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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")
```

```
## 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)
```

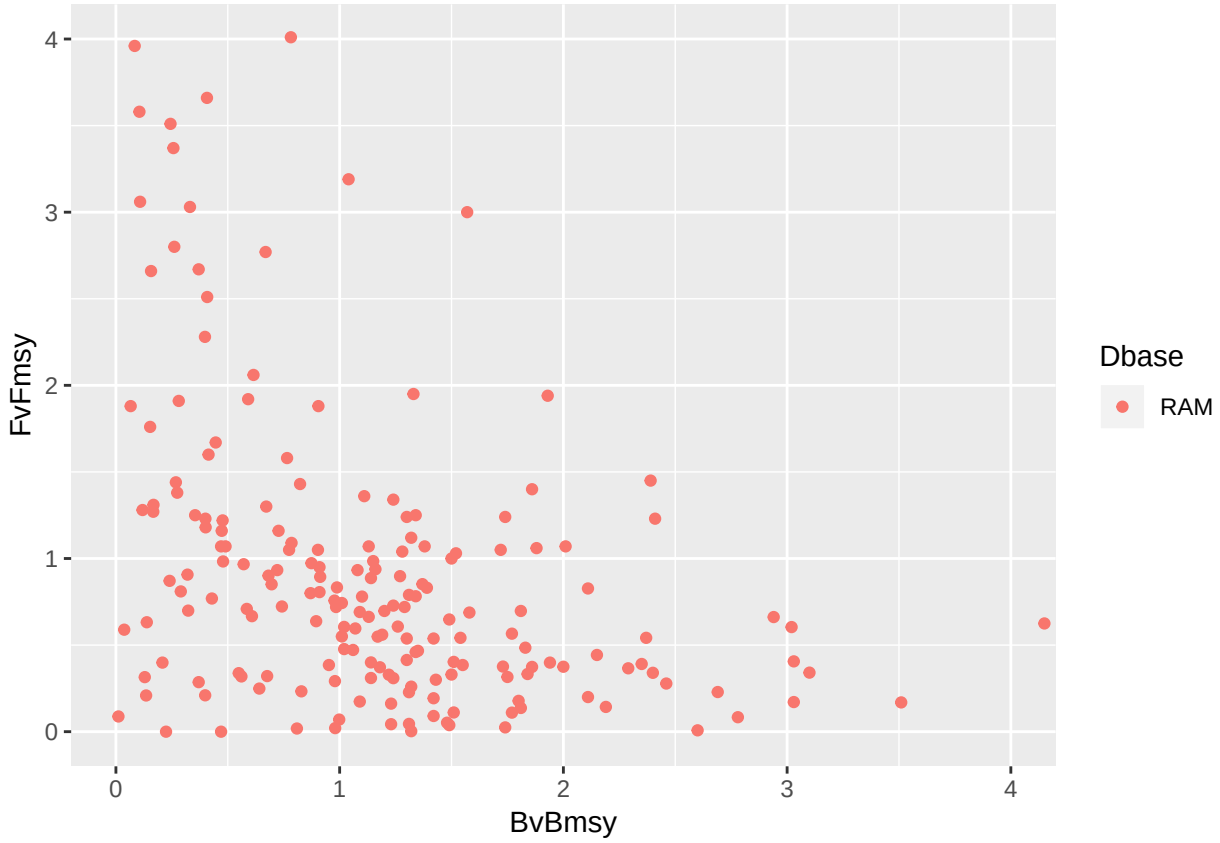
```
## Warning: 11 parsing failures.
## row # A tibble: 5 x 5 col     row   col               expected actual                         file ex
## ... ................. ... ..................................................................... ..
## See problems(...) for more details.
```

```
#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"

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()
```

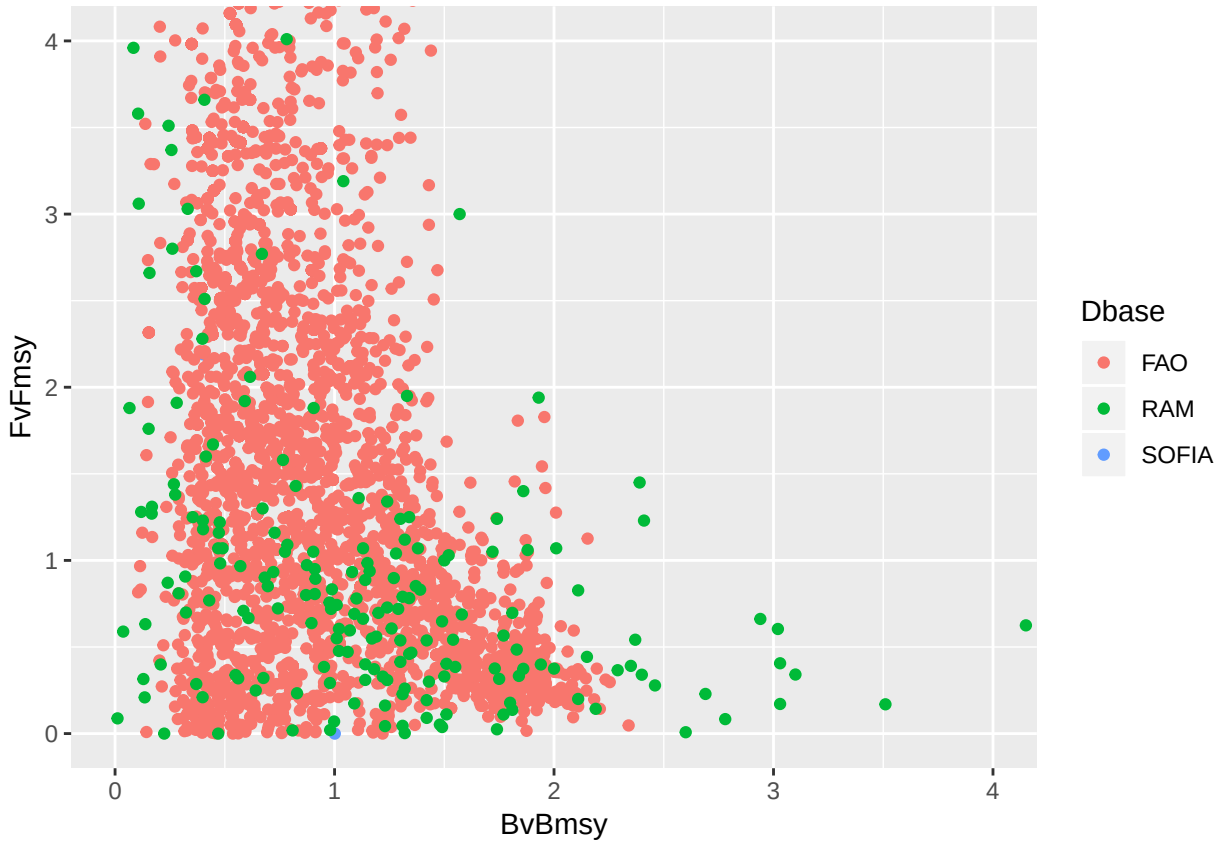
```
a
```

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




```
b
```

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

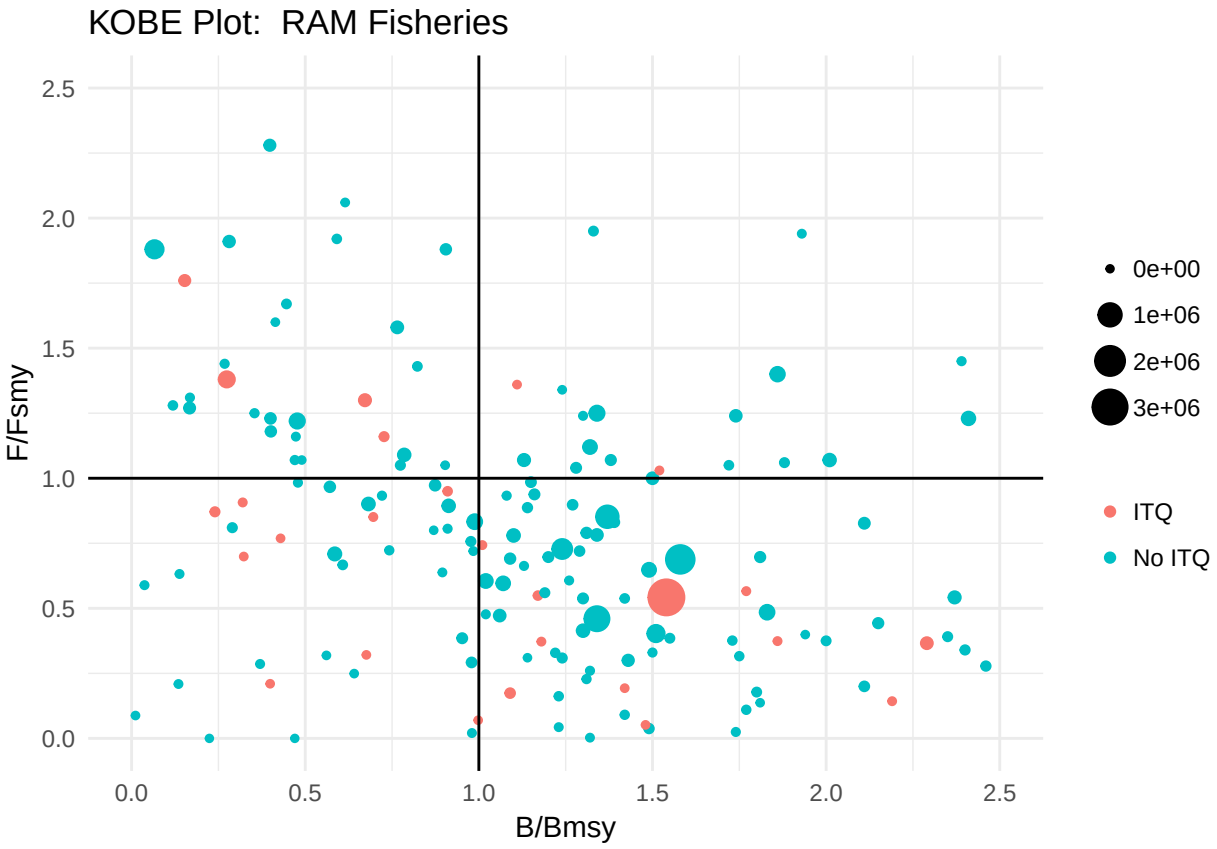



```
#median F and B values
dbase_median <- fisheries_recent %>%
  select(BvBmsy,FvFmsy, Dbase) %>%
    group_by(Dbase) %>%
    na.omit() %>%
    summarise_each(funs(median)) %>%
    ggplot()+
    geom_point(aes(x=BvBmsy, y=FvFmsy, colour=Dbase))


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/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 Fisheries")

F_B_graph_ram
```

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



KOBE Plots with only most recent year of fisheries

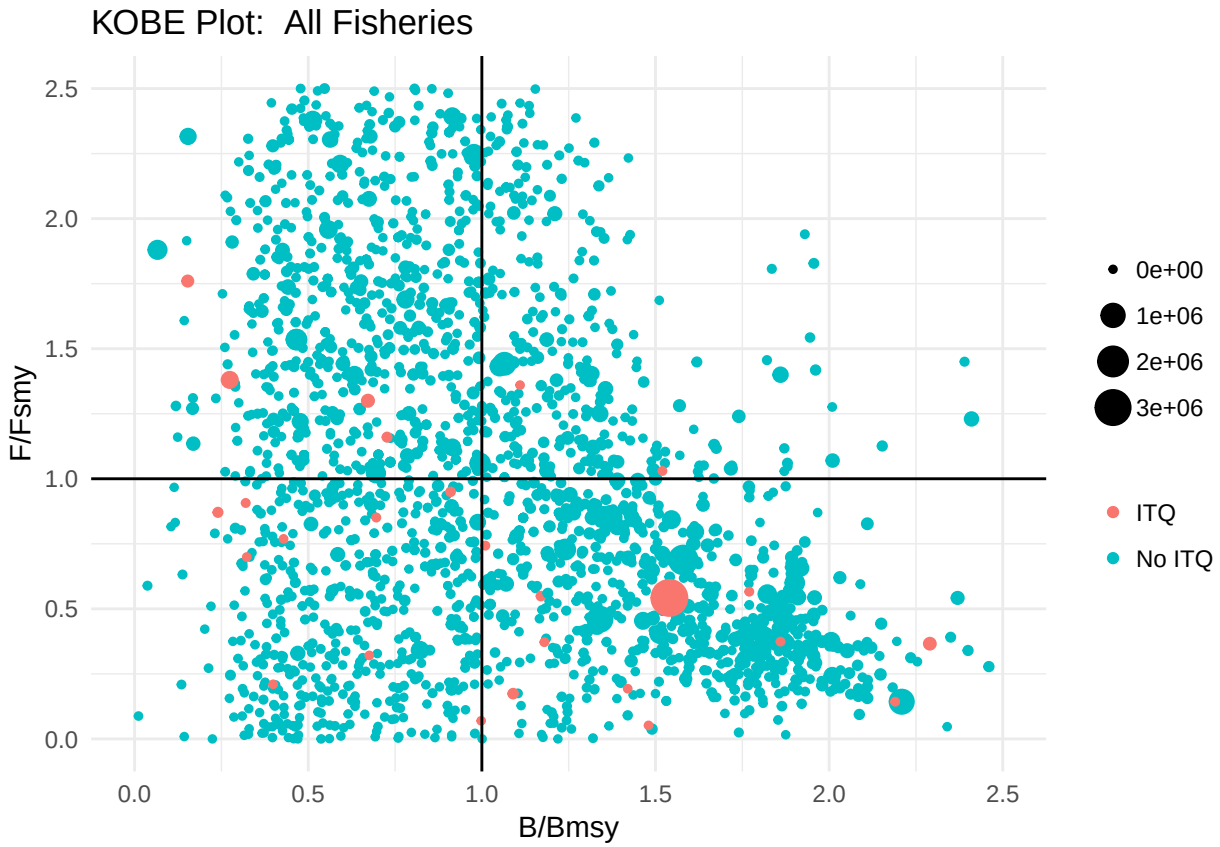
All Data Sources

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/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")

F_B_graph
```

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

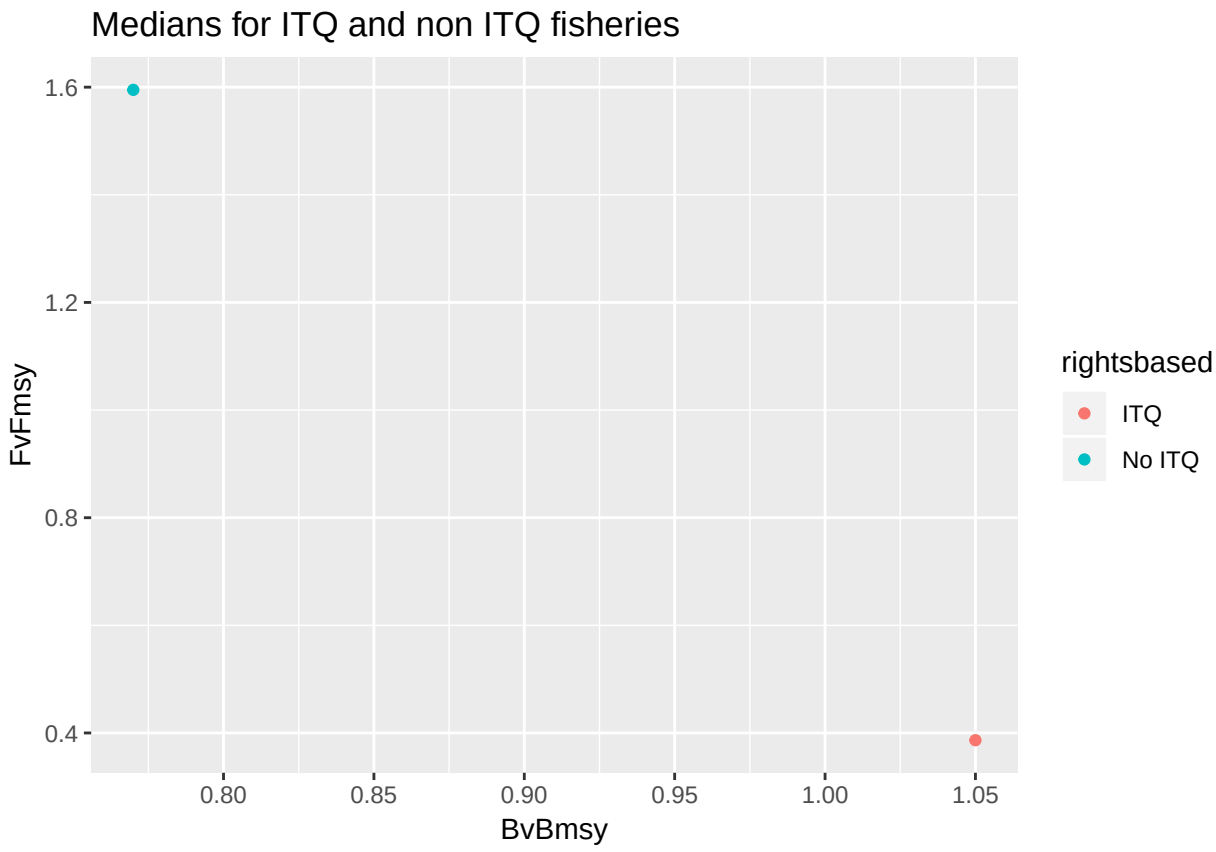



```
itq_median <- fisheries_KOBE %>%
  select(BvBmsy,FvFmsy, rightsbased) %>%
  group_by(rightsbased) %>%
    na.omit() %>%
    summarise_each(funs(median)) %>%
    ggplot()+
```

```
    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 ex
## ... ................. ... ..................................................................... ..
## 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

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

Probablity 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", "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)


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  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 ex
## ... ................. ... ..................................................................... ..
## 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", "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 == 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"))

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: 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")
```

```
## 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, IdLe

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

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  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
```

```r
summary(itq_turf_glm)
```

```
##
## Call:
## glm(formula = rightsbased ~ gdp_center + SpeciesCat, family = "binomial",
##     data = gdp_rightsbased)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -2.65671  -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", "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 == 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")
```

```r
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_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
##     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
```

```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
## -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
```

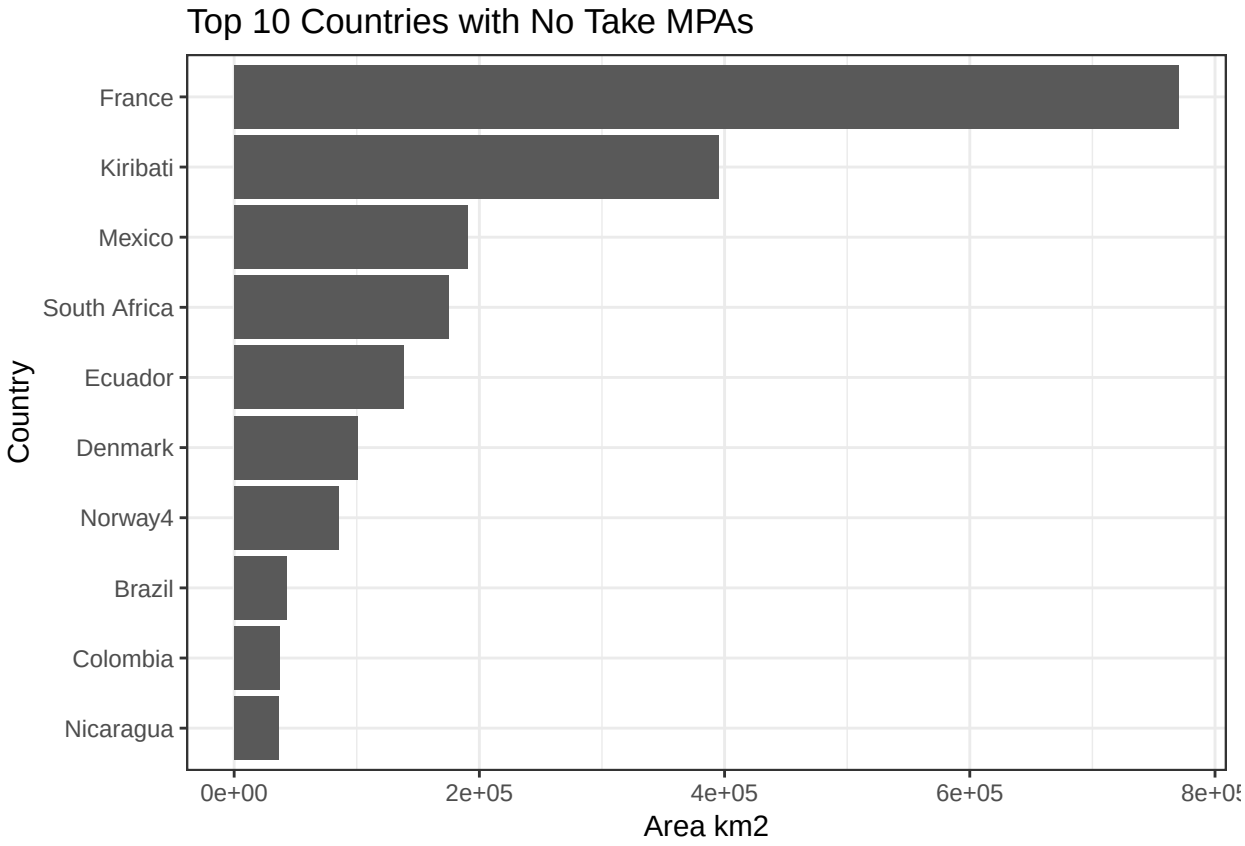
MPA New Costello Data

These MPAs are at least 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")
```

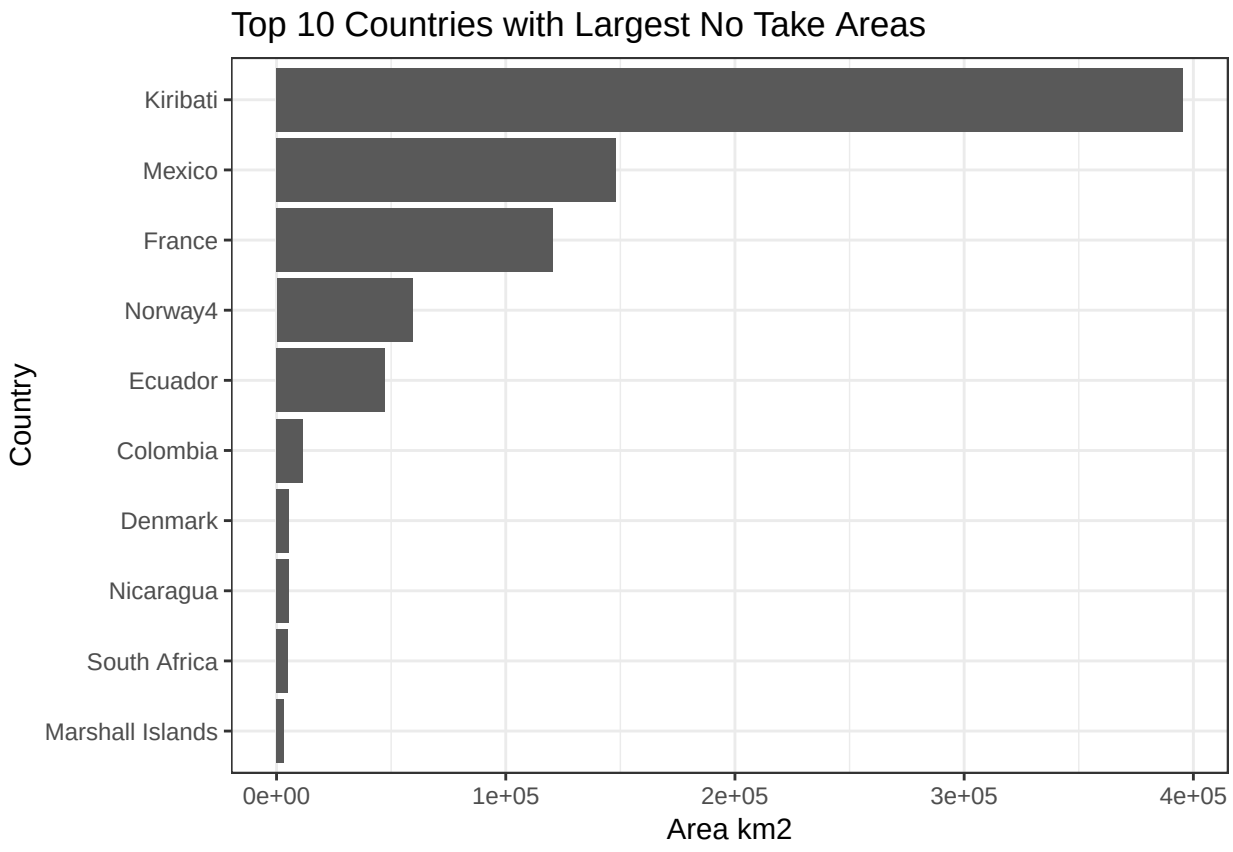


These are the countries with the highest area of no-take

```
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