpeciesCat == 34 | SpeciesCat == 35 | SpeciesCat == 36 | SpeciesCat == 37 ~ "3",
    SpeciesCat == 42 | SpeciesCat == 43 | SpeciesCat == 44 | SpeciesCat == 45 | SpeciesCat == 46 | SpeciesCat == 47 ~ "4",
    SpeciesCat == 52 | SpeciesCat == 53 | SpeciesCat == 54 | SpeciesCat == 55 | SpeciesCat == 56 | SpeciesCat == 57 ~ "5",
    SpeciesCat == 74 | SpeciesCat == 76 | SpeciesCat == 77 ~ "7"
  )) %>%
  select(Country, SciName, MainCat, rightsbased) %>%
  filter(MainCat != "NA")

gdp_all <- read_excel("data/un_gdp_2016.xls")

gdp <- gdp_all %>%
  select(Country, gdp_center) %>%
  filter(gdp_center != "NA")

merge_gdp_mc_rb <- merge(gdp, fisheries_recent_regression_1, by = c("Country"))

gdp_mc_rb <- filter(merge_gdp_mc_rb, MainCat != "NA")

gdp_mc_rb$MainCat <- factor(gdp_mc_rb$MainCat)
gdp_mc_rb$rightsbased <- as.numeric(gdp_mc_rb$rightsbased)

itq_glm_mc <- glm(formula = rightsbased ~ gdp_center + MainCat, family = "binomial", data = gdp_mc_rb)

itq_glm_mc

##
## Call:  glm(formula = rightsbased ~ gdp_center + MainCat, family = "binomial",
##          data = gdp_mc_rb)

```

```
##
## Coefficients:
## (Intercept)    gdp_center    MainCat3    MainCat4    MainCat5
##      -21.0840      0.8308      15.6562      16.3928      0.1010
##      MainCat7
##        0.3709
##
## Degrees of Freedom: 2976 Total (i.e. Null);  2971 Residual
## Null Deviance:      229.9
## Residual Deviance: 209.4      AIC: 221.4

summary(itq_glm_mc)

##
## Call:
## glm(formula = rightsbased ~ gdp_center + MainCat, family = "binomial",
##      data = gdp_mc_rb)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -0.5603  -0.1178  -0.0887  -0.0734   3.4024
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -21.0840   1872.2786  -0.011  0.99102
## gdp_center     0.8308     0.2287   3.633  0.00028 ***
## MainCat3      15.6562   1872.2786   0.008  0.99333
## MainCat4      16.3928   1872.2786   0.009  0.99301
## MainCat5       0.1010   2082.9637   0.000  0.99996
## MainCat7       0.3709   3632.8237   0.000  0.99992
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 229.94  on 2976  degrees of freedom
## Residual deviance: 209.35  on 2971  degrees of freedom
## AIC: 221.35
##
## Number of Fisher Scoring iterations: 19
```

Larger categories do not seem to make a difference

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

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

## Warning: Missing column names filled in: 'X1' [1]
## Parsed with column specification:
## cols(
##   .default = col_character(),
##   X1 = col_integer(),
##   Year = col_integer(),
```

```

## Biomass = col_double(),
## Catch = col_integer(),
## BvBmsy = col_double(),
## FvFmsy = col_double(),
## SpeciesCat.x = col_integer(),
## Profits = col_double(),
## MSY = col_double(),
## Price = col_double(),
## g = col_double(),
## k = col_double(),
## c = col_double(),
## phi = col_double()
## )

## See spec(...) for full column specifications.

## Warning in rbind(names(probs), probs_f): number of columns of result is not
## a multiple of vector length (arg 1)

## Warning: 11 parsing failures.
## row # A tibble: 5 x 5 col      row      col      expected actual      file exp
## ... .....
## See problems(...) for more details.

fisheries_recent$itq[is.na(fisheries_recent$itq)] <- "FALSE"
fisheries_recent$ivq[is.na(fisheries_recent$ivq)] <- "FALSE"
fisheries_recent$iq[is.na(fisheries_recent$iq)] <- "FALSE"
fisheries_recent$turf[is.na(fisheries_recent$turf)] <- "FALSE"

fisheries_recent_generousturf_1 <- fisheries_recent %>%
  select(Country, assess_id_short, Year, CommName, Biomass, Catch, BvBmsy, FvFmsy, Dbase, SciName, IdLev)

colnames(fisheries_recent_generousturf_1) <- c("Country", "assess_id_short", "Year", "CommName", "Biomass", "Catch", "BvBmsy", "FvFmsy", "Dbase", "SciName", "IdLev")

fisheries_recent_generousturf <- merge(fisheries_recent_generousturf_1, turfs_edf_dt, by = c("Country", "assess_id_short", "Year", "CommName", "Biomass", "Catch", "BvBmsy", "FvFmsy", "Dbase", "SciName", "IdLev"))

fisheries_recent_generousturf$turf[is.na(fisheries_recent_generousturf$turf)] <- "FALSE"
fisheries_recent_generousturf$itq[is.na(fisheries_recent_generousturf$itq)] <- "FALSE"
fisheries_recent_generousturf$ivq[is.na(fisheries_recent_generousturf$ivq)] <- "FALSE"
fisheries_recent_generousturf$iq[is.na(fisheries_recent_generousturf$iq)] <- "FALSE"

fisheries_recent_generousturf_rightsbased <- fisheries_recent_generousturf %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "1",
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "0"
  ))

gdp_all <- read_excel("data/un_gdp_2016.xls")

gdp <- gdp_all %>%
  select(Country, gdp_center) %>%
  filter(gdp_center != "NA")

join_gdp_rightsbased <- merge(gdp, fisheries_recent_generousturf_rightsbased, by = c("Country", "assess_id_short", "Year", "CommName", "Biomass", "Catch", "BvBmsy", "FvFmsy", "Dbase", "SciName", "IdLev"))

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

```

```

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

itq_turf_glm <- glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial", data = gdp_rightsbased)
itq_glm

##
## Call:  glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##      data = gdp_rightsbased)
##
## Coefficients:
## (Intercept)      gdp_center  SpeciesCat24  SpeciesCat25  SpeciesCat31
## -23.25301      0.65372      0.72199      0.57817      0.23871
## SpeciesCat32  SpeciesCat33  SpeciesCat34  SpeciesCat35  SpeciesCat36
##  21.62558     16.66962     18.37206     18.52555     0.05396
## SpeciesCat37  SpeciesCat38  SpeciesCat42  SpeciesCat43  SpeciesCat44
##  21.11106      0.41897      0.44894     19.86649     0.27557
## SpeciesCat45  SpeciesCat47  SpeciesCat52  SpeciesCat53  SpeciesCat54
##   0.56464      0.58032      0.20064      0.46886     0.48184
## SpeciesCat55  SpeciesCat56  SpeciesCat57  SpeciesCat76  SpeciesCat77
##   0.09233      0.30466      0.52054      0.59030     0.73787
##
## Degrees of Freedom: 3287 Total (i.e. Null);  3263 Residual
## Null Deviance:      233.7
## Residual Deviance: 160    AIC: 210

summary(itq_turf_glm)

##
## Call:
## glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##      data = gdp_rightsbased)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -2.65671  -0.00003   0.00005   0.45544   1.49233
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)    19.5241  17730.3686   0.001  0.9991
## gdp_center     -1.9748    0.9631  -2.050  0.0403 *
## SpeciesCat31     2.8040  25074.5288   0.000  0.9999
## SpeciesCat32   -40.3459  19823.1550  -0.002  0.9984
## SpeciesCat33   -15.5482  17730.3686  -0.001  0.9993
## SpeciesCat34   -18.3570  17730.3687  -0.001  0.9992
## SpeciesCat35   -18.3274  17730.3686  -0.001  0.9992
## SpeciesCat37   -16.8745  17730.3687  -0.001  0.9992
## SpeciesCat42     2.9090  19308.5707   0.000  0.9999
## SpeciesCat43   -19.6626  17730.3686  -0.001  0.9991
## SpeciesCat44     0.8975  25074.5286   0.000  1.0000
## SpeciesCat45     2.4163  19000.6267   0.000  0.9999
## SpeciesCat47     0.8975  25074.5286   0.000  1.0000
## SpeciesCat52     0.8975  25074.5288   0.000  1.0000

```

```
## SpeciesCat53      3.0872 21715.1786    0.000    0.9999
## SpeciesCat54      1.8394 19543.1278    0.000    0.9999
## SpeciesCat56      1.4260 19695.2349    0.000    0.9999
## SpeciesCat57      2.6784 19786.6083    0.000    0.9999
## SpeciesCat76      0.8975 25074.5286    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: 84.306  on 73  degrees of freedom
## Residual deviance: 30.618  on 55  degrees of freedom
## (3214 observations deleted due to missingness)
## AIC: 68.618
##
## Number of Fisher Scoring iterations: 19
```

The intercepts for the species categories are not coming up as significant at all. Recategorized fish according to the next level up for the ISSCAAP codes. Reclassifications are below:

Larger Categories for ISSCAAP Codes 22-24 = diadromous fishes = 2 31-35, 37 = marine fishes = 3 42-45,47 = crustaceans = 4 52-58 = molluscs = 5 74,76,77 = miscellaneous aquatic animals = 7

Rerun Logits with higher up species categories

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

```
## Warning: Missing column names filled in: 'X1' [1]
```

```
## Parsed with column specification:
```

```
## cols(
##   .default = col_character(),
##   X1 = col_integer(),
##   Year = col_integer(),
##   Biomass = col_double(),
##   Catch = col_integer(),
##   BvBmsy = col_double(),
##   FvFmsy = col_double(),
##   SpeciesCat.x = col_integer(),
##   Profits = col_double(),
##   MSY = col_double(),
##   Price = col_double(),
##   g = col_double(),
##   k = col_double(),
##   c = col_double(),
##   phi = col_double()
## )
```

```
## See spec(...) for full column specifications.
```

```
## Warning in rbind(names(probs), probs_f): number of columns of result is not
## a multiple of vector length (arg 1)
```

```
## Warning: 11 parsing failures.
```

```
## row # A tibble: 5 x 5 col      row      col      expected actual      file exp
## ... ..
```

```

## See problems(...) for more details.
fisheries_recent$itq[is.na(fisheries_recent$itq)] <- "FALSE"
fisheries_recent$ivq[is.na(fisheries_recent$ivq)] <- "FALSE"
fisheries_recent$iq[is.na(fisheries_recent$iq)] <- "FALSE"
fisheries_recent$turf[is.na(fisheries_recent$turf)] <- "FALSE"

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()
## )

fisheries_recent_generousturf_1 <- fisheries_recent %>%
  select(Country, assess_id_short, Year, CommName, Biomass, Catch, BvBmsy, FvFmsy, Dbase, SciName, IdLev)

colnames(fisheries_recent_generousturf_1) <- c("Country", "assess_id_short", "Year", "CommName", "Biomass", "Catch", "BvBmsy", "FvFmsy", "Dbase", "SciName", "IdLev")

fisheries_recent_generousturf <- merge(fisheries_recent_generousturf_1, turfs_edf_dt, by = c("Country", "assess_id_short"))

fisheries_recent_generousturf$turf[is.na(fisheries_recent_generousturf$turf)] <- "FALSE"
fisheries_recent_generousturf$itq[is.na(fisheries_recent_generousturf$itq)] <- "FALSE"
fisheries_recent_generousturf$ivq[is.na(fisheries_recent_generousturf$ivq)] <- "FALSE"
fisheries_recent_generousturf$iq[is.na(fisheries_recent_generousturf$iq)] <- "FALSE"

fisheries_recent_turf_i_mc <- fisheries_recent_generousturf %>%
  mutate(rightsbased = case_when(
    turf == TRUE ~ "1",
    itq == TRUE | iq == TRUE | ivq == TRUE ~ "0"
  )) %>%
  mutate(MainCat = case_when(
    SpeciesCat == 22 | SpeciesCat == 23 | SpeciesCat == 24 ~ "2",
    SpeciesCat == 31 | SpeciesCat == 32 | SpeciesCat == 33 | SpeciesCat == 34 | SpeciesCat == 35 | SpeciesCat == 36 | SpeciesCat == 37 ~ "3",
    SpeciesCat == 42 | SpeciesCat == 43 | SpeciesCat == 44 | SpeciesCat == 45 | SpeciesCat == 46 | SpeciesCat == 47 ~ "4",
    SpeciesCat == 52 | SpeciesCat == 53 | SpeciesCat == 54 | SpeciesCat == 55 | SpeciesCat == 56 | SpeciesCat == 57 ~ "5",
    SpeciesCat == 74 | SpeciesCat == 76 | SpeciesCat == 77 ~ "7"
  )) %>%
  select(Country, SciName, MainCat, rightsbased) %>%
  filter(MainCat != "NA")

gdp_all <- read_excel("data/un_gdp_2016.xls")

gdp <- gdp_all %>%
  select(Country, gdp_center) %>%
  filter(gdp_center != "NA")

```



```

join_gdp_turf_i_mc <- merge(gdp, fisheries_recent_turf_i_mc, by = c("Country"))

gdp_turf_i_mc <- filter(join_gdp_turf_i_mc, MainCat != "NA" )

gdp_turf_i_mc$MainCat <- factor(gdp_turf_i_mc$MainCat)
gdp_turf_i_mc$rightsbased <- as.numeric(gdp_turf_i_mc$rightsbased)

turf_itq_mc_glm <- glm(formula = rightsbased ~ gdp_center + MainCat, family = "binomial", data = gdp_turf_i_mc)
turf_itq_mc_glm

##
## Call:  glm(formula = rightsbased ~ gdp_center + MainCat, family = "binomial",
##      data = gdp_turf_i_mc)
##
## Coefficients:
## (Intercept)    gdp_center    MainCat3    MainCat4    MainCat5
##      18.2663     -0.5681    -17.1565    -17.2261     0.5635
##      MainCat7
##      0.2582
##
## Degrees of Freedom: 73 Total (i.e. Null);  68 Residual
## (2903 observations deleted due to missingness)
## Null Deviance:      84.31
## Residual Deviance: 71.08    AIC: 83.08

summary(turf_itq_mc_glm)

##
## Call:
## glm(formula = rightsbased ~ gdp_center + MainCat, family = "binomial",
##      data = gdp_turf_i_mc)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.7798  -0.9451   0.6731   0.9343   1.1082
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   18.2663   6522.6388   0.003   0.998
## gdp_center    -0.5681    0.4789  -1.186   0.236
## MainCat3     -17.1565   6522.6389  -0.003   0.998
## MainCat4     -17.2261   6522.6389  -0.003   0.998
## MainCat5       0.5635   6732.3040   0.000   1.000
## MainCat7       0.2582   9224.4041   0.000   1.000
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 84.306  on 73  degrees of freedom
## Residual deviance: 71.085  on 68  degrees of freedom
## (2903 observations deleted due to missingness)
## AIC: 83.085
##
## Number of Fisher Scoring iterations: 17

```

MPA New Costello Data

These MPAs are at least partially no-take but some of the percentages are very low

```
mpa_costello_data <- read_excel("data/mpa_costello_data.xlsx")
```

```
##Choose only MPAs that have some no take
```

```
mpa_no_take <- mpa_costello_data %>%  
  filter(no_take == "1")
```

```
mpa_no_take_10 <- top_n(mpa_no_take, 10, mpa_area)  
mpa_no_take_10
```

```
## # A tibble: 10 x 9
```

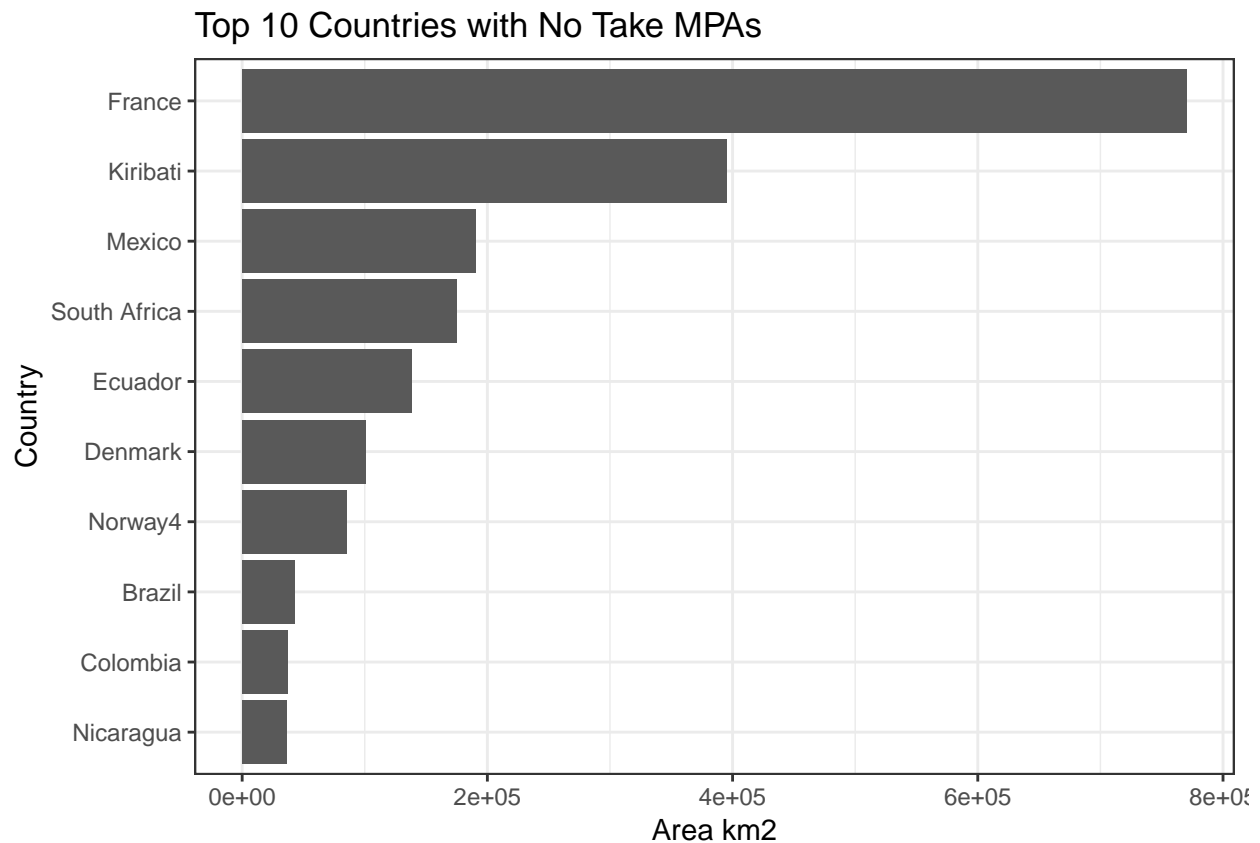
```
##       Country land_area coastline      eez mpa_area no_take_area  
##       <chr>      <dbl>      <chr>    <dbl>    <dbl>      <dbl>  
## 1      Brazil  8515770      7491  3677599  42674.20    565.20  
## 2    Colombia  1138910      3208   728664  37333.77   11513.18  
## 3     Denmark    43094      7314  2640568 100824.34    5370.62  
## 4     Ecuador  283561      2237  1096362 138423.77   47172.28  
## 5       France  643801      3427 10070572 770512.70  120545.11  
## 6     Kiribati     811      1143  3439933 395389.00  395389.00  
## 7       Mexico 1964375      9330  3186922 190365.68  147972.76  
## 8    Nicaragua  130370       910   228255  36011.33    5329.94  
## 9      Norway4   323802     25148  2464161  85275.88   59326.67  
## 10 South Africa 1219090      2798  1547609 174832.89    4846.42
```

```
## # ... with 3 more variables: percent_mpa <dbl>, percent_no_take <dbl>,  
## #   no_take <dbl>
```

```
##all countries
```

```
mpa_no_take_10$Country <- factor(mpa_no_take_10$Country, levels = mpa_no_take_10$Country[order(mpa_no_t
```

```
ggplot(mpa_no_take_10, aes(x = Country, y = mpa_area)) +  
  geom_bar(stat = "identity")+  
  ggtitle("Top 10 Countries with No Take MPAs")+  
  coord_flip()+  
  theme_bw()+  
  ylab("Area km2")
```



These are the countries with the highest area of no-take

```
mpa_costello_data <- read_excel("data/mpa_costello_data.xlsx")
```

```
##Choose only MPAs that have some no take
```

```
mpa_no_take <- mpa_costello_data %>%  
  filter(no_take == "1")
```

```
mpa_no_take_area_10 <- top_n(mpa_no_take, 10, no_take_area)
```

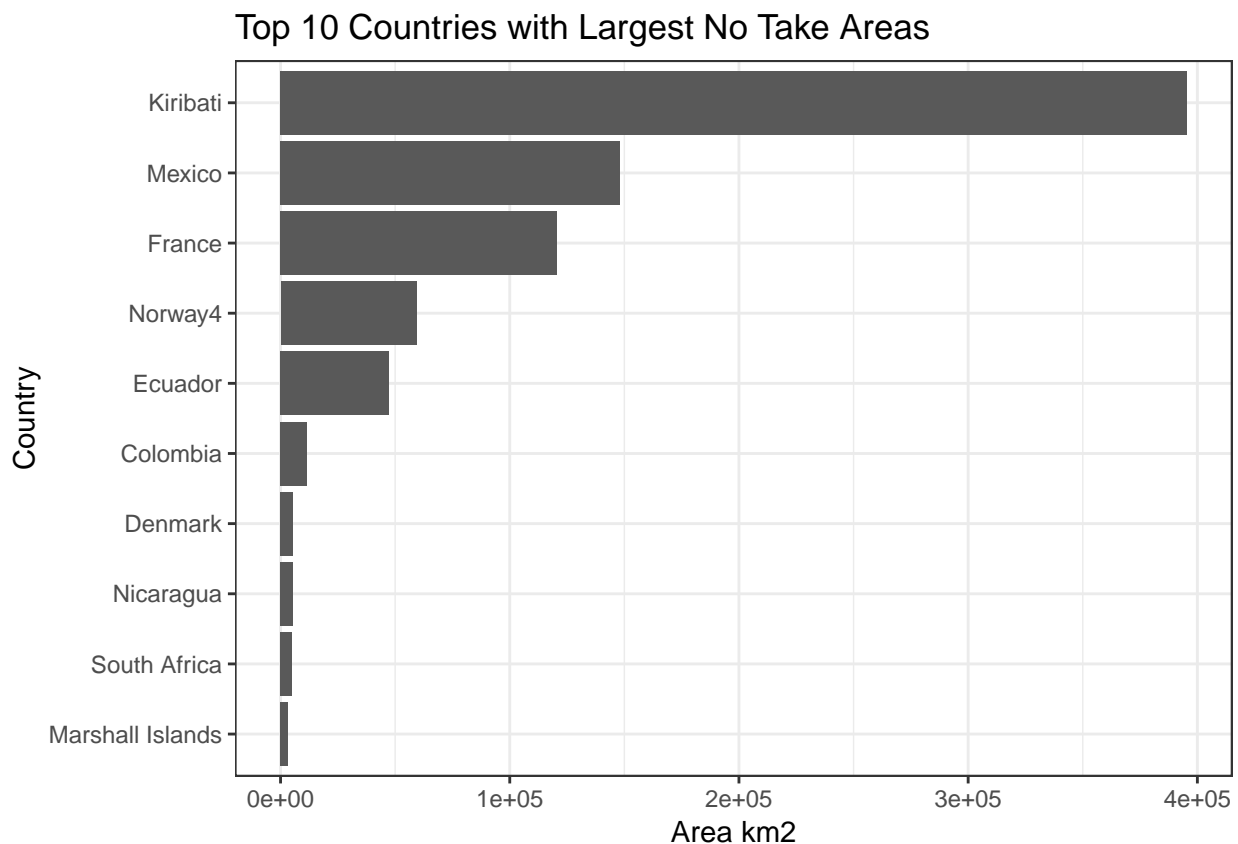
```
mpa_no_take_area_10
```

```
## # A tibble: 10 x 9
```

```
##       Country land_area coastline      eez  mpa_area no_take_area  
##       <chr>      <dbl>      <chr>    <dbl>    <dbl>      <dbl>  
## 1  Colombia  1138910      3208  728664  37333.77  11513.18  
## 2  Denmark    43094       7314 2640568 100824.34   5370.62  
## 3  Ecuador   283561      2237 1096362 138423.77  47172.28  
## 4  France    643801      3427 10070572 770512.70 120545.11  
## 5  Kiribati     811       1143 3439933 395389.00 395389.00  
## 6 Marshall Islands 181        370 2001410   3338.81   3338.81  
## 7  Mexico   1964375      9330 3186922 190365.68 147972.76  
## 8  Nicaragua  130370       910  228255  36011.33   5329.94  
## 9  Norway4   323802     25148 2464161  85275.88  59326.67  
## 10 South Africa 1219090      2798 1547609 174832.89  4846.42  
## # ... with 3 more variables: percent_mpa <dbl>, percent_no_take <dbl>,  
## #   no_take <dbl>
```

```
##all countries
mpa_no_take_area_10$Country <- factor(mpa_no_take_area_10$Country, levels = mpa_no_take_area_10$Country)

ggplot(mpa_no_take_area_10, aes(x = Country, y = no_take_area)) +
  geom_bar(stat = "identity")+
  ggtitle("Top 10 Countries with Largest No Take Areas")+
  coord_flip()+
  theme_bw()+
  ylab("Area km2")
```



Estimates of lost global economic value from lack of management

1. Costello et al 2016 2050

- RBFM policy applied to just stocks of conservation concern = \$31 billion in fisheries profit
- RBFM policy applied to all stocks = \$53 billion in fisheries profit

2. Original Sunken Billions (2009)

- “current annual net benefits from marine capture fisheries are tens of billions of U.S. dollars less than the potential benefits”

```
include_graphics("sunkenbillionstable.png")
```

Table 4.2 Estimates of the Economic Losses from Global Marine Fisheries		
Source	Estimate of losses	Drivers/focus of proposed solutions
FAO 1993	\$54 aggregate loss, or approximately 75 percent of the gross revenue	Open access, subsidies
Garcia and Newton 1997	\$46 billion deficit	Overcapacity, loss of high-value species
Sanchirico and Wilen 2002	\$90 billion (future projection)	Rents in ITQ fisheries approach 60–70 percent of gross revenues.
Wilen 2005	\$80 billion	Secure tenure
World Bank (this study)	\$51 billion	Comprehensive governance reform

3. Updated Sunken Billions (2012)

- economic losses of about \$83 billion