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Contents

KOBE Plots with only most recent year of fisheries

RAM only

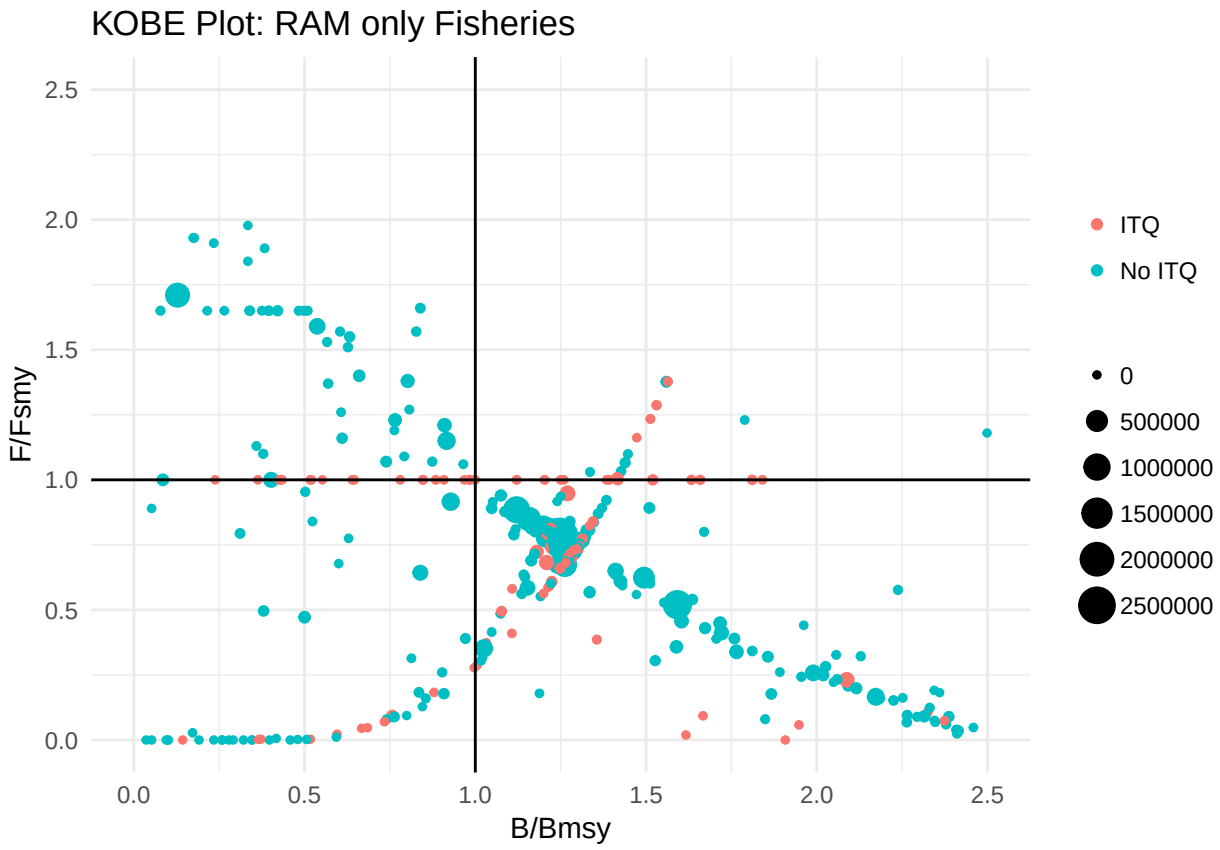
No data: ITQ = FALSE

```
#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")

#assuming that when no data is avaliable 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"
```

```
#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"

ggplot(data = fisheries_KOBE_ram, 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(0, 2.5)+
  xlim(0, 2.5)+
  geom_hline(aes(yintercept=1))+
  geom_vline(aes(xintercept=1))+
  ggtitle("KOBE Plot: RAM only Fisheries")
```

```
## Warning: Removed 44 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/Fsmy") +
  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")
```

Total Catch: Most recent year for each fishery

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

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

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

```
#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] 174065.5
```

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

```
## [1] 3874741
```

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

```
## [1] 66155763
```

turf = 174,065.5 = 0.248% of total catch itq = 3,874,741 = 5.5% of total catch no itq = 66,155,763 = 94.23% of total catch Total = 70,204,569.5

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")

#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.x,SciName, Ca

#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] 1643571
```

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

```
## [1] 3874741
```

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

```
## [1] 64815841
```

Generous Turf Catch Estimates:

turf = 1,643,571 -> 2.3% global catch itq= 3,874,741 -> 5.5% global catch no itq = 64,815,841 -> 92.1% global catch

Total: 70,334,153

Logit regressions

- new UN GDP data, 2016 only
- Scaled GDPs

Probablity of itq = f(ISSCAPP and GDP)

```r
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.x, CommName, Biomass, Catch, BvBmsy, FvFmsy, Dbase, SciName, Idl

colnames(fisheries_recent_generousturf_1) <- c("Country", "assess_id_short", "Year", "CommName", "Biomas
fisheries_recent_generousturf <- merge(fisheries_recent_generousturf_1, turfs_edf_dt, by = c("Country",

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)
```

```r
itq_glm <- glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial", data = gdp_rightsba
itq_glm
```

```
##
## Call:  glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##     data = gdp_rightsbased)
##
## Coefficients:
##  (Intercept)    gdp_center  SpeciesCat21  SpeciesCat23  SpeciesCat24
##    -22.38871       1.17283       1.48334      -0.50172       0.72629
## SpeciesCat25  SpeciesCat31  SpeciesCat32  SpeciesCat33  SpeciesCat34
##      0.31783      -0.27485      20.53283      16.57917      18.53260
## SpeciesCat35  SpeciesCat36  SpeciesCat37  SpeciesCat38  SpeciesCat42
##     16.51380      -0.31297      19.25749       0.08795      16.70121
## SpeciesCat43  SpeciesCat44  SpeciesCat45  SpeciesCat47  SpeciesCat52
##     18.61606       0.02175       0.34586       0.55252      -0.20077
## SpeciesCat53  SpeciesCat54  SpeciesCat55  SpeciesCat56  SpeciesCat57
##      0.21062       0.01714      -0.49057      -0.06732       0.33176
## SpeciesCat76  SpeciesCat77
##      0.23477       0.91402
##
## Degrees of Freedom: 4059 Total (i.e. Null);  4033 Residual
## Null Deviance:       521.5
## Residual Deviance: 357.9     AIC: 411.9
```

```r
summary(itq_glm)
```

```
##
## Call:
## glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##     data = gdp_rightsbased)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -1.3283  -0.1017  -0.0568   0.0000   3.5618
##
## Coefficients:
##                Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -2.239e+01  5.419e+03  -0.004    0.997
## gdp_center    1.173e+00  1.766e-01   6.640 3.14e-11 ***
## SpeciesCat21  1.483e+00  2.137e+04   0.000    1.000
## SpeciesCat23 -5.017e-01  6.435e+03   0.000    1.000
## SpeciesCat24  7.263e-01  6.817e+03   0.000    1.000
## SpeciesCat25  3.178e-01  7.543e+03   0.000    1.000
## SpeciesCat31 -2.748e-01  5.671e+03   0.000    1.000
## SpeciesCat32  2.053e+01  5.419e+03   0.004    0.997
## SpeciesCat33  1.658e+01  5.419e+03   0.003    0.998
## SpeciesCat34  1.853e+01  5.419e+03   0.003    0.997
## SpeciesCat35  1.651e+01  5.419e+03   0.003    0.998
## SpeciesCat36 -3.130e-01  2.973e+04   0.000    1.000
## SpeciesCat37  1.926e+01  5.419e+03   0.004    0.997
## SpeciesCat38  8.795e-02  5.613e+03   0.000    1.000
## SpeciesCat42  1.670e+01  5.419e+03   0.003    0.998
## SpeciesCat43  1.862e+01  5.419e+03   0.003    0.997
```

```
## SpeciesCat44  2.175e-02  9.138e+03   0.000    1.000
## SpeciesCat45  3.459e-01  5.684e+03   0.000    1.000
## SpeciesCat47  5.525e-01  9.930e+03   0.000    1.000
## SpeciesCat52 -2.008e-01  6.834e+03   0.000    1.000
## SpeciesCat53  2.106e-01  7.236e+03   0.000    1.000
## SpeciesCat54  1.714e-02  7.104e+03   0.000    1.000
## SpeciesCat55 -4.906e-01  7.058e+03   0.000    1.000
## SpeciesCat56 -6.732e-02  6.085e+03   0.000    1.000
## SpeciesCat57  3.318e-01  5.782e+03   0.000    1.000
## SpeciesCat76  2.348e-01  7.065e+03   0.000    1.000
## SpeciesCat77  9.140e-01  2.973e+04   0.000    1.000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 521.45  on 4059  degrees of freedom
## Residual deviance: 357.91  on 4033  degrees of freedom
## AIC: 411.91
##
## Number of Fisher Scoring iterations: 20
```

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 11,13 = freshwater fish = 1 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")
```

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

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

```
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"
```

```r
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()
## )
```

```r
fisheries_recent_generousturf_1 <- fisheries_recent %>%
  select(Country, assess_id_short, Year.x, CommName, Biomass, Catch, BvBmsy, FvFmsy, Dbase, SciName, Idl

colnames(fisheries_recent_generousturf_1) <- c("Country", "assess_id_short", "Year", "CommName", "Biomas

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

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 == 11 | SpeciesCat == 13 ~ "1",
    SpeciesCat == 22 | SpeciesCat == 23 | SpeciesCat == 24 ~ "2",
    SpeciesCat == 31 | SpeciesCat == 32 | SpeciesCat == 33 | SpeciesCat == 34 | SpeciesCat     == 35 | S
    SpeciesCat == 42 | SpeciesCat == 43 | SpeciesCat == 44 | SpeciesCat == 45 | SpeciesCat      == 47 ~
    SpeciesCat == 52 | SpeciesCat == 53 | SpeciesCat ==54 |  SpeciesCat == 55 | SpeciesCat     == 56 | S
    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"))
```

```r
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     MainCat2     MainCat3     MainCat4
##   -21.41218      1.20618     -0.12889     16.55515     16.55837
##    MainCat5     MainCat7
##     0.05377      0.25376
##
## Degrees of Freedom: 3666 Total (i.e. Null);  3660 Residual
## Null Deviance:       511.6
## Residual Deviance: 434.2     AIC: 448.2
```

```r
summary(itq_glm_mc)
```

```
##
## Call:
## glm(formula = rightsbased ~ gdp_center + MainCat, family = "binomial",
##     data = gdp_mc_rb)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -0.9294  -0.1647  -0.1041  -0.0870   3.2804
##
## Coefficients:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -21.41218 3267.67067  -0.007    0.995
## gdp_center     1.20618    0.15294   7.887 3.11e-15 ***
## MainCat2      -0.12889 3628.31482   0.000    1.000
## MainCat3      16.55515 3267.67067   0.005    0.996
## MainCat4      16.55837 3267.67068   0.005    0.996
## MainCat5       0.05377 3362.19455   0.000    1.000
## MainCat7       0.25376 4232.63507   0.000    1.000
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 511.62  on 3666  degrees of freedom
## Residual deviance: 434.17  on 3660  degrees of freedom
## AIC: 448.17
##
## Number of Fisher Scoring iterations: 19
```

Larger categories do not seem to make a difference

Run Turf versus ITQ probably: prob(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")
```

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

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

```
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.x, CommName, Biomass, Catch, BvBmsy, FvFmsy, Dbase, SciName, Id

colnames(fisheries_recent_generousturf_1) <- c("Country", "assess_id_short", "Year", "CommName", "Biomas

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

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")
```

```r
join_gdp_rightsbased <- merge(gdp, fisheries_recent_generousturf_rightsbased, by = c("Country"))

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_ri
itq_glm
```

```
##
## Call:  glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##     data = gdp_rightsbased)
##
## Coefficients:
##  (Intercept)    gdp_center  SpeciesCat21  SpeciesCat23  SpeciesCat24
##    -22.38871       1.17283       1.48334      -0.50172       0.72629
## SpeciesCat25  SpeciesCat31  SpeciesCat32  SpeciesCat33  SpeciesCat34
##      0.31783      -0.27485      20.53283      16.57917      18.53260
## SpeciesCat35  SpeciesCat36  SpeciesCat37  SpeciesCat38  SpeciesCat42
##     16.51380      -0.31297      19.25749       0.08795      16.70121
## SpeciesCat43  SpeciesCat44  SpeciesCat45  SpeciesCat47  SpeciesCat52
##     18.61606       0.02175       0.34586       0.55252      -0.20077
## SpeciesCat53  SpeciesCat54  SpeciesCat55  SpeciesCat56  SpeciesCat57
##      0.21062       0.01714      -0.49057      -0.06732       0.33176
## SpeciesCat76  SpeciesCat77
##      0.23477       0.91402
##
## Degrees of Freedom: 4059 Total (i.e. Null);  4033 Residual
## Null Deviance:       521.5
## Residual Deviance: 357.9     AIC: 411.9
```

```r
summary(itq_turf_glm)
```

```
##
## Call:
## glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##     data = gdp_rightsbased)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -2.70647  -0.33636   0.00005   0.37282   2.30684
##
## Coefficients:
##                Estimate Std. Error z value Pr(>|z|)
## (Intercept)     18.6216 10754.0129   0.002  0.99862
## gdp_center      -1.7900     0.6721  -2.663  0.00773 **
## SpeciesCat31     2.5416 13170.9222   0.000  0.99985
## SpeciesCat32   -19.0878 10754.0129  -0.002  0.99858
## SpeciesCat33   -15.8633 10754.0130  -0.001  0.99882
## SpeciesCat34   -19.6128 10754.0130  -0.002  0.99854
## SpeciesCat35   -17.4839 10754.0130  -0.002  0.99870
## SpeciesCat37   -15.7553 10754.0130  -0.001  0.99883
```

```
## SpeciesCat42   -15.6175 10754.0130  -0.001  0.99884
## SpeciesCat43   -18.9135 10754.0130  -0.002  0.99860
## SpeciesCat44     0.8135 15208.4709   0.000  0.99996
## SpeciesCat45     2.5266 11403.4582   0.000  0.99982
## SpeciesCat47     1.3746 13093.8373   0.000  0.99992
## SpeciesCat52     0.8135 15208.4709   0.000  0.99996
## SpeciesCat53     2.7983 13170.9222   0.000  0.99983
## SpeciesCat54     1.6238 11872.2555   0.000  0.99989
## SpeciesCat55     0.8135 15208.4709   0.000  0.99996
## SpeciesCat56     1.6796 11684.9203   0.000  0.99989
## SpeciesCat57     2.4225 12002.5912   0.000  0.99984
## SpeciesCat76     0.8135 15208.4709   0.000  0.99996
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 151.845  on 110  degrees of freedom
## Residual deviance:  61.797  on  91  degrees of freedom
##   (3949 observations deleted due to missingness)
## AIC: 101.8
##
## Number of Fisher Scoring iterations: 18
```

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 11,13 = freshwater fish = 1 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")
```

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

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

```r
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()
## )
```

```r
fisheries_recent_generousturf_1 <- fisheries_recent %>%
  select(Country, assess_id_short, Year.x, CommName, Biomass, Catch, BvBmsy, FvFmsy, Dbase, SciName, Idl

colnames(fisheries_recent_generousturf_1) <- c("Country", "assess_id_short", "Year", "CommName", "Biomas

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

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 == 11 | SpeciesCat == 13 ~ "1",
    SpeciesCat == 22 | SpeciesCat == 23 | SpeciesCat == 24 ~ "2",
    SpeciesCat == 31 | SpeciesCat == 32 | SpeciesCat == 33 | SpeciesCat == 34 | SpeciesCat     == 35 | S
    SpeciesCat == 42 | SpeciesCat == 43 | SpeciesCat == 44 | SpeciesCat == 45 | SpeciesCat      == 47 ~
    SpeciesCat == 52 | SpeciesCat == 53 | SpeciesCat ==54 |  SpeciesCat == 55 | SpeciesCat     == 56 | S
    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")
```

```r
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_tu
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
##     17.6993      -1.6428     -16.4036     -16.0726       1.7272
##    MainCat7
##      0.7466
##
## Degrees of Freedom: 110 Total (i.e. Null);  105 Residual
##   (3556 observations deleted due to missingness)
## Null Deviance:       151.8
## Residual Deviance: 108.1     AIC: 120.1
```

```r
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
## -2.06357  -0.78263   0.00008   0.84061   1.63252
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   17.6993  6522.6387   0.003 0.997835
## gdp_center    -1.6428     0.4463  -3.681 0.000233 ***
## MainCat3     -16.4036  6522.6387  -0.003 0.997993
## MainCat4     -16.0726  6522.6388  -0.002 0.998034
## MainCat5       1.7272  6684.2500   0.000 0.999794
## MainCat7       0.7466  9224.4041   0.000 0.999935
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 151.85  on 110  degrees of freedom
## Residual deviance: 108.10  on 105  degrees of freedom
##   (3556 observations deleted due to missingness)
## AIC: 120.1
```

```
##
## Number of Fisher Scoring iterations: 17
```

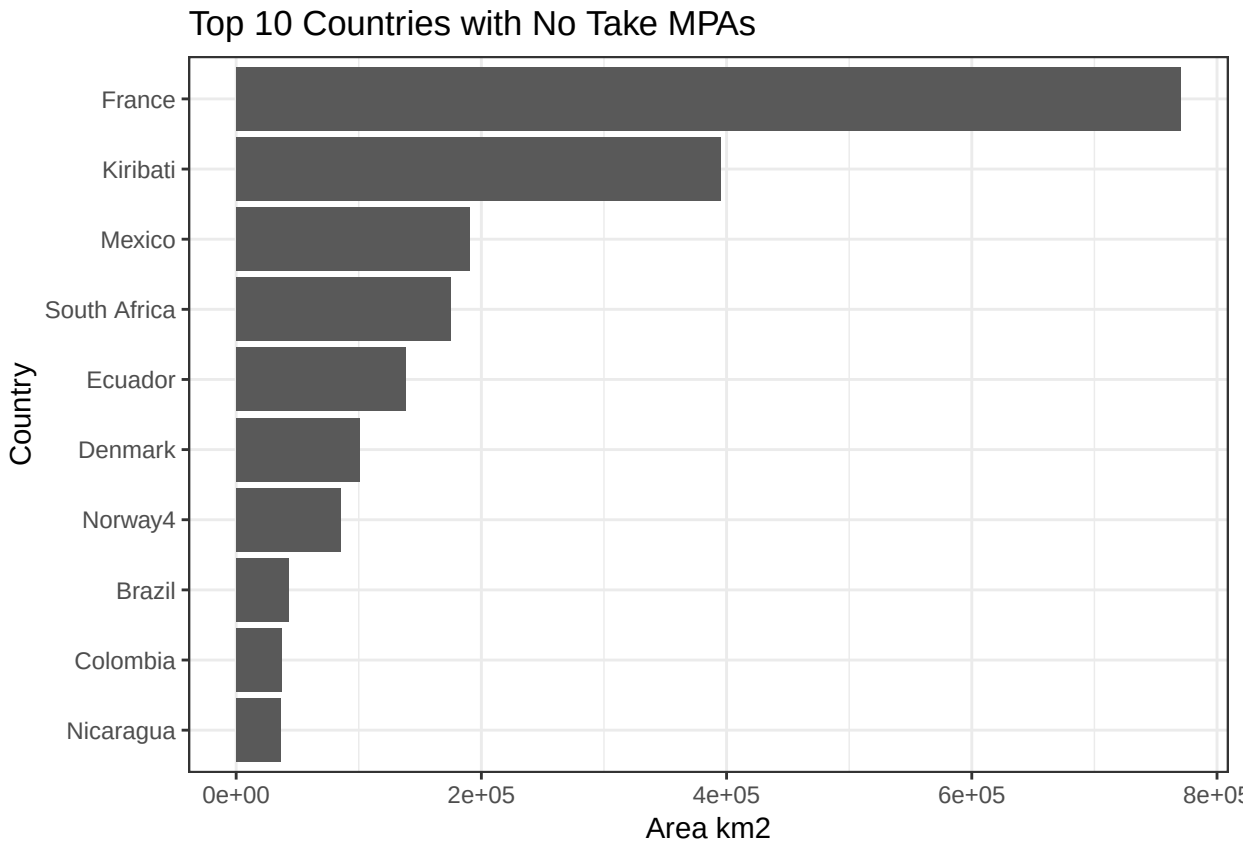
MPA New Costello Data

These MPAs are at least partitally 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_ta

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")
```

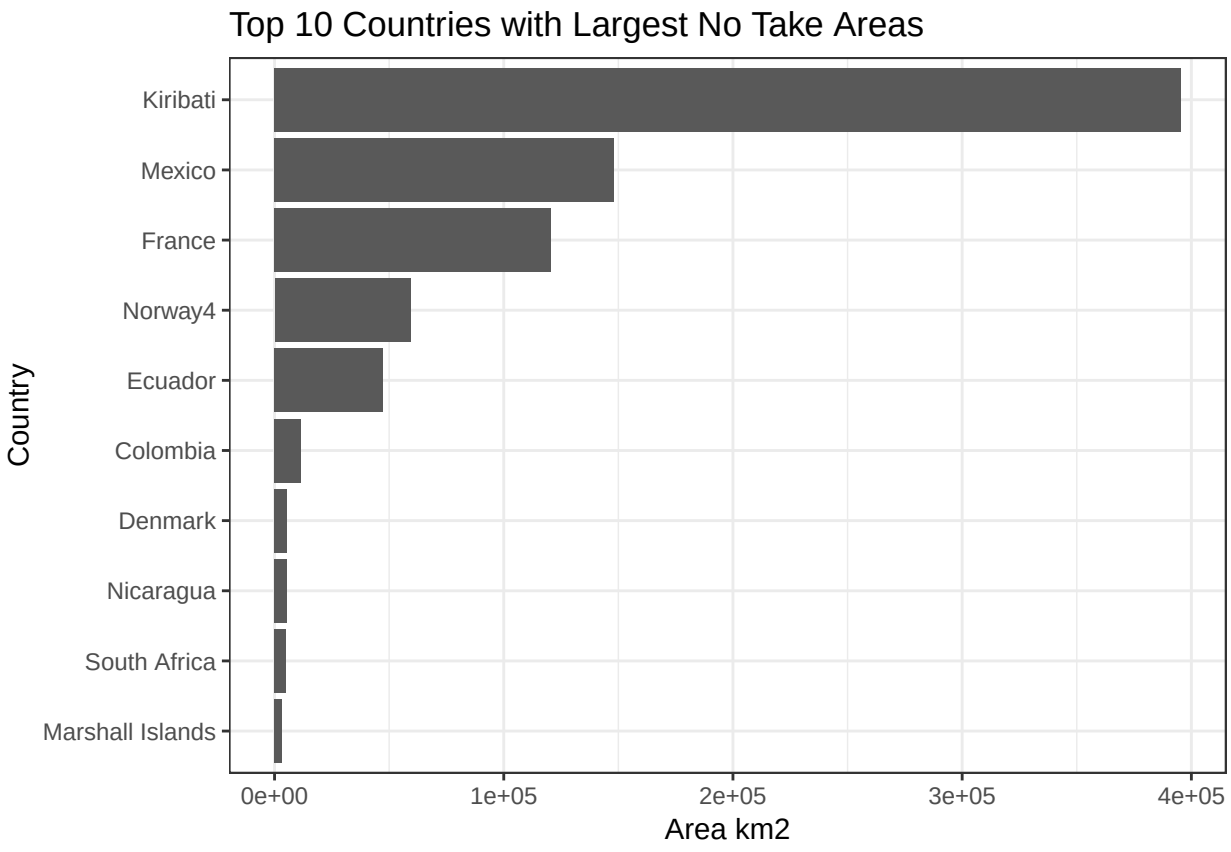


These are the countries with the highest area of no-take

```
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 managemnet

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