TCBD Results - Draft V2

Ciara Hovis, CSIS Lab, Michigan State University

14 October 2020

Table of Contents

# 1. Summary

Synthesis of results for telacoupling/biodiversity systematic review. It consists of response summaries and visualizations of the accepted papers.

# 2. R Setup

The script presented here was done using R (version 4.0.2; R Core Team 2020) and its packages.

Load libraries, directories, and custom functions from source file.

# 3. Load data

# surveys  
 ab\_screen <- read.csv(paste0(dat.dir, 'absScreening\\AbsScreen1\_Merge.csv'))  
 ab\_maybes <- read.csv(paste0(dat.dir, 'absScreening\\AbsScreen2\_maybes\_to\_keep.csv'))  
 ab\_yeses <- read.csv(paste0(dat.dir, 'absScreening\\final\_sample\_for\_coding.csv'))  
 assignments <- read.csv(paste0(dat.dir,'absScreening\\Coding\_MergeAssign\_R1.csv'))  
  
 survey1 <- read.csv(paste0(dat.dir,'survey1\_cleaned.csv'))  
 s2 <- read.csv(paste0(dat.dir,'survey2\_cleaned.csv'))  
 survey3 <- read.csv(paste0(dat.dir,'survey3\_cleaned.csv'))  
 s23 <- read.csv(paste0(dat.dir,'s23.csv'))  
   
 taxEff<- read.csv(paste0(dat.dir,'tax\_eff.csv'))  
   
# factor format  
 s23$maj\_eff<-factor(s23$maj\_eff, c("Beneficial","Harmful","Changed", "Mixed","Not significant or unclear"))  
 s23\_maj <- s23[!duplicated(s23$paper\_id),]  
   
 taxEff$maj\_eff\_taxa<-factor(taxEff$maj\_eff\_taxa, c("Beneficial","Harmful","Changed", "Mixed","Not significant or unclear"))  
 taxEff\_maj <- taxEff[!duplicated(taxEff$tax\_ID),]

# 4. Survey 1 & 2 Results

## 4.1 Sample Results

Accepted/rejected published papers over time

Total number of papers at the coding stage = 591

# get total numbers but also ensure both values here match  
 nrow(survey1)  
 length(unique(survey1$paper\_id))

## [1] 591  
## [1] 591

Number of accepted and rejected papers.

Accepted = 131 (22%) , Rejected = 460 (78%)

# get summary  
 ddply(survey1, .(status), summarize,  
 # total count of entries   
 count=length(status))  
sum(survey1$status == 'accept')/nrow(survey1)  
sum(survey1$status == 'reject')/nrow(survey1)

## status count  
## 1 accept 131  
## 2 reject 460  
## [1] 0.2216582  
## [1] 0.7783418

Visualizing accepted papers over time, including the ones from the abstract screening process.

# all abstract screened papers (n=7306)  
 ab\_screen <- ab\_screen[!ab\_screen$PY==2020,] #remove 2020 studies  
 ab\_all <- ab\_screen[!duplicated(ab\_screen$TITLE),];nrow(ab\_all)  
  
# remove the papers accepted in screening from the abstract screening list (n=6665)  
 ab\_reject <- anti\_join(ab\_all,ab\_maybes,by=c("TITLE"))  
 ab\_reject <- anti\_join(ab\_reject,ab\_yeses,by=c("TITLE"))  
 ab\_reject <- ab\_reject[!duplicated(ab\_reject$TITLE,ab\_reject$PY),];nrow(ab\_reject)  
   
# all papers that were accepted from abstract screening (n=641)  
 ab\_accept <- ab\_yeses[!duplicated(ab\_yeses$TITLE),]  
  
   
# accepted papers from the assignment list for full review (n=595)  
 papers\_reviewed <- assignments[!duplicated(assignments$TITLE),]  
  
# papers with PDF not available or rejected because of language (n=46)  
 paper\_unavail <- anti\_join(ab\_accept,papers\_reviewed,by=c("TITLE"))  
 paper\_unavail <- paper\_unavail[!duplicated(paper\_unavail$TITLE),]  
   
# rejected papers or not yet reviewed (n=460)  
   
 keep <- subset(survey1, status=='accept')  
 reject <- anti\_join(survey1,keep)  
  
 papers\_rejected <- anti\_join(papers\_reviewed,keep,by=c("STUDY\_ID.1"="paper\_id"))  
 papers\_rejected <- papers\_rejected[!duplicated(papers\_rejected$TITLE),]

## [1] 7306  
## [1] 6665

# show numbers:  
 paste('original number of papers in WOS search:',nrow(ab\_screen))  
 paste('number of duplicates in WOS search:',nrow(ab\_screen)-nrow(ab\_all))  
 paste('number of abstracts screened:',nrow(ab\_all))  
 paste('number of accepted abstracts:',nrow(ab\_accept))  
 paste('number of rejected abstracts:',nrow(ab\_reject))  
 paste('number of accepted papers unavailable or non-English:',  
 nrow(paper\_unavail))  
 paste('number of papers available for full review:',  
 nrow(papers\_reviewed))  
 paste('number of full papers accepted for synthesis:',  
 nrow(keep))   
 paste('number of full papers rejected from synthesis:',nrow(reject))  
 paste('number of full papers not yet reviewed for synthesis:',  
 nrow(papers\_rejected)-nrow(reject)-5)  
   
# num of full papers not yet reviewed is -1, idk why. Maybe due to common papers? The check below is True so I'm not worried.   
   
   
# test if they add up correctly  
 paste('COUNT TESTS:')  
 paste('total full papers:',  
 nrow(papers\_reviewed) == nrow(ab\_accept) - nrow(paper\_unavail))  
 paste('total abstract screen:',  
 nrow(ab\_all) == nrow(ab\_reject) + nrow(ab\_accept))

## [1] "original number of papers in WOS search: 7318"  
## [1] "number of duplicates in WOS search: 12"  
## [1] "number of abstracts screened: 7306"  
## [1] "number of accepted abstracts: 641"  
## [1] "number of rejected abstracts: 6665"  
## [1] "number of accepted papers unavailable or non-English: 46"  
## [1] "number of papers available for full review: 595"  
## [1] "number of full papers accepted for synthesis: 131"  
## [1] "number of full papers rejected from synthesis: 460"  
## [1] "number of full papers not yet reviewed for synthesis: -1"  
## [1] "COUNT TESTS:"  
## [1] "total full papers: TRUE"  
## [1] "total abstract screen: TRUE"

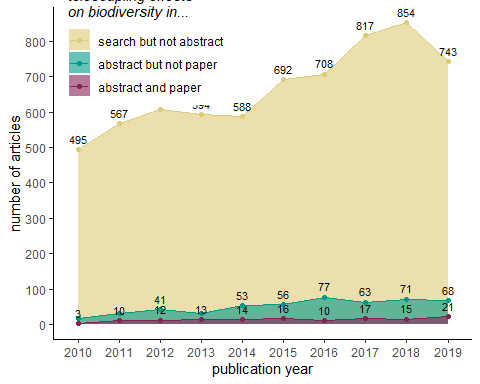
Next, simplify columns and combine for three tiers in the plot.

# select columns  
 # papers found in WOS but don't meet criteria  
 reject\_abstract\_level <- subset(ab\_reject,select=c("STUDY\_ID","PY"))  
 # WOS papers that meet criteria but don't directly look at coupling effects on biodiv  
 reject\_paper\_level <- subset(papers\_rejected,select=c("STUDY\_ID.1","PY"))  
 reject\_paper\_level2 <- subset(paper\_unavail,select=c("STUDY\_ID","PY"))  
 # papers that do look at coupling effects on biodiv  
 accept\_paper\_level <- subset(keep,select=c("paper\_id","year\_pub"))  
   
# rename columns  
 colnames(reject\_abstract\_level) <- c('paper\_id','year\_pub')  
 colnames(reject\_paper\_level) <- c('paper\_id','year\_pub')  
 colnames(reject\_paper\_level2) <- c('paper\_id','year\_pub')  
   
# add columns  
 #papers that discuss tc effects on biodiv in...  
 reject\_abstract\_level$type <- 'search but not abstract'  
 reject\_paper\_level$type <- 'abstract but not paper'  
 reject\_paper\_level2$type <- 'abstract but not paper'  
 accept\_paper\_level$type <- 'abstract and paper'  
   
# rbind (should be 7307 rows)  
 papers <- rbind(reject\_abstract\_level,reject\_paper\_level,  
 reject\_paper\_level2, # <-- NOT SURE IF UNAVAILABLE PAPERS BELONG HERE  
 accept\_paper\_level)  
  
# check  
 nrow(papers)

## [1] 7306

Plot image.

# Get a count of records per year  
 paper\_ct <- ddply(papers, .(year\_pub,type), summarize, count=length(year\_pub))  
  
# Change to factors  
 paper\_ct$year\_pub <- as.factor(paper\_ct$year\_pub)  
 paper\_ct$type <- factor(paper\_ct$type,  
 levels = c('search but not abstract',  
 'abstract but not paper',  
 'abstract and paper'))  
   
 papers.fig <- ggplot(paper\_ct, aes(x=year\_pub, y=count)) +   
 geom\_area(position="identity",  
 aes(y=count, fill = type, group = type), alpha=0.6) +  
 geom\_point(aes(y =count, color = type, group = type))+  
 geom\_line(aes(y =count, color = type, group = type))+  
 geom\_text(aes(label=count),size=3,  
 position=position\_dodge(.7),  
 vjust=-.7,  
 check\_overlap=TRUE)+  
 scale\_color\_manual(  
 name=expression(italic("telecoupling effects\non biodiversity in...")),  
 values=paper\_col)+  
 scale\_fill\_manual(  
 name=expression(italic("telecoupling effects\non biodiversity in...")),  
 values=paper\_col)+  
 xlab("publication year")+  
 ylab("number of articles") + ylim(0,860)+  
 scale\_y\_continuous(breaks=seq(0,850,100)) +  
 theme\_classic()+  
 theme(legend.position = c(0.22,0.87))  
   
# show here  
 papers.fig



Acceptance rate for abstract screening.

# get total abstract acceptance rate  
 sum(ab\_all$INCLUDE=='YES')/nrow(ab\_all)

## [1] 0.08007117

Acceptance rate for papers that were reviewed (**NOTE:** this includes the 5 common surveys).

# get total paper acceptance rate  
 sum(survey1$status=='accept')/nrow(survey1)

## [1] 0.2216582

Acceptance rate per person (**NOTE:** this excludes the 5 common surveys per person, but has a rate for it on its own as “all”).

# get summary  
 acr <- ddply(survey1, .(coder\_id), summarize,  
 # total count of entries   
 count=length(coder\_id),  
 accept=sum(status=='accept'),  
 reject=sum(status=='reject'),  
 # percent acceptance  
 accept\_rate=sum(status=='accept')/length(coder\_id))  
 acr

## coder\_id count accept reject accept\_rate  
## 1 A\_Herzberger 63 20 43 0.3174603  
## 2 A\_Torres 51 7 44 0.1372549  
## 3 all 5 4 1 0.8000000  
## 4 C\_Hovis 92 19 73 0.2065217  
## 5 E\_Dean 43 7 36 0.1627907  
## 6 E\_Xing 43 9 34 0.2093023  
## 7 K\_Kapsar 52 11 41 0.2115385  
## 8 M\_Lei 43 15 28 0.3488372  
## 9 MG\_Chung 43 5 38 0.1162791  
## 10 X\_Wu 67 18 49 0.2686567  
## 11 Y\_Dou 5 0 5 0.0000000  
## 12 Y\_Li 32 2 30 0.0625000  
## 13 Y\_Zhang 52 14 38 0.2692308

Average per-person acceptance rates

# mean per-person acceptance rate   
 mean(acr$accept\_rate)

## [1] 0.2392594

Unique study ids for survey 2 and 3

length(unique(s2$paper\_id))   
length(unique(survey3$paper\_id))  
length(unique(s23$paper\_id))  
  
`%notin%` <- Negate(`%in%`)  
  
halp <- s2[which(unique(s2$paper\_id) %notin% unique(survey3$paper\_id)),]

## [1] 131  
## [1] 131  
## [1] 131

## 4.2 General Results

Proportion of effects at article and metric level

# Table of maj\_eff  
table(taxEff\_maj$maj\_eff\_taxa)  
prop.table(table(taxEff\_maj$maj\_eff\_tax))  
  
# Table of sig\_eff  
table(s23$sig\_effect)  
prop.table(table(s23$sig\_effect))  
nrow(s23)

##   
## Beneficial Harmful   
## 16 67   
## Changed Mixed   
## 11 9   
## Not significant or unclear   
## 33   
##   
## Beneficial Harmful   
## 0.11764706 0.49264706   
## Changed Mixed   
## 0.08088235 0.06617647   
## Not significant or unclear   
## 0.24264706   
##   
## Beneficial Changed   
## 82 101   
## Harmful Not significant or unclear   
## 225 358   
##   
## Beneficial Changed   
## 0.1070496 0.1318538   
## Harmful Not significant or unclear   
## 0.2937337 0.4673629   
## [1] 766

Habitat Frequency (study level, n= 131)

habitat.study <- count(s23\_maj, 'hab')  
print(habitat.study)  
prop.table(table(s23\_maj$hab))

## hab freq  
## 1 Freshwater 22  
## 2 Freshwater;Marine 1  
## 3 Marine 25  
## 4 Not specified/Global study 2  
## 5 Terrestrial 75  
## 6 Terrestrial;Freshwater 4  
## 7 Terrestrial;Marine 2  
##   
## Freshwater Freshwater;Marine   
## 0.167938931 0.007633588   
## Marine Not specified/Global study   
## 0.190839695 0.015267176   
## Terrestrial Terrestrial;Freshwater   
## 0.572519084 0.030534351   
## Terrestrial;Marine   
## 0.015267176

Taxa Frequency (study level, n=131)

desired\_length <- 8   
empty\_list <- vector(mode = "list", length = desired\_length)  
  
taxa <- (taxEff\_maj$taxa)  
table(taxa)  
taxa.list <- c('Mammals', 'Plants', 'Reptiles', 'Amphibians', 'Birds', 'Fish', 'Invertebrates', 'Multiple')  
taxa.count <- empty\_list  
  
for (i in 1:length(taxa.list)) {  
   
 taxa.count[i] <- sum(str\_count(taxa, taxa.list[i]))  
 }  
  
taxa.count <- as.data.frame(cbind(taxa.list,taxa.count))  
taxa.count  
taxa.count$perc <- (as.numeric(taxa.count$taxa.count)/131) \* 100  
taxa.count <- taxa.count[order(-taxa.count$perc),]  
taxa.count  
  
mult <- as.data.frame((table(taxEff\_maj$paper\_id)))  
mult <- mult[which(mult$Freq != 1),]  
num.mult <- sum(nrow(mult),(taxa.count[2,8]))   
  
# Others? Not a big deal since taxa is clarified in survey 3.Not a big deal.  
  
othTaxa <- s2[which(s2$taxa == 'Other'),]

## taxa  
## Amphibians Birds Fish Invertebrates   
## 1 37 15 31   
## Mammals Multiple Plants/Trees/Shrubs Reptiles   
## 15 4 28 5   
## taxa.list taxa.count  
## 1 Mammals 15  
## 2 Plants 28  
## 3 Reptiles 5  
## 4 Amphibians 1  
## 5 Birds 37  
## 6 Fish 15  
## 7 Invertebrates 31  
## 8 Multiple 4  
## taxa.list taxa.count perc  
## 5 Birds 37 28.2442748  
## 7 Invertebrates 31 23.6641221  
## 2 Plants 28 21.3740458  
## 1 Mammals 15 11.4503817  
## 6 Fish 15 11.4503817  
## 3 Reptiles 5 3.8167939  
## 8 Multiple 4 3.0534351  
## 4 Amphibians 1 0.7633588

Flow frequency (study level, n=131)

desired\_length <- 9   
empty\_list <- vector(mode = 'list', length = desired\_length)  
  
tc <- s2$tele\_cat  
tc.list <-c("Energy Transfer","Investment","Knowledge Transfer",  
 "Migration (human)",  
 "Species Dispersal","Tourism","Trade","Waste Transfer","Water Transfer")  
tc.count <- empty\_list  
  
for (i in 1:length(tc.list)) {  
   
 tc.count[i] <- sum(str\_count(tc, tc.list[i]))  
 }  
  
tc.count <- as.data.frame(cbind(tc.list,tc.count))  
tc.count  
  
  
# Can't get loop to count the migration values for some reason, manual input code below  
# Migration (human) n=4 # Migration (non-human) n=0  
tc.table <- table(s2$tele\_cat)  
tc.table  
tc.count[4,2] <- tc.table[5] + tc.table[13] # Migration (human) n=4   
  
tc.count$perc <- (as.numeric(tc.count$tc.count)/131) \* 100  
tc.count <- tc.count[order(-tc.count$perc),]  
tc.count  
  
  
#gather(tc.count)  
  
multiple <- str\_count(tc, ';')  
multiple <- multiple != 0  
multiple <- table(multiple) ["TRUE"]  
multiple/nrow(s2)

## tc.list tc.count  
## 1 Energy Transfer 9  
## 2 Investment 8  
## 3 Knowledge Transfer 13  
## 4 Migration (human) 0  
## 5 Species Dispersal 17  
## 6 Tourism 57  
## 7 Trade 34  
## 8 Waste Transfer 2  
## 9 Water Transfer 4  
##   
## Energy Transfer Investment   
## 7 4   
## Knowledge Transfer Knowledge Transfer;Investment   
## 6 3   
## Migration (human) Species Dispersal   
## 3 13   
## Species Dispersal;Knowledge Transfer Tourism   
## 1 54   
## Tourism;Investment Trade   
## 1 25   
## Trade;Energy Transfer Trade;Knowledge Transfer   
## 1 2   
## Trade;Migration (human) Trade;Species Dispersal   
## 1 3   
## Trade;Tourism Trade;Tourism;Knowledge Transfer   
## 1 1   
## Waste Transfer Water Transfer   
## 1 2   
## Water Transfer;Energy Transfer Water Transfer;Waste Transfer   
## 1 1   
## tc.list tc.count perc  
## 6 Tourism 57 43.511450  
## 7 Trade 34 25.954198  
## 5 Species Dispersal 17 12.977099  
## 3 Knowledge Transfer 13 9.923664  
## 1 Energy Transfer 9 6.870229  
## 2 Investment 8 6.106870  
## 4 Migration (human) 4 3.053435  
## 9 Water Transfer 4 3.053435  
## 8 Waste Transfer 2 1.526718  
## TRUE   
## 0.1221374

Number of metrics reported by each paper

# get summary  
 ddply(survey3, .(paper\_id), summarize,  
 # total count of entries   
 num\_entries=length(entry\_id),  
 perc\_dataset=length(entry\_id)/nrow(survey3),  
 num\_taxa=length(unique(taxa))) %>%   
 arrange(desc(perc\_dataset))  
  
num.metric <- count(survey3$paper\_id)  
mult.metric <- num.metric[num.metric$freq > 1,]  
  
nrow(mult.metric)/131  
  
range(num.metric$freq)  
sum(num.metric$freq)

## paper\_id num\_entries perc\_dataset num\_taxa  
## 1 84 162 0.211212516 1  
## 2 4060 57 0.074315515 1  
## 3 1551 27 0.035202086 1  
## 4 1488 24 0.031290743 1  
## 5 3772 22 0.028683181 1  
## 6 6502 21 0.027379400 1  
## 7 134 20 0.026075619 1  
## 8 4155 20 0.026075619 1  
## 9 4552 15 0.019556714 1  
## 10 479 14 0.018252934 1  
## 11 3112 13 0.016949153 1  
## 12 3989 12 0.015645372 1  
## 13 4831 11 0.014341591 1  
## 14 1007 10 0.013037810 1  
## 15 2606 9 0.011734029 1  
## 16 3924 8 0.010430248 1  
## 17 5844 8 0.010430248 1  
## 18 6254 8 0.010430248 1  
## 19 1376 7 0.009126467 2  
## 20 5756 7 0.009126467 1  
## 21 6948 7 0.009126467 1  
## 22 227 6 0.007822686 1  
## 23 264 6 0.007822686 1  
## 24 1893 6 0.007822686 2  
## 25 3122 6 0.007822686 1  
## 26 3485 6 0.007822686 1  
## 27 3849 6 0.007822686 1  
## 28 4551 6 0.007822686 1  
## 29 5076 6 0.007822686 1  
## 30 5905 6 0.007822686 1  
## 31 6511 6 0.007822686 1  
## 32 357 5 0.006518905 1  
## 33 1366 5 0.006518905 1  
## 34 1743 5 0.006518905 1  
## 35 2050 5 0.006518905 1  
## 36 2642 5 0.006518905 1  
## 37 5926 5 0.006518905 1  
## 38 6396 5 0.006518905 1  
## 39 292 4 0.005215124 1  
## 40 302 4 0.005215124 1  
## 41 471 4 0.005215124 1  
## 42 826 4 0.005215124 1  
## 43 1299 4 0.005215124 1  
## 44 1590 4 0.005215124 1  
## 45 1616 4 0.005215124 1  
## 46 2401 4 0.005215124 1  
## 47 2546 4 0.005215124 1  
## 48 2998 4 0.005215124 1  
## 49 3484 4 0.005215124 1  
## 50 4020 4 0.005215124 1  
## 51 4063 4 0.005215124 1  
## 52 4257 4 0.005215124 1  
## 53 4293 4 0.005215124 1  
## 54 5746 4 0.005215124 1  
## 55 379 3 0.003911343 1  
## 56 483 3 0.003911343 1  
## 57 518 3 0.003911343 1  
## 58 1270 3 0.003911343 1  
## 59 2345 3 0.003911343 1  
## 60 3247 3 0.003911343 1  
## 61 3361 3 0.003911343 1  
## 62 4209 3 0.003911343 1  
## 63 4445 3 0.003911343 1  
## 64 5063 3 0.003911343 1  
## 65 6321 3 0.003911343 2  
## 66 80 2 0.002607562 2  
## 67 339 2 0.002607562 2  
## 68 396 2 0.002607562 1  
## 69 425 2 0.002607562 1  
## 70 466 2 0.002607562 1  
## 71 510 2 0.002607562 1  
## 72 708 2 0.002607562 1  
## 73 713 2 0.002607562 1  
## 74 1565 2 0.002607562 1  
## 75 1799 2 0.002607562 1  
## 76 2201 2 0.002607562 1  
## 77 2670 2 0.002607562 1  
## 78 3081 2 0.002607562 1  
## 79 3151 2 0.002607562 1  
## 80 3165 2 0.002607562 1  
## 81 3456 2 0.002607562 1  
## 82 3511 2 0.002607562 1  
## 83 3583 2 0.002607562 1  
## 84 3697 2 0.002607562 1  
## 85 4760 2 0.002607562 1  
## 86 4832 2 0.002607562 1  
## 87 5175 2 0.002607562 1  
## 88 5875 2 0.002607562 1  
## 89 5966 2 0.002607562 1  
## 90 6331 2 0.002607562 1  
## 91 6655 2 0.002607562 1  
## 92 6845 2 0.002607562 1  
## 93 17 1 0.001303781 1  
## 94 44 1 0.001303781 1  
## 95 45 1 0.001303781 1  
## 96 311 1 0.001303781 1  
## 97 523 1 0.001303781 1  
## 98 654 1 0.001303781 1  
## 99 813 1 0.001303781 1  
## 100 897 1 0.001303781 1  
## 101 992 1 0.001303781 1  
## 102 1040 1 0.001303781 1  
## 103 1349 1 0.001303781 1  
## 104 1368 1 0.001303781 1  
## 105 1681 1 0.001303781 1  
## 106 1821 1 0.001303781 1  
## 107 2222 1 0.001303781 1  
## 108 2253 1 0.001303781 1  
## 109 2284 1 0.001303781 1  
## 110 3243 1 0.001303781 1  
## 111 3668 1 0.001303781 1  
## 112 3868 1 0.001303781 1  
## 113 4087 1 0.001303781 1  
## 114 4393 1 0.001303781 1  
## 115 4509 1 0.001303781 1  
## 116 4518 1 0.001303781 1  
## 117 4574 1 0.001303781 1  
## 118 4850 1 0.001303781 1  
## 119 5125 1 0.001303781 1  
## 120 5309 1 0.001303781 1  
## 121 5314 1 0.001303781 1  
## 122 5477 1 0.001303781 1  
## 123 5486 1 0.001303781 1  
## 124 5577 1 0.001303781 1  
## 125 5773 1 0.001303781 1  
## 126 5782 1 0.001303781 1  
## 127 5804 1 0.001303781 1  
## 128 5853 1 0.001303781 1  
## 129 6195 1 0.001303781 1  
## 130 6820 1 0.001303781 1  
## 131 3790002 1 0.001303781 1  
## [1] 0.7022901  
## [1] 1 162  
## [1] 767

## 4.3 Biodiversity and Flow Categories by Country

Continent freq n=131

cont <- s23\_maj$bd\_continents  
table(cont)  
desired\_length <- 7   
empty\_list <- vector(mode = 'list', length = desired\_length)  
  
cont.list <-c("North America","South America","Africa","Europe","Oceania","Asia","Antarctica")  
cont.count <- empty\_list  
  
for (i in 1:length(cont.list)) {  
   
 cont.count[i] <- sum(str\_count(cont, cont.list[i]))  
 }  
  
cont.count <- as.data.frame(cbind(cont.list,cont.count))  
cont.count  
cont.count$perc <- (as.numeric(cont.count$cont.count)/131) \* 100  
cont.count <- cont.count[order(-cont.count$perc),]  
cont.count

## cont  
## Africa Antarctica Asia Europe Europe;Africa   
## 10 2 25 29 1   
## Global North America Oceania South America   
## 5 22 11 26   
## cont.list cont.count  
## 1 North America 22  
## 2 South America 26  
## 3 Africa 11  
## 4 Europe 30  
## 5 Oceania 11  
## 6 Asia 25  
## 7 Antarctica 2  
## cont.list cont.count perc  
## 4 Europe 30 22.900763  
## 2 South America 26 19.847328  
## 6 Asia 25 19.083969  
## 1 North America 22 16.793893  
## 3 Africa 11 8.396947  
## 5 Oceania 11 8.396947  
## 7 Antarctica 2 1.526718

Biodiversity country map

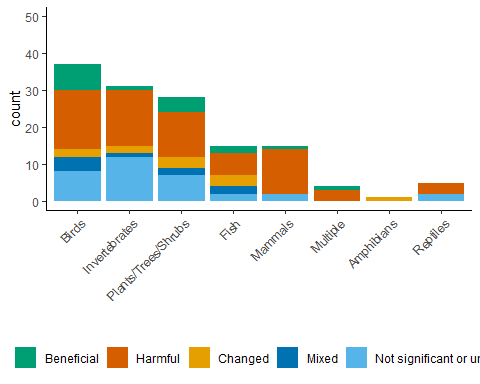
shp <- ne\_countries(scale = 50, returnclass = 'sf') %>% #st\_as\_sf() %>%  
 select(name, iso\_a3) %>% ## , economy, income\_grp  
 # filter(name != 'Antarctica') %>%  
 # filter(name == 'France') %>%  
 dplyr::mutate(  
 iso\_a3 = if\_else(name == 'France', 'FRA', iso\_a3),  
 iso\_a3 = if\_else(name == 'Norway', 'NOR', iso\_a3))  
# plot(shp[1])  
  
shp %>% filter(name == 'Norway')  
  
### - Read in Data  
  
df99 <- s23\_maj  
  
### - biodiv\_countries  
ctr\_bio <- df99 %>%  
 select(paper\_id, biodiv\_countries) %>%  
 data.frame(., do.call(rbind, str\_split(.$biodiv\_countries,';'))) %>%  
 gather(key = 'key', value = biodiv\_countries, 3:ncol(.)) %>%  
 dplyr::mutate(biodiv\_countries = trimws(biodiv\_countries)) %>%  
 dplyr::distinct(paper\_id, biodiv\_countries, .keep\_all = T) %>%  
 filter(biodiv\_countries != '') %>%  
 arrange(paper\_id) %>%  
 group\_by(biodiv\_countries) %>%  
 tally()%>%  
 arrange(desc(n)) #%>%  
# str(ctr\_bio)  
  
table(ctr\_bio$biodiv\_countries)  
  
# install.packages("jsonlite", repos="https://cran.rstudio.com/")  
library("jsonlite")  
json\_file <- 'https://datahub.io/JohnSnowLabs/country-and-continent-codes-list/datapackage.json'  
json\_data <- fromJSON(paste(readLines(json\_file), collapse=""))  
# get list of all resources:  
print(json\_data$resources$name)  
  
# print all tabular data(if exists any) to 'data'  
for(i in 1:length(json\_data$resources$datahub$type)){  
 if(json\_data$resources$datahub$type[i]=='derived/csv'){  
 path\_to\_file = json\_data$resources$path[i]  
 data <- read.csv(url(path\_to\_file))  
 print(data)  
 }  
}  
  
cont <- cbind(data$Continent\_Name,data$Country\_Name,data$Three\_Letter\_Country\_Code)  
cont <- as.data.frame(cont)  
  
# Match continent and country name to biodiversity countries  
names(cont)[1:3] <- c("continent","ctr\_name","ctr\_code")  
  
ctr\_bio$continent <- cont$continent[match(ctr\_bio$biodiv\_countries,cont$ctr\_code)] # add continent name  
ctr\_bio$ctr\_name <- cont$ctr\_name[match(ctr\_bio$biodiv\_countries,cont$ctr\_code)] # add country name  
  
ctr\_bio$continent[which(ctr\_bio$biodiv\_countries == 'GLO')]<- 'Global'  
ctr\_bio$ctr\_name[which(ctr\_bio$biodiv\_countries == 'GLO')]<- 'Global'

## Simple feature collection with 1 feature and 2 fields  
## geometry type: MULTIPOLYGON  
## dimension: XY  
## bbox: xmin: -9.098877 ymin: 58.02095 xmax: 33.6293 ymax: 80.47783  
## CRS: +proj=longlat +datum=WGS84 +no\_defs +ellps=WGS84 +towgs84=0,0,0  
## name iso\_a3 geometry  
## 1 Norway NOR MULTIPOLYGON (((5.08584 60....  
##   
## ALB ARG ATA AUS AUT BEL BEN BGR BHS BLR BOL BRA BTN BWA CAF CAN CHL CHN COL CRI   
## 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   
## CUB CYP CZE DEU DNK DZA ECU ESP EST FIN FRA GBR GLO GRC HRV HUN IDN IND IRL IRN   
## 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   
## ITA KOR LCA LTU LUX LVA MAR MDV MEX MLT MNE MNG MWI MYS NAM NLD NPL NZL PER PHL   
## 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   
## POL PRT PRY PYF ROU RUS SLB SVK SVN SWE THA TZA UKR URY USA ZAF ZWE   
## 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   
## [1] "validation\_report"   
## [2] "country-and-continent-codes-list-csv\_csv"   
## [3] "country-and-continent-codes-list-csv\_json"  
## [4] "country-and-continent-codes-list\_zip"   
## [5] "country-and-continent-codes-list-csv"   
## Continent\_Name Continent\_Code  
## 1 Asia AS  
## 2 Europe EU  
## 3 Antarctica AN  
## 4 Africa AF  
## 5 Oceania OC  
## 6 Europe EU  
## 7 Africa AF  
## 8 North America <NA>  
## 9 Europe EU  
## 10 Asia AS  
## 11 South America SA  
## 12 Oceania OC  
## 13 Europe EU  
## 14 North America <NA>  
## 15 Asia AS  
## 16 Asia AS  
## 17 Europe EU  
## 18 Asia AS  
## 19 North America <NA>  
## 20 Europe EU  
## 21 North America <NA>  
## 22 Asia AS  
## 23 South America SA  
## 24 Europe EU  
## 25 Africa AF  
## 26 Antarctica AN  
## 27 South America SA  
## 28 North America <NA>  
## 29 Asia AS  
## 30 Oceania OC  
## 31 North America <NA>  
## 32 Asia AS  
## 33 Europe EU  
## 34 Asia AS  
## 35 Africa AF  
## 36 Europe EU  
## 37 Asia AS  
## 38 Africa AF  
## 39 North America <NA>  
## 40 Africa AF  
## 41 North America <NA>  
## 42 Africa AF  
## 43 Asia AS  
## 44 Africa AF  
## 45 South America SA  
## 46 Asia AS  
## 47 Asia AS  
## 48 Asia AS  
## 49 Asia AS  
## 50 South America SA  
## 51 Africa AF  
## 52 Africa AF  
## 53 Africa AF  
## 54 Africa AF  
## 55 Oceania OC  
## 56 North America <NA>  
## 57 Europe EU  
## 58 North America <NA>  
## 59 Europe EU  
## 60 Asia AS  
## 61 Europe EU  
## 62 Africa AF  
## 63 Europe EU  
## 64 North America <NA>  
## 65 North America <NA>  
## 66 South America SA  
## 67 North America <NA>  
## 68 Africa AF  
## 69 Africa AF  
## 70 Africa AF  
## 71 Europe EU  
## 72 Europe EU  
## 73 South America SA  
## 74 Antarctica AN  
## 75 Oceania OC  
## 76 Europe EU  
## 77 Europe EU  
## 78 Europe EU  
## 79 South America SA  
## 80 Oceania OC  
## 81 Antarctica AN  
## 82 Africa AF  
## 83 Africa AF  
## 84 Europe EU  
## 85 Asia AS  
## 86 Africa AF  
## 87 Asia AS  
## 88 Europe EU  
## 89 Africa AF  
## 90 Europe EU  
## 91 Oceania OC  
## 92 Europe EU  
## 93 North America <NA>  
## 94 North America <NA>  
## 95 North America <NA>  
## 96 Oceania OC  
## 97 North America <NA>  
## 98 Africa AF  
## 99 South America SA  
## 100 North America <NA>  
## 101 Antarctica AN  
## 102 Europe EU  
## 103 North America <NA>  
## 104 Asia AS  
## 105 Europe EU  
## 106 Europe EU  
## 107 Asia AS  
## 108 Asia AS  
## 109 Asia AS  
## 110 Asia AS  
## 111 Europe EU  
## 112 Asia AS  
## 113 Europe EU  
## 114 Africa AF  
## 115 North America <NA>  
## 116 Asia AS  
## 117 Europe EU  
## 118 Asia AS  
## 119 Asia AS  
## 120 Africa AF  
## 121 Asia AS  
## 122 Asia AS  
## 123 Asia AS  
## 124 Asia AS  
## 125 Asia AS  
## 126 Asia AS  
## 127 Africa AF  
## 128 Europe EU  
## 129 Africa AF  
## 130 Africa AF  
## 131 Europe EU  
## 132 Europe EU  
## 133 Europe EU  
## 134 Asia AS  
## 135 Africa AF  
## 136 Africa AF  
## 137 Asia AS  
## 138 Asia AS  
## 139 Africa AF  
## 140 Europe EU  
## 141 North America <NA>  
## 142 Africa AF  
## 143 Africa AF  
## 144 North America <NA>  
## 145 Europe EU  
## 146 Asia AS  
## 147 Europe EU  
## 148 Europe EU  
## 149 North America <NA>  
## 150 Africa AF  
## 151 Africa AF  
## 152 Asia AS  
## 153 Africa AF  
## 154 Oceania OC  
## 155 Asia AS  
## 156 Europe EU  
## 157 North America <NA>  
## 158 North America <NA>  
## 159 North America <NA>  
## 160 North America <NA>  
## 161 North America <NA>  
## 162 Oceania OC  
## 163 Oceania OC  
## 164 Oceania OC  
## 165 North America <NA>  
## 166 Africa AF  
## 167 Africa AF  
## 168 Oceania OC  
## 169 Oceania OC  
## 170 Europe EU  
## 171 Oceania OC  
## 172 Oceania OC  
## 173 North America <NA>  
## 174 Oceania OC  
## 175 Oceania OC  
## 176 Oceania OC  
## 177 Asia AS  
## 178 North America <NA>  
## 179 Oceania OC  
## 180 South America SA  
## 181 South America SA  
## 182 Asia AS  
## 183 Oceania OC  
## 184 Europe EU  
## 185 Europe EU  
## 186 Africa AF  
## 187 Asia AS  
## 188 North America <NA>  
## 189 Asia AS  
## 190 Africa AF  
## 191 Europe EU  
## 192 Europe EU  
## 193 Asia AS  
## 194 Africa AF  
## 195 North America <NA>  
## 196 Africa AF  
## 197 North America <NA>  
## 198 North America <NA>  
## 199 North America <NA>  
## 200 North America <NA>  
## 201 North America <NA>  
## 202 North America <NA>  
## 203 Europe EU  
## 204 Africa AF  
## 205 Asia AS  
## 206 Africa AF  
## 207 Europe EU  
## 208 Africa AF  
## 209 Africa AF  
## 210 Asia AS  
## 211 Europe EU  
## 212 Asia AS  
## 213 Europe EU  
## 214 Africa AF  
## 215 Africa AF  
## 216 Africa AF  
## 217 Europe EU  
## 218 Africa AF  
## 219 Africa AF  
## 220 Africa AF  
## 221 South America SA  
## 222 Europe EU  
## 223 Africa AF  
## 224 Europe EU  
## 225 Europe EU  
## 226 Asia AS  
## 227 Asia AS  
## 228 Asia AS  
## 229 Africa AF  
## 230 Oceania OC  
## 231 Oceania OC  
## 232 North America <NA>  
## 233 Asia AS  
## 234 Africa AF  
## 235 Europe EU  
## 236 Asia AS  
## 237 Asia AS  
## 238 North America <NA>  
## 239 Oceania OC  
## 240 Africa AF  
## 241 Europe EU  
## 242 Europe EU  
## 243 Africa AF  
## 244 Europe EU  
## 245 Europe EU  
## 246 Europe EU  
## 247 Europe EU  
## 248 Africa AF  
## 249 North America <NA>  
## 250 North America <NA>  
## 251 Africa AF  
## 252 South America SA  
## 253 Asia AS  
## 254 South America SA  
## 255 Oceania OC  
## 256 Oceania OC  
## 257 Asia AS  
## 258 Africa AF  
## 259 Oceania OC  
## 260 Asia AS  
## 261 Asia AS  
## 262 Asia AS  
## Country\_Name Two\_Letter\_Country\_Code  
## 1 Afghanistan, Islamic Republic of AF  
## 2 Albania, Republic of AL  
## 3 Antarctica (the territory South of 60 deg S) AQ  
## 4 Algeria, People's Democratic Republic of DZ  
## 5 American Samoa AS  
## 6 Andorra, Principality of AD  
## 7 Angola, Republic of AO  
## 8 Antigua and Barbuda AG  
## 9 Azerbaijan, Republic of AZ  
## 10 Azerbaijan, Republic of AZ  
## 11 Argentina, Argentine Republic AR  
## 12 Australia, Commonwealth of AU  
## 13 Austria, Republic of AT  
## 14 Bahamas, Commonwealth of the BS  
## 15 Bahrain, Kingdom of BH  
## 16 Bangladesh, People's Republic of BD  
## 17 Armenia, Republic of AM  
## 18 Armenia, Republic of AM  
## 19 Barbados BB  
## 20 Belgium, Kingdom of BE  
## 21 Bermuda BM  
## 22 Bhutan, Kingdom of BT  
## 23 Bolivia, Republic of BO  
## 24 Bosnia and Herzegovina BA  
## 25 Botswana, Republic of BW  
## 26 Bouvet Island (Bouvetoya) BV  
## 27 Brazil, Federative Republic of BR  
## 28 Belize BZ  
## 29 British Indian Ocean Territory (Chagos Archipelago) IO  
## 30 Solomon Islands SB  
## 31 British Virgin Islands VG  
## 32 Brunei Darussalam BN  
## 33 Bulgaria, Republic of BG  
## 34 Myanmar, Union of MM  
## 35 Burundi, Republic of BI  
## 36 Belarus, Republic of BY  
## 37 Cambodia, Kingdom of KH  
## 38 Cameroon, Republic of CM  
## 39 Canada CA  
## 40 Cape Verde, Republic of CV  
## 41 Cayman Islands KY  
## 42 Central African Republic CF  
## 43 Sri Lanka, Democratic Socialist Republic of LK  
## 44 Chad, Republic of TD  
## 45 Chile, Republic of CL  
## 46 China, People's Republic of CN  
## 47 Taiwan TW  
## 48 Christmas Island CX  
## 49 Cocos (Keeling) Islands CC  
## 50 Colombia, Republic of CO  
## 51 Comoros, Union of the KM  
## 52 Mayotte YT  
## 53 Congo, Republic of the CG  
## 54 Congo, Democratic Republic of the CD  
## 55 Cook Islands CK  
## 56 Costa Rica, Republic of CR  
## 57 Croatia, Republic of HR  
## 58 Cuba, Republic of CU  
## 59 Cyprus, Republic of CY  
## 60 Cyprus, Republic of CY  
## 61 Czech Republic CZ  
## 62 Benin, Republic of BJ  
## 63 Denmark, Kingdom of DK  
## 64 Dominica, Commonwealth of DM  
## 65 Dominican Republic DO  
## 66 Ecuador, Republic of EC  
## 67 El Salvador, Republic of SV  
## 68 Equatorial Guinea, Republic of GQ  
## 69 Ethiopia, Federal Democratic Republic of ET  
## 70 Eritrea, State of ER  
## 71 Estonia, Republic of EE  
## 72 Faroe Islands FO  
## 73 Falkland Islands (Malvinas) FK  
## 74 South Georgia and the South Sandwich Islands GS  
## 75 Fiji, Republic of the Fiji Islands FJ  
## 76 Finland, Republic of FI  
## 77 Ã…land Islands AX  
## 78 France, French Republic FR  
## 79 French Guiana GF  
## 80 French Polynesia PF  
## 81 French Southern Territories TF  
## 82 Djibouti, Republic of DJ  
## 83 Gabon, Gabonese Republic GA  
## 84 Georgia GE  
## 85 Georgia GE  
## 86 Gambia, Republic of the GM  
## 87 Palestinian Territory, Occupied PS  
## 88 Germany, Federal Republic of DE  
## 89 Ghana, Republic of GH  
## 90 Gibraltar GI  
## 91 Kiribati, Republic of KI  
## 92 Greece, Hellenic Republic GR  
## 93 Greenland GL  
## 94 Grenada GD  
## 95 Guadeloupe GP  
## 96 Guam GU  
## 97 Guatemala, Republic of GT  
## 98 Guinea, Republic of GN  
## 99 Guyana, Co-operative Republic of GY  
## 100 Haiti, Republic of HT  
## 101 Heard Island and McDonald Islands HM  
## 102 Holy See (Vatican City State) VA  
## 103 Honduras, Republic of HN  
## 104 Hong Kong, Special Administrative Region of China HK  
## 105 Hungary, Republic of HU  
## 106 Iceland, Republic of IS  
## 107 India, Republic of IN  
## 108 Indonesia, Republic of ID  
## 109 Iran, Islamic Republic of IR  
## 110 Iraq, Republic of IQ  
## 111 Ireland IE  
## 112 Israel, State of IL  
## 113 Italy, Italian Republic IT  
## 114 Cote d'Ivoire, Republic of CI  
## 115 Jamaica JM  
## 116 Japan JP  
## 117 Kazakhstan, Republic of KZ  
## 118 Kazakhstan, Republic of KZ  
## 119 Jordan, Hashemite Kingdom of JO  
## 120 Kenya, Republic of KE  
## 121 Korea, Democratic People's Republic of KP  
## 122 Korea, Republic of KR  
## 123 Kuwait, State of KW  
## 124 Kyrgyz Republic KG  
## 125 Lao People's Democratic Republic LA  
## 126 Lebanon, Lebanese Republic LB  
## 127 Lesotho, Kingdom of LS  
## 128 Latvia, Republic of LV  
## 129 Liberia, Republic of LR  
## 130 Libyan Arab Jamahiriya LY  
## 131 Liechtenstein, Principality of LI  
## 132 Lithuania, Republic of LT  
## 133 Luxembourg, Grand Duchy of LU  
## 134 Macao, Special Administrative Region of China MO  
## 135 Madagascar, Republic of MG  
## 136 Malawi, Republic of MW  
## 137 Malaysia MY  
## 138 Maldives, Republic of MV  
## 139 Mali, Republic of ML  
## 140 Malta, Republic of MT  
## 141 Martinique MQ  
## 142 Mauritania, Islamic Republic of MR  
## 143 Mauritius, Republic of MU  
## 144 Mexico, United Mexican States MX  
## 145 Monaco, Principality of MC  
## 146 Mongolia MN  
## 147 Moldova, Republic of MD  
## 148 Montenegro, Republic of ME  
## 149 Montserrat MS  
## 150 Morocco, Kingdom of MA  
## 151 Mozambique, Republic of MZ  
## 152 Oman, Sultanate of OM  
## 153 Namibia, Republic of <NA>  
## 154 Nauru, Republic of NR  
## 155 Nepal, State of NP  
## 156 Netherlands, Kingdom of the NL  
## 157 Netherlands Antilles AN  
## 158 CuraÃ§ao CW  
## 159 Aruba AW  
## 160 Sint Maarten (Netherlands) SX  
## 161 Bonaire, Sint Eustatius and Saba BQ  
## 162 New Caledonia NC  
## 163 Vanuatu, Republic of VU  
## 164 New Zealand NZ  
## 165 Nicaragua, Republic of NI  
## 166 Niger, Republic of NE  
## 167 Nigeria, Federal Republic of NG  
## 168 Niue NU  
## 169 Norfolk Island NF  
## 170 Norway, Kingdom of NO  
## 171 Northern Mariana Islands, Commonwealth of the MP  
## 172 United States Minor Outlying Islands UM  
## 173 United States Minor Outlying Islands UM  
## 174 Micronesia, Federated States of FM  
## 175 Marshall Islands, Republic of the MH  
## 176 Palau, Republic of PW  
## 177 Pakistan, Islamic Republic of PK  
## 178 Panama, Republic of PA  
## 179 Papua New Guinea, Independent State of PG  
## 180 Paraguay, Republic of PY  
## 181 Peru, Republic of PE  
## 182 Philippines, Republic of the PH  
## 183 Pitcairn Islands PN  
## 184 Poland, Republic of PL  
## 185 Portugal, Portuguese Republic PT  
## 186 Guinea-Bissau, Republic of GW  
## 187 Timor-Leste, Democratic Republic of TL  
## 188 Puerto Rico, Commonwealth of PR  
## 189 Qatar, State of QA  
## 190 Reunion RE  
## 191 Romania RO  
## 192 Russian Federation RU  
## 193 Russian Federation RU  
## 194 Rwanda, Republic of RW  
## 195 Saint Barthelemy BL  
## 196 Saint Helena SH  
## 197 Saint Kitts and Nevis, Federation of KN  
## 198 Anguilla AI  
## 199 Saint Lucia LC  
## 200 Saint Martin MF  
## 201 Saint Pierre and Miquelon PM  
## 202 Saint Vincent and the Grenadines VC  
## 203 San Marino, Republic of SM  
## 204 Sao Tome and Principe, Democratic Republic of ST  
## 205 Saudi Arabia, Kingdom of SA  
## 206 Senegal, Republic of SN  
## 207 Serbia, Republic of RS  
## 208 Seychelles, Republic of SC  
## 209 Sierra Leone, Republic of SL  
## 210 Singapore, Republic of SG  
## 211 Slovakia (Slovak Republic) SK  
## 212 Vietnam, Socialist Republic of VN  
## 213 Slovenia, Republic of SI  
## 214 Somalia, Somali Republic SO  
## 215 South Africa, Republic of ZA  
## 216 Zimbabwe, Republic of ZW  
## 217 Spain, Kingdom of ES  
## 218 South Sudan SS  
## 219 Western Sahara EH  
## 220 Sudan, Republic of SD  
## 221 Suriname, Republic of SR  
## 222 Svalbard & Jan Mayen Islands SJ  
## 223 Swaziland, Kingdom of SZ  
## 224 Sweden, Kingdom of SE  
## 225 Switzerland, Swiss Confederation CH  
## 226 Syrian Arab Republic SY  
## 227 Tajikistan, Republic of TJ  
## 228 Thailand, Kingdom of TH  
## 229 Togo, Togolese Republic TG  
## 230 Tokelau TK  
## 231 Tonga, Kingdom of TO  
## 232 Trinidad and Tobago, Republic of TT  
## 233 United Arab Emirates AE  
## 234 Tunisia, Tunisian Republic TN  
## 235 Turkey, Republic of TR  
## 236 Turkey, Republic of TR  
## 237 Turkmenistan TM  
## 238 Turks and Caicos Islands TC  
## 239 Tuvalu TV  
## 240 Uganda, Republic of UG  
## 241 Ukraine UA  
## 242 Macedonia, The Former Yugoslav Republic of MK  
## 243 Egypt, Arab Republic of EG  
## 244 United Kingdom of Great Britain & Northern Ireland GB  
## 245 Guernsey, Bailiwick of GG  
## 246 Jersey, Bailiwick of JE  
## 247 Isle of Man IM  
## 248 Tanzania, United Republic of TZ  
## 249 United States of America US  
## 250 United States Virgin Islands VI  
## 251 Burkina Faso BF  
## 252 Uruguay, Eastern Republic of UY  
## 253 Uzbekistan, Republic of UZ  
## 254 Venezuela, Bolivarian Republic of VE  
## 255 Wallis and Futuna WF  
## 256 Samoa, Independent State of WS  
## 257 Yemen YE  
## 258 Zambia, Republic of ZM  
## 259 Disputed Territory XX  
## 260 Iraq-Saudi Arabia Neutral Zone XE  
## 261 United Nations Neutral Zone XD  
## 262 Spratly Islands XS  
## Three\_Letter\_Country\_Code Country\_Number  
## 1 AFG 4  
## 2 ALB 8  
## 3 ATA 10  
## 4 DZA 12  
## 5 ASM 16  
## 6 AND 20  
## 7 AGO 24  
## 8 ATG 28  
## 9 AZE 31  
## 10 AZE 31  
## 11 ARG 32  
## 12 AUS 36  
## 13 AUT 40  
## 14 BHS 44  
## 15 BHR 48  
## 16 BGD 50  
## 17 ARM 51  
## 18 ARM 51  
## 19 BRB 52  
## 20 BEL 56  
## 21 BMU 60  
## 22 BTN 64  
## 23 BOL 68  
## 24 BIH 70  
## 25 BWA 72  
## 26 BVT 74  
## 27 BRA 76  
## 28 BLZ 84  
## 29 IOT 86  
## 30 SLB 90  
## 31 VGB 92  
## 32 BRN 96  
## 33 BGR 100  
## 34 MMR 104  
## 35 BDI 108  
## 36 BLR 112  
## 37 KHM 116  
## 38 CMR 120  
## 39 CAN 124  
## 40 CPV 132  
## 41 CYM 136  
## 42 CAF 140  
## 43 LKA 144  
## 44 TCD 148  
## 45 CHL 152  
## 46 CHN 156  
## 47 TWN 158  
## 48 CXR 162  
## 49 CCK 166  
## 50 COL 170  
## 51 COM 174  
## 52 MYT 175  
## 53 COG 178  
## 54 COD 180  
## 55 COK 184  
## 56 CRI 188  
## 57 HRV 191  
## 58 CUB 192  
## 59 CYP 196  
## 60 CYP 196  
## 61 CZE 203  
## 62 BEN 204  
## 63 DNK 208  
## 64 DMA 212  
## 65 DOM 214  
## 66 ECU 218  
## 67 SLV 222  
## 68 GNQ 226  
## 69 ETH 231  
## 70 ERI 232  
## 71 EST 233  
## 72 FRO 234  
## 73 FLK 238  
## 74 SGS 239  
## 75 FJI 242  
## 76 FIN 246  
## 77 ALA 248  
## 78 FRA 250  
## 79 GUF 254  
## 80 PYF 258  
## 81 ATF 260  
## 82 DJI 262  
## 83 GAB 266  
## 84 GEO 268  
## 85 GEO 268  
## 86 GMB 270  
## 87 PSE 275  
## 88 DEU 276  
## 89 GHA 288  
## 90 GIB 292  
## 91 KIR 296  
## 92 GRC 300  
## 93 GRL 304  
## 94 GRD 308  
## 95 GLP 312  
## 96 GUM 316  
## 97 GTM 320  
## 98 GIN 324  
## 99 GUY 328  
## 100 HTI 332  
## 101 HMD 334  
## 102 VAT 336  
## 103 HND 340  
## 104 HKG 344  
## 105 HUN 348  
## 106 ISL 352  
## 107 IND 356  
## 108 IDN 360  
## 109 IRN 364  
## 110 IRQ 368  
## 111 IRL 372  
## 112 ISR 376  
## 113 ITA 380  
## 114 CIV 384  
## 115 JAM 388  
## 116 JPN 392  
## 117 KAZ 398  
## 118 KAZ 398  
## 119 JOR 400  
## 120 KEN 404  
## 121 PRK 408  
## 122 KOR 410  
## 123 KWT 414  
## 124 KGZ 417  
## 125 LAO 418  
## 126 LBN 422  
## 127 LSO 426  
## 128 LVA 428  
## 129 LBR 430  
## 130 LBY 434  
## 131 LIE 438  
## 132 LTU 440  
## 133 LUX 442  
## 134 MAC 446  
## 135 MDG 450  
## 136 MWI 454  
## 137 MYS 458  
## 138 MDV 462  
## 139 MLI 466  
## 140 MLT 470  
## 141 MTQ 474  
## 142 MRT 478  
## 143 MUS 480  
## 144 MEX 484  
## 145 MCO 492  
## 146 MNG 496  
## 147 MDA 498  
## 148 MNE 499  
## 149 MSR 500  
## 150 MAR 504  
## 151 MOZ 508  
## 152 OMN 512  
## 153 NAM 516  
## 154 NRU 520  
## 155 NPL 524  
## 156 NLD 528  
## 157 ANT 530  
## 158 CUW 531  
## 159 ABW 533  
## 160 SXM 534  
## 161 BES 535  
## 162 NCL 540  
## 163 VUT 548  
## 164 NZL 554  
## 165 NIC 558  
## 166 NER 562  
## 167 NGA 566  
## 168 NIU 570  
## 169 NFK 574  
## 170 NOR 578  
## 171 MNP 580  
## 172 UMI 581  
## 173 UMI 581  
## 174 FSM 583  
## 175 MHL 584  
## 176 PLW 585  
## 177 PAK 586  
## 178 PAN 591  
## 179 PNG 598  
## 180 PRY 600  
## 181 PER 604  
## 182 PHL 608  
## 183 PCN 612  
## 184 POL 616  
## 185 PRT 620  
## 186 GNB 624  
## 187 TLS 626  
## 188 PRI 630  
## 189 QAT 634  
## 190 REU 638  
## 191 ROU 642  
## 192 RUS 643  
## 193 RUS 643  
## 194 RWA 646  
## 195 BLM 652  
## 196 SHN 654  
## 197 KNA 659  
## 198 AIA 660  
## 199 LCA 662  
## 200 MAF 663  
## 201 SPM 666  
## 202 VCT 670  
## 203 SMR 674  
## 204 STP 678  
## 205 SAU 682  
## 206 SEN 686  
## 207 SRB 688  
## 208 SYC 690  
## 209 SLE 694  
## 210 SGP 702  
## 211 SVK 703  
## 212 VNM 704  
## 213 SVN 705  
## 214 SOM 706  
## 215 ZAF 710  
## 216 ZWE 716  
## 217 ESP 724  
## 218 SSD 728  
## 219 ESH 732  
## 220 SDN 736  
## 221 SUR 740  
## 222 SJM 744  
## 223 SWZ 748  
## 224 SWE 752  
## 225 CHE 756  
## 226 SYR 760  
## 227 TJK 762  
## 228 THA 764  
## 229 TGO 768  
## 230 TKL 772  
## 231 TON 776  
## 232 TTO 780  
## 233 ARE 784  
## 234 TUN 788  
## 235 TUR 792  
## 236 TUR 792  
## 237 TKM 795  
## 238 TCA 796  
## 239 TUV 798  
## 240 UGA 800  
## 241 UKR 804  
## 242 MKD 807  
## 243 EGY 818  
## 244 GBR 826  
## 245 GGY 831  
## 246 JEY 832  
## 247 IMN 833  
## 248 TZA 834  
## 249 USA 840  
## 250 VIR 850  
## 251 BFA 854  
## 252 URY 858  
## 253 UZB 860  
## 254 VEN 862  
## 255 WLF 876  
## 256 WSM 882  
## 257 YEM 887  
## 258 ZMB 894  
## 259 NA  
## 260 NA  
## 261 NA  
## 262 NA

# 5. Telecoupling Impact by Taxa

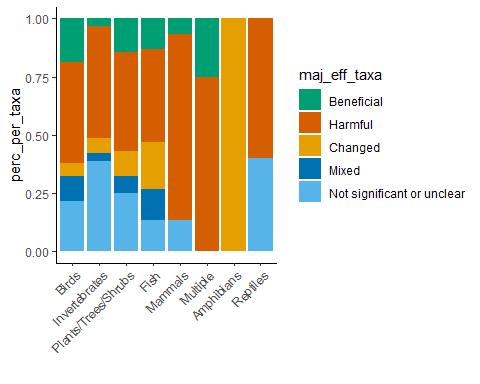
Note that n=136, some papers reported metrics for multiple taxa. Maj\_eff was determined based on paper and taxa for these figures.

taxa\_tab <- as.data.frame(table(taxEff\_maj$maj\_eff\_taxa))  
taxa\_tab$perc <- (taxa\_tab$Freq/sum(taxa\_tab$Freq))\*100  
taxa\_tab  
# get summary  
 a <- ddply(taxEff\_maj, .(taxa, maj\_eff\_taxa), summarize,  
 # total count of entries   
 count=length(taxa)) %>%  
 # percents of effects within totals per taxa  
 group\_by(taxa) %>%  
 nest() %>%   
 mutate(perc\_per\_taxa=map(data, function(x) x$count/sum(x$count))) %>%   
 unnest(cols = c(data, perc\_per\_taxa))  
  
# save as csv  
# write.csv(a, paste0(tab.dir,'survey3\_summary\_effects\_by\_taxa.csv'),row.names = TRUE)  
  
 q <- table(taxEff\_maj$taxa)  
 q <- q[order(-(q))]  
 taxa.sorted <- names(q);taxa.sorted  
 taxa.sorted <- c(taxa.sorted,taxa.sorted[6])  
 taxa.sorted <-taxa.sorted[-6]  
 a$taxa <- factor(a$taxa,taxa.sorted)  
 taxa.bar.data <- a  
# Stack plot (count)  
 taxa\_bar <- ggplot(a, aes(fill=maj\_eff\_taxa, y=count, x=taxa)) +   
 geom\_bar(position="stack", stat="identity") +  
 theme\_classic() +  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1)) +  
 scale\_fill\_manual(values=majeff\_col) +  
 xlab("") +   
 ylim(0,50) +  
 theme(legend.position = "bottom",legend.justification='center',   
 legend.direction='horizontal',legend.title = element\_blank())  
taxa\_bar



## Var1 Freq perc  
## 1 Beneficial 16 11.764706  
## 2 Harmful 67 49.264706  
## 3 Changed 11 8.088235  
## 4 Mixed 9 6.617647  
## 5 Not significant or unclear 33 24.264706  
## [1] "Birds" "Invertebrates" "Plants/Trees/Shrubs"  
## [4] "Fish" "Mammals" "Reptiles"   
## [7] "Multiple" "Amphibians"

# Stack plot (percentage)  
 quick\_plot <- ggplot(a, aes(fill=maj\_eff\_taxa, y=perc\_per\_taxa, x=taxa)) +   
 geom\_bar(position="stack", stat="identity") +  
 theme\_classic() +  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1)) +  
 scale\_fill\_manual(values=majeff\_col) +  
 xlab("")  
quick\_plot



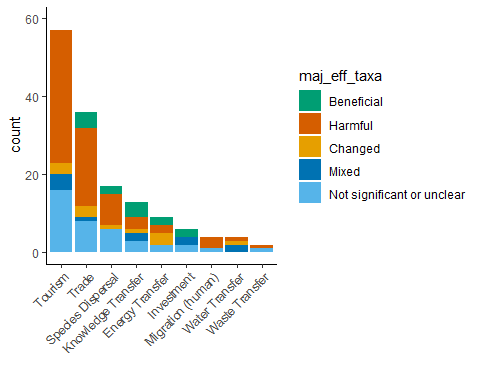
# 7. Telecoupling Impact by Flow

Duplicate rows with multiple flow types. This means that effects and other results will be *duplicated* as well.

The reason for doing this is so that we can attribute biodiversity impacts to the specific flows that may have been studied together, and whose individual impacts cannot be decoupled.

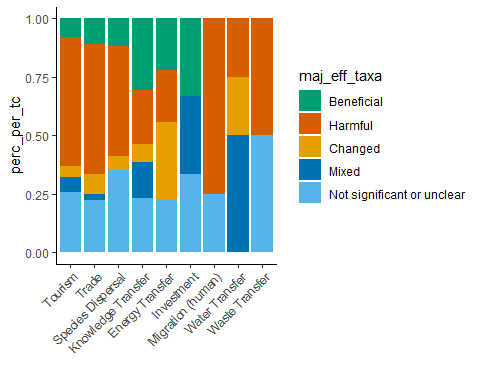
* Tourism and Trade were the most represented in our sample and both had majority Harmful imapcts reported.
* The flow categories that showed somewhat beneficial impacts where Investment, Water Transfer, and Knowledge Transfer.

# set as character  
taxEff\_maj$tc <- as.character(taxEff\_maj$tc)  
  
# show original length of rows  
 print(paste('Original number of rows:',nrow(taxEff\_maj)))  
  
# split multiple flows listed in a row into other new rows  
 taxEff\_maj\_rep <- separate\_rows(taxEff\_maj, tc, sep=";", convert = TRUE)  
 taxEff\_maj\_rep$tc <- as.factor(taxEff\_maj\_rep$tc)  
  
# show new length of rows  
 print(paste('Number of rows after separating multiple flows per paper:',nrow(taxEff\_maj\_rep)))  
  
# show levels  
# summary(tcRep$tc)  
tc\_tab <- as.data.frame(table(taxEff\_maj\_rep$maj\_eff\_taxa))  
tc\_tab$perc <- (tc\_tab$Freq/sum(tc\_tab$Freq))\*100  
tc\_tab  
  
  
# get summary  
 a <- ddply(taxEff\_maj\_rep, .(tc, maj\_eff\_taxa), summarize,  
 # total count of entries   
 count=length(tc)) %>%  
 # percents of effects within totals per tc  
 group\_by(tc) %>%  
 nest() %>%   
 mutate(perc\_per\_tc=map(data, function(x) x$count/sum(x$count))) %>%   
 unnest(cols = c(data, perc\_per\_tc))  
   
 q <- table(taxEff\_maj\_rep$tc)  
 q <- q[order(-(q))]  
 tc.sorted <- names(q);tc.sorted  
 a$tc <- factor(a$tc,tc.sorted)  
 flow\_bar\_data <- a  
# save as csv  
# write.csv(a, paste0(tab.dir,'survey3\_summary\_effects\_by\_flow.csv'),row.names = TRUE)  
   
# Stack plot (count)  
 flow\_bar <- ggplot(a, aes(fill=maj\_eff\_taxa, y=count, x=tc)) +   
 geom\_bar(position="stack", stat="identity") +  
 theme\_classic() +  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1)) +  
 scale\_fill\_manual(values=majeff\_col) +  
 xlab("") +  
 ylim(0,60)  
  
  
  
# view  
 flow\_bar



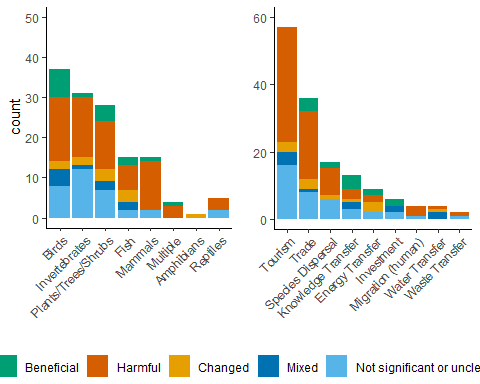
## [1] "Original number of rows: 136"  
## [1] "Number of rows after separating multiple flows per paper: 153"  
## Var1 Freq perc  
## 1 Beneficial 19 12.418301  
## 2 Harmful 72 47.058824  
## 3 Changed 12 7.843137  
## 4 Mixed 11 7.189542  
## 5 Not significant or unclear 39 25.490196  
## [1] "Tourism" "Trade" "Species Dispersal"   
## [4] "Knowledge Transfer" "Energy Transfer" "Investment"   
## [7] "Migration (human)" "Water Transfer" "Waste Transfer"

# Stack plot (percent)  
 quick\_plot <- ggplot(a, aes(fill=maj\_eff\_taxa, y=perc\_per\_tc, x=tc)) +   
 geom\_bar(position="stack", stat="identity") +  
 theme\_classic() +  
 theme(axis.text.x = element\_text(angle = 45, hjust = 1)) +  
 scale\_fill\_manual(values=majeff\_col) +  
 xlab("")  
  
quick\_plot



Side by side plot of taxa barchart and flow barchart

taxa\_bar2 <- taxa\_bar + theme(legend.position = 'none')   
  
flow\_bar2 <- flow\_bar + ylab(element\_blank()) + theme(legend.position = 'none')   
   
   
   
# theme(legend.position = "bottom",legend.justification='center',   
# legend.direction='horizontal',legend.title = element\_blank())  
  
#extract legend  
#https://github.com/hadley/ggplot2/wiki/Share-a-legend-between-two-ggplot2-graphs  
g\_legend<-function(a.gplot){  
 tmp <- ggplot\_gtable(ggplot\_build(a.gplot))  
 leg <- which(sapply(tmp$grobs, function(x) x$name) == "guide-box")  
 legend <- tmp$grobs[[leg]]  
 return(legend)}  
  
mylegend<-g\_legend(taxa\_bar)  
  
merge\_bar <- grid.arrange(arrangeGrob(taxa\_bar2,flow\_bar2,nrow=1),mylegend, nrow=2,heights=c(10, 1))



#merge\_bar <- ggarrange(taxa\_bar2, flow\_bar2, mylegend,ncol=2, nrow=2,labels = c('a', 'b'))  
#merge\_bar

# 8. Telecoupling impacts by at the entry level

Replicate TC flows by entry

* This figure shows the direction of telecoupling impacts at the entry level (i.e. all 700+ metrics recorded)
* Most studies report multiple species richness and abundance.
* Most habitat metrics were significantly Harmful, except in the case of knowledge transfer telecouplings.

# set as character  
 s23$tc <- as.character(s23$tc)  
 poo<-s23[is.na(s23$tc),]  
   
   
# show original length of rows  
 print(paste('Original number of rows:',nrow(s23)))  
  
# split multiple flows listed in a row into other new rows  
 tcRep <- separate\_rows(s23, tc, sep=";", convert = TRUE)  
 tcRep$tc <- as.factor(tcRep$tc)  
  
# show new length of rows  
 print(paste('Number of rows after separating multiple flows per paper:',nrow(tcRep)))  
   
 tcRep\_maj <- tcRep[!duplicated(tcRep$paper\_id),]

## [1] "Original number of rows: 766"  
## [1] "Number of rows after separating multiple flows per paper: 806"

## Impacts by metric

Convert to long format, where metric is indicated.

# subset  
 metrics <- subset(tcRep,  
 select=c('paper\_id','entry\_id',  
 'taxa','tc','sig\_effect',  
 'biodiv\_cat\_1sp',  
 'biodiv\_cat\_multsp',  
 'biodiv\_cat\_habitat'))  
# melt  
 metrics\_long <- melt(metrics, id.vars=c('paper\_id','entry\_id',  
 'taxa','tc','sig\_effect'))  
   
# remove NA fields  
 metrics\_long <- metrics\_long[!is.na(metrics\_long$value),]  
  
# change colnames  
 colnames(metrics\_long)[6] <- 'metric\_type'  
 colnames(metrics\_long)[7] <- 'metric'  
  
  
# change levels  
 levels(metrics\_long$metric\_type) <- c('Single species',  
 'Multiple species',  
 'Habitat')  
  
 levels(as.factor(metrics\_long$metric))  
  
# remove parentheses  
 metrics\_long$metric <- gsub("\\s\*\\([^\\)]+\\)", '',  
 as.character(metrics\_long$metric))  
  
# capitalize each word  
 metrics\_long$metric <- tools::toTitleCase(metrics\_long$metric)  
   
# adjust name  
 metrics\_long$metric <- gsub("With-in", 'Within',  
 as.character(metrics\_long$metric))  
   
# change levels, moving other to the end  
 metrics\_long$metric <- factor(metrics\_long$metric,  
 c("Abundance/Density",  
 "Amount",  
 "Composition",  
 "Detection",  
 "Diversity Index",  
 "Evenness",  
 "Movement",  
 "Occurrence",  
 "Population Dynamics",  
 "Quality",  
 "Richness",  
 "Within Species Diversity"  
 ))  
   
# check levels  
 levels(as.factor(metrics\_long$metric))  
  
# get summary  
 metric\_flow <- ddply(metrics\_long,  
 .(metric\_type, metric, tc, sig\_effect),  
 summarize,  
 # total count of entries   
 count=length(metric))  
  
# save as csv  
# write.csv(metric\_flow, paste0(tab.dir,'synthesis\_sig\_effects\_metric\_and\_flow.csv'),row.names = TRUE)  
  
# sig\_effects level change  
 metric\_flow$sig\_effect <- gsub("\\s\*\\([^\\)]+\\)", '',  
 as.character(metric\_flow$sig\_effect))  
 metric\_flow$sig\_effect <- factor(metric\_flow$sig\_effect,  
 c( "Beneficial","Harmful","Changed","Not significant or unclear"))  
# telecoupling level change  
   
 q <- table(metric\_flow$tc)  
 q <- q[order(-(q))]  
 tc.sorted <- names(q)  
 metric\_flow$tc <- factor(metric\_flow$tc,tc.sorted)

## [1] "Abundance/Density (biomass, mass, number of individuals, individuals/unit area)"  
## [2] "Abundance/Density (number of individuals, individuals/unit area, biomass)"   
## [3] "Amount (e.g. land use change from non-habitat to habitat)"   
## [4] "Composition (what species?)"   
## [5] "Diversity index (Shannon-Weiner, Simpson's, Inverse Simpson's, etc.)"   
## [6] "Evenness"   
## [7] "Movement"   
## [8] "Occurrence"   
## [9] "Occurrence (presence, range, persistence, etc., NOT detection)"   
## [10] "Population dynamics (survival, fitness, reproduction, mortality, etc.)"   
## [11] "Quality (pollution, connectence, disturbance, etc.)"   
## [12] "Richness (number of species)"   
## [13] "With-in species diversity (genetic diversity, age structure, etc.)"   
## [1] "Abundance/Density" "Amount"   
## [3] "Composition" "Detection"   
## [5] "Diversity Index" "Evenness"   
## [7] "Movement" "Occurrence"   
## [9] "Population Dynamics" "Quality"   
## [11] "Richness" "Within Species Diversity"

## Flow & Taxa data

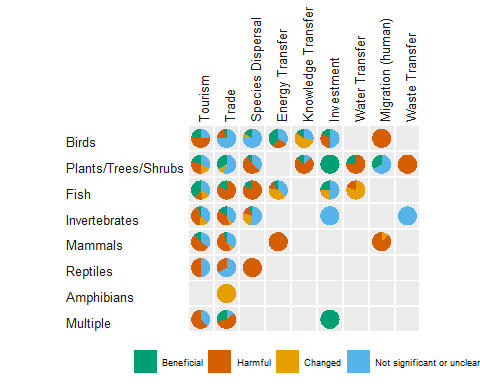
Convert to long format, where metric is indicated.

# get summary  
 metric\_flow <- ddply(metrics\_long,  
 .(taxa, tc, sig\_effect),  
 summarize,  
 # total count of entries   
 count=length(metric))  
  
# save as csv  
# write.csv(metric\_flow, paste0(tab.dir,'synthesis\_sig\_effects\_metric\_and\_flow.csv'),row.names = TRUE)  
  
# sig\_effects level change  
 metric\_flow$sig\_effect <- gsub("\\s\*\\([^\\)]+\\)", '',  
 as.character(metric\_flow$sig\_effect))  
 metric\_flow$sig\_effect <- factor(metric\_flow$sig\_effect,  
 c( "Beneficial","Harmful","Changed","Not significant or unclear"))  
 metric\_flow$tc <- factor(metric\_flow$tc,tc.sorted)  
   
 q <- table(metric\_flow$taxa)  
 q <- q[order(-(q))]  
 taxa.sorted <- names(q);taxa.sorted  
 taxa.sorted <- c(taxa.sorted,taxa.sorted[6])  
 taxa.sorted <-taxa.sorted[-6]  
 metric\_flow$taxa <- factor(metric\_flow$taxa,taxa.sorted)

## [1] "Birds" "Plants/Trees/Shrubs" "Fish"   
## [4] "Invertebrates" "Mammals" "Multiple"   
## [7] "Reptiles" "Amphibians"

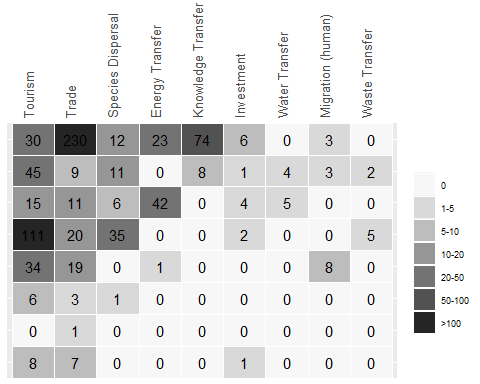
##Flow and taxa figure

# Matrix of pie charts  
 sig\_effect\_cols <- sigeff\_col  
  
 metric\_flow\_fig <- ggplot(metric\_flow) +  
 aes(x='', y = count, fill = sig\_effect) +  
 geom\_bar(position='fill',  
 stat='identity',  
 width = 1,  
 size = 0.01) +  
 # activate for vertical or horizontal version  
 facet\_grid(taxa ~ tc, switch='y') + #horizontal  
 #facet\_grid(tc ~ metric, switch='y') + #vertical  
 # convert to pie chart  
 coord\_polar(theta = 'y') +  
 # colors  
 scale\_fill\_manual(  
 values=sig\_effect\_cols,  
 guide = guide\_legend(reverse = FALSE)) +  
 scale\_y\_discrete(position='right',expand=c(0,0))+  
 # style  
 theme\_gray(base\_size=8)+  
 theme(  
 axis.title=element\_blank(),  
 axis.line=element\_blank(),  
 axis.ticks=element\_blank(),  
 axis.text=element\_blank(),  
   
 legend.position = "bottom",  
 legend.justification='center',  
 legend.direction='horizontal',  
 legend.title = element\_blank(),  
   
 panel.border = element\_blank(),  
 panel.grid=element\_blank(),  
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),  
 plot.background = element\_rect(),  
 plot.title=element\_blank(),  
 strip.text.x = element\_text(size=10,  
 angle=90, vjust=0, hjust = 0),  
 strip.text.y.left = element\_text(size=10,  
 angle=0, vjust=0, hjust = 0),  
 strip.background = element\_rect(fill='white'),  
 panel.spacing = unit(0.1, 'lines')  
 ) +  
 # labels  
 ylab('') + xlab('')  
  
  
  
# display image  
 metric\_flow\_fig



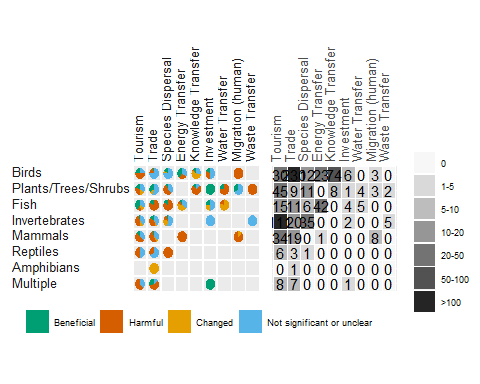
Flow Taxa Heatmap

# Load data of number of studies by taxa and flow  
nr\_metric\_tele <- aggregate(x = metric\_flow$count,  
 by = list(metric\_flow$taxa, metric\_flow$tc),  
 FUN = sum)  
  
   
  
# Rename columns  
  
names(nr\_metric\_tele)[1:3] <- c("taxa", "telecoupling", "count")  
  
# Fill the gaps  
  
mat\_nr\_metric\_tele <-dcast(nr\_metric\_tele, taxa ~ telecoupling, value.var = 'count')  
filled\_nr\_metric\_tele <- melt(mat\_nr\_metric\_tele, id=c("taxa"))  
filled\_nr\_metric\_tele[is.na(filled\_nr\_metric\_tele)] <- 0  
names(filled\_nr\_metric\_tele)[2:3] <- c("telecoupling", "count")  
  
# Create 'count' categories for representation  
  
filled\_nr\_metric\_tele$count\_factor <- cut(filled\_nr\_metric\_tele$count,  
 breaks = c(-1,0,5,10,20,50,100,max(filled\_nr\_metric\_tele$count,na.rm=T)),  
 labels=c("0","1-5","5-10","10-20","20-50","50-100",">100"))  
  
  
# Change order of factor levels for consistency with other figures  
filled\_nr\_metric\_tele$taxa <- factor(filled\_nr\_metric\_tele$taxa, rev(taxa.sorted))  
  
# Heatmap plot  
  
heatmap\_telemetric <- ggplot(filled\_nr\_metric\_tele,  
 aes(x=telecoupling, y=taxa, fill=count\_factor)) +  
 geom\_tile(color = "white", size=0.25) +  
 geom\_text(aes(label = count )) +  
 scale\_fill\_manual(values=heat\_col)+  
 labs(x="",y="")+  
 scale\_y\_discrete(expand=c(0,0))+  
 theme\_grey(base\_size=8)+  
  
 theme(legend.title = element\_blank(),  
 # legend.text = element\_blank(),  
 legend.position = "right",  
 plot.background=element\_blank(),  
 plot.title = element\_blank(),  
 axis.title= element\_blank(),  
 axis.ticks = element\_blank(),  
 axis.text.x.top = element\_text(size=10, angle = 90, vjust=0,  
 hjust = 0),  
 axis.text.y.left = element\_blank(),  
 strip.background = element\_rect(fill="white"),  
 panel.spacing = unit(0.1, "lines")) +  
 scale\_x\_discrete(position = "top") +  
 labs(fill = "number of entries")  
  
heatmap\_telemetric



Side by side plot

# grid.arrange(metric\_flow\_fig, heatmap\_telemetric, ncol=2)  
k<-ggarrange(metric\_flow\_fig, heatmap\_telemetric, ncol=2)



#This actually save the plot in a image  
 ggsave(file="figure2\_Pies.svg", plot=metric\_flow\_fig, width=10, height=8)  
 ggsave(file="figure2\_Heat.svg", plot=heatmap\_telemetric, width=10, height=8)  
 ggsave(file="figure2\_Full.svg", plot=k, width=10, height=8)

## Country/Region Entry Effects

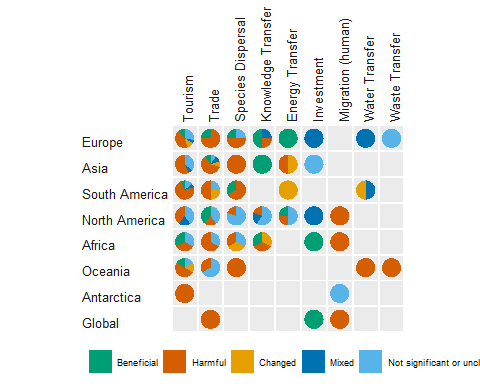
NOTE: Needed to repeat one of the rows because one study contained two continents, this makes the n go from 153 to 154

# Get continents, tc\_cat, and maj\_eff  
ctr\_tc\_raw <- subset(taxEff\_maj\_rep, select = c('paper\_id', 'bd\_continents', 'tc', 'maj\_eff\_taxa'))  
   
print(paste('Original number of rows:',nrow(ctr\_tc\_raw)))  
  
# split multiple flows listed in a row into other new rows  
 ctr\_tc\_raw <- separate\_rows(ctr\_tc\_raw, bd\_continents, sep=";", convert = TRUE)  
  
# show new length of rows  
 print(paste('Number of rows after separating multiple flows per paper:',nrow(ctr\_tc\_raw)))

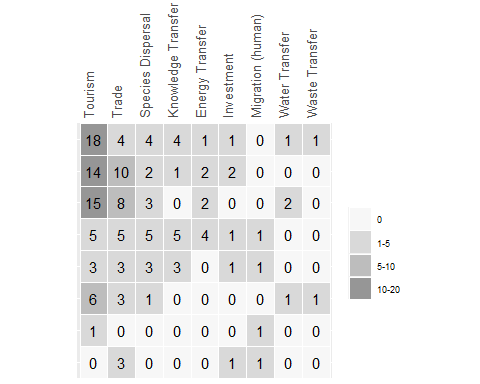
## [1] "Original number of rows: 153"  
## [1] "Number of rows after separating multiple flows per paper: 154"

# sig\_effects level change  
 ctr\_tc\_raw$maj\_eff\_taxa <- factor( ctr\_tc\_raw$maj\_eff\_taxa,  
 c( "Beneficial","Harmful","Changed","Mixed","Not significant or unclear"))  
# telecoupling level change  
  
 q <- table(ctr\_tc\_raw$tc)  
 q <- q[order(-(q))]  
 tc.sorted <- names(q)  
 ctr\_tc\_raw$tc <- factor( ctr\_tc\_raw$tc,tc.sorted)  
   
# continent level change   
 q <- table(ctr\_tc\_raw$bd\_continents)  
 q <- q[order(-(q))]  
 cont.sorted <- names(q)  
 cont.sorted <- c(cont.sorted[-7],cont.sorted[7])  
 ctr\_tc\_raw$bd\_continents <- factor(ctr\_tc\_raw$bd\_continents,cont.sorted)

ctr\_tc\_count <- ddply(ctr\_tc\_raw,  
 .(bd\_continents, tc, maj\_eff\_taxa),  
 summarize,  
 # total count of entries   
 count=length(maj\_eff\_taxa))  
cont\_impact <- ddply(ctr\_tc\_raw,  
 .(bd\_continents, maj\_eff\_taxa),  
 summarize,  
 # total count of entries   
 count=length(maj\_eff\_taxa)) %>%  
 group\_by(bd\_continents) %>%  
 nest() %>%   
 mutate(perc\_per\_taxa=map(data, function(x) x$count/sum(x$count))) %>%   
 unnest(cols = c(data, perc\_per\_taxa))  
  
ctr\_tc\_fig <- ggplot(ctr\_tc\_count) +  
 aes(x='', y = count, fill = maj\_eff\_taxa) +  
 geom\_bar(position='fill',  
 stat='identity',  
 width = 1,  
 size = 0.01) +  
 # activate for vertical or horizontal version  
 facet\_grid(bd\_continents ~ tc, switch='y') + #horizontal  
 #facet\_grid(tc ~ metric, switch='y') + #vertical  
 # convert to pie chart  
 coord\_polar(theta = 'y') +  
 # colors  
 scale\_fill\_manual(  
 values=majeff\_col,  
 guide = guide\_legend(reverse = FALSE)) +  
 scale\_y\_discrete(position='right',expand=c(0,0))+  
 # style  
 theme\_gray(base\_size=8)+  
 theme(  
 axis.title=element\_blank(),  
 axis.line=element\_blank(),  
 axis.ticks=element\_blank(),  
 axis.text=element\_blank(),  
   
 legend.position = "bottom",  
 legend.justification='center',  
 legend.direction='horizontal',  
 legend.title = element\_blank(),  
   
 panel.border = element\_blank(),  
 panel.grid=element\_blank(),  
 panel.grid.major = element\_blank(),  
 panel.grid.minor = element\_blank(),  
 plot.background = element\_rect(),  
 plot.title=element\_blank(),  
 strip.text.x = element\_text(size=10,  
 angle=90, vjust=0, hjust = 0),  
 strip.text.y.left = element\_text(size=10,  
 angle=0, vjust=0, hjust = 0),  
 strip.background = element\_rect(fill='white'),  
 panel.spacing = unit(0.1, 'lines'),  
 aspect.ratio = 1) +  
 # labels  
 ylab('') + xlab('')  
  
  
  
# display image  
 ctr\_tc\_fig

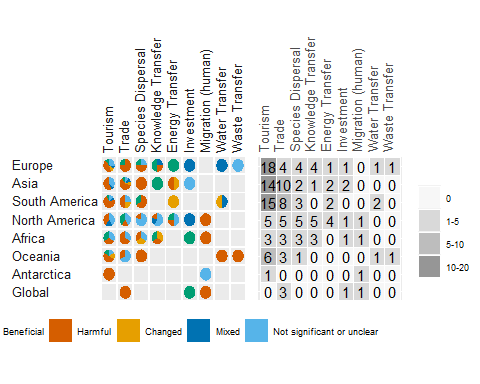


cont\_freq <- as.data.frame(cbind(ctr\_tc\_count$bd\_continents,ctr\_tc\_count$count))  
cont\_freq$V2<-as.numeric(cont\_freq$V2)  
sum(as.numeric(cont\_freq$V2))  
  
hi <-aggregate(x = cont\_freq$V2, by = list(cont\_freq$V1), FUN = sum)  
hi <- hi[order(-hi$x),]  
hi$perc <- hi$x / (sum(hi$x)) \* 100  
  
  
num\_ctr\_tele <- aggregate(x = ctr\_tc\_count$count,  
 by = list(ctr\_tc\_count$bd\_continents, ctr\_tc\_count$tc),  
 FUN = sum)  
  
  
  
names(num\_ctr\_tele)[1:3] <- c("continent", "telecoupling", "count")  
  
num\_ctr\_tele$continent <- factor(num\_ctr\_tele$continent, rev(cont.sorted) )  
  
  
# Fill the gaps  
  
mat\_num\_ctr\_tele <-dcast(num\_ctr\_tele, continent ~ telecoupling, value.var = 'count')  
filled\_num\_ctr\_tele <- melt(mat\_num\_ctr\_tele, id=c("continent"))  
filled\_num\_ctr\_tele[is.na(filled\_num\_ctr\_tele)] <- 0  
names(filled\_num\_ctr\_tele)[2:3] <- c("telecoupling", "count")  
  
# Create 'count' categories for representation  
  
filled\_num\_ctr\_tele$count\_factor <- cut(filled\_num\_ctr\_tele$count,  
 breaks = c(-1,0,5,10,20,50,100,max(filled\_num\_ctr\_tele$count,na.rm=T)),  
 labels=c("0","1-5","5-10","10-20","20-50","50-100",">100"))  
  
  
# Change order of factor levels for consistency with other figures  
  
#filled\_num\_ctr\_tele$continent <- factor(filled\_num\_ctr\_tele$continent, c('South America','Oceania',  
#'North America', 'Europe','Asia','Antarctica','Africa'))  
  
# Heatmap plot  
  
heatmap\_tele\_ctr <- ggplot(filled\_num\_ctr\_tele,  
 aes(x=telecoupling, y=continent, fill=count\_factor)) +  
 geom\_tile(color = "white", size=0.25) +  
 geom\_text(aes(label = count )) +  
 scale\_fill\_manual(values=heat\_col)+  
 labs(x="",y="")+  
 scale\_y\_discrete(expand=c(0,0))+  
 theme\_grey(base\_size=8)+  
  
 theme(legend.title = element\_blank(),  
 # legend.text = element\_blank(),  
 legend.position = "right",  
 plot.background=element\_blank(),  
 plot.title = element\_blank(),  
 axis.title= element\_blank(),  
 axis.ticks = element\_blank(),  
 axis.text.x.top = element\_text(size=10, angle = 90, vjust=0,hjust = 0),  
 axis.text.y.left = element\_blank(),  
 strip.background = element\_rect(fill="white"),  
 panel.spacing = unit(0.1, "lines"),  
 aspect.ratio = 1) +  
 scale\_x\_discrete(position = "top") +  
 labs(fill = "number of entries")  
  
heatmap\_tele\_ctr



## [1] 154

k<-ggarrange(ctr\_tc\_fig, heatmap\_tele\_ctr, ncol=2)



#This actually save the plot in a image  
 ggsave(file="figure4\_Pies.svg", plot=ctr\_tc\_fig, width=10, height=8)  
 ggsave(file="figure4\_Heat.svg", plot=heatmap\_tele\_ctr, width=10, height=8)  
 ggsave(file="figure4\_Full.svg", plot=k, width=10, height=8)

Metric types

# subset  
 metrics2 <- subset(s23,  
 select=c('paper\_id','entry\_id','taxa',  
 'biodiv\_cat\_1sp',  
 'biodiv\_cat\_multsp',  
 'biodiv\_cat\_habitat'))  
# melt  
 metrics\_long2 <- melt(metrics2, id.vars=c('paper\_id','entry\_id',  
 'taxa'))  
   
# remove NA fields  
 metrics\_long2 <- metrics\_long2[!is.na(metrics\_long2$value),]  
  
# change colnames  
 colnames(metrics\_long2)[4] <- 'metric\_type'  
 colnames(metrics\_long2)[5] <- 'metric'  
  
metrics\_long2$metric\_name <- paste0(metrics\_long2$metric\_type,'\_', metrics\_long2$metric)  
  
metric\_freq<-as.data.frame(table(metrics\_long2$metric\_name))  
metric\_freq <- metric\_freq[order(-metric\_freq$Freq),]  
total\_met <- nrow(s23)  
metric\_freq$perc <- (metric\_freq$Freq/total\_met)\*100  
  
  
table(s23$biodiv\_cat\_1sp)  
abun <- s23[which(s23$biodiv\_cat\_1sp == 'Abundance/Density (number of individuals, individuals/unit area, biomass)'),]  
occ <- s23[which(s23$biodiv\_cat\_1sp == 'Occurrence (presence, range, persistence, etc., NOT detection)'),]

##   
## Abundance/Density (number of individuals, individuals/unit area, biomass)   
## 188   
## Movement   
## 5   
## Occurrence (presence, range, persistence, etc., NOT detection)   
## 186   
## Population dynamics (survival, fitness, reproduction, mortality, etc.)   
## 5   
## With-in species diversity (genetic diversity, age structure, etc.)   
## 32

# Number check for Manuscript

## Abstract

### Percentage of impacts

Numbers with repeating tc, n=153

nrow(taxEff\_maj\_rep)  
table(taxEff\_maj\_rep$maj\_eff\_taxa)  
prop.table(table(taxEff\_maj\_rep$maj\_eff\_taxa))

## [1] 153  
##   
## Beneficial Harmful   
## 19 72   
## Changed Mixed   
## 12 11   
## Not significant or unclear   
## 39   
##   
## Beneficial Harmful   
## 0.12418301 0.47058824   
## Changed Mixed   
## 0.07843137 0.07189542   
## Not significant or unclear   
## 0.25490196

Numbers with no repeating tc, n=136 USED FOR MS

nrow(taxEff\_maj)  
table(taxEff\_maj$maj\_eff\_taxa)  
prop.table(table(taxEff\_maj$maj\_eff\_tax))

## [1] 136  
##   
## Beneficial Harmful   
## 16 67   
## Changed Mixed   
## 11 9   
## Not significant or unclear   
## 33   
##   
## Beneficial Harmful   
## 0.11764706 0.49264706   
## Changed Mixed   
## 0.08088235 0.06617647   
## Not significant or unclear   
## 0.24264706

## Results

### Paragraph 1 - Impacts on Biodiversity, Metric-Level

Number of entries/metrics, n=767

nrow(s23)

## [1] 766

Percentage impact type among metrics/entries

table(s23$sig\_effect)  
prop.table(table(s23$sig\_effect))

##   
## Beneficial Changed   
## 82 101   
## Harmful Not significant or unclear   
## 225 358   
##   
## Beneficial Changed   
## 0.1070496 0.1318538   
## Harmful Not significant or unclear   
## 0.2937337 0.4673629

Freq of metric type

metric\_freq

## Var1  
## 1 biodiv\_cat\_1sp\_Abundance/Density (number of individuals, individuals/unit area, biomass)  
## 3 biodiv\_cat\_1sp\_Occurrence (presence, range, persistence, etc., NOT detection)  
## 8 biodiv\_cat\_multsp\_Abundance/Density (biomass, mass, number of individuals, individuals/unit area)  
## 14 biodiv\_cat\_multsp\_Richness (number of species)  
## 10 biodiv\_cat\_multsp\_Diversity index (Shannon-Weiner, Simpson's, Inverse Simpson's, etc.)  
## 9 biodiv\_cat\_multsp\_Composition (what species?)  
## 5 biodiv\_cat\_1sp\_With-in species diversity (genetic diversity, age structure, etc.)  
## 13 biodiv\_cat\_multsp\_Population dynamics (survival, fitness, reproduction, mortality, etc.)  
## 7 biodiv\_cat\_habitat\_Quality (pollution, connectence, disturbance, etc.)  
## 6 biodiv\_cat\_habitat\_Amount (e.g. land use change from non-habitat to habitat)  
## 12 biodiv\_cat\_multsp\_Occurrence  
## 2 biodiv\_cat\_1sp\_Movement  
## 4 biodiv\_cat\_1sp\_Population dynamics (survival, fitness, reproduction, mortality, etc.)  
## 11 biodiv\_cat\_multsp\_Evenness  
## Freq perc  
## 1 188 24.5430809  
## 3 186 24.2819843  
## 8 110 14.3603133  
## 14 107 13.9686684  
## 10 54 7.0496084  
## 9 37 4.8302872  
## 5 32 4.1775457  
## 13 13 1.6971279  
## 7 9 1.1749347  
## 6 8 1.0443864  
## 12 7 0.9138381  
## 2 5 0.6527415  
## 4 5 0.6527415  
## 11 5 0.6527415

### Paragraph 2 - Multiple bd metrics

Percent of articles reporting mult bd metrics

num.metric <- count(survey3$paper\_id)  
mult.metric <- num.metric[num.metric$freq > 1,]  
nrow(mult.metric)/131

## [1] 0.7022901

Range of metric number

range(num.metric$freq)

## [1] 1 162

### Paragraph 3 - Impacts on biodiversity, Study-Level

Percent impact of study level vs metric level

Table of study level

prop.table(table(taxEff\_maj$maj\_eff\_tax))

##   
## Beneficial Harmful   
## 0.11764706 0.49264706   
## Changed Mixed   
## 0.08088235 0.06617647   
## Not significant or unclear   
## 0.24264706

Table of metric level

prop.table(table(s23$sig\_effect))

##   
## Beneficial Changed   
## 0.1070496 0.1318538   
## Harmful Not significant or unclear   
## 0.2937337 0.4673629

Percent impact at study level for taxa

taxa.bar.data[which(taxa.bar.data$taxa == 'Mammals'),]   
taxa.bar.data[which(taxa.bar.data$taxa == 'Birds'),]   
taxa.bar.data[which(taxa.bar.data$taxa == 'Plants/Trees/Shrubs'),]  
taxa.bar.data[which(taxa.bar.data$taxa == 'Fish'),]  
taxa.bar.data[which(taxa.bar.data$taxa == 'Invertebrates'),]  
taxa.bar.data[which(taxa.bar.data$taxa == 'Reptiles'),]  
taxa.bar.data[which(taxa.bar.data$taxa == 'Amphibians'),]  
taxa.bar.data[which(taxa.bar.data$taxa == 'Multiple'),]

## # A tibble: 3 x 4  
## # Groups: taxa [1]  
## taxa maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Mammals Beneficial 1 0.0667  
## 2 Mammals Harmful 12 0.8   
## 3 Mammals Not significant or unclear 2 0.133   
## # A tibble: 5 x 4  
## # Groups: taxa [1]  
## taxa maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Birds Beneficial 7 0.189   
## 2 Birds Harmful 16 0.432   
## 3 Birds Changed 2 0.0541  
## 4 Birds Mixed 4 0.108   
## 5 Birds Not significant or unclear 8 0.216   
## # A tibble: 5 x 4  
## # Groups: taxa [1]  
## taxa maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Plants/Trees/Shrubs Beneficial 4 0.143   
## 2 Plants/Trees/Shrubs Harmful 12 0.429   
## 3 Plants/Trees/Shrubs Changed 3 0.107   
## 4 Plants/Trees/Shrubs Mixed 2 0.0714  
## 5 Plants/Trees/Shrubs Not significant or unclear 7 0.25   
## # A tibble: 5 x 4  
## # Groups: taxa [1]  
## taxa maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Fish Beneficial 2 0.133  
## 2 Fish Harmful 6 0.4   
## 3 Fish Changed 3 0.2   
## 4 Fish Mixed 2 0.133  
## 5 Fish Not significant or unclear 2 0.133  
## # A tibble: 5 x 4  
## # Groups: taxa [1]  
## taxa maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Invertebrates Beneficial 1 0.0323  
## 2 Invertebrates Harmful 15 0.484   
## 3 Invertebrates Changed 2 0.0645  
## 4 Invertebrates Mixed 1 0.0323  
## 5 Invertebrates Not significant or unclear 12 0.387   
## # A tibble: 2 x 4  
## # Groups: taxa [1]  
## taxa maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Reptiles Harmful 3 0.6  
## 2 Reptiles Not significant or unclear 2 0.4  
## # A tibble: 1 x 4  
## # Groups: taxa [1]  
## taxa maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Amphibians Changed 1 1  
## # A tibble: 2 x 4  
## # Groups: taxa [1]  
## taxa maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Multiple Beneficial 1 0.25  
## 2 Multiple Harmful 3 0.75

### Paragraph 4 - Percent impact at study level for flow

Impact percentages by flow

flow\_bar\_data[which(flow\_bar\_data$tc == 'Tourism'),]   
flow\_bar\_data[which(flow\_bar\_data$tc == 'Trade'),]   
flow\_bar\_data[which(flow\_bar\_data$tc == 'Species Dispersal'),]   
flow\_bar\_data[which(flow\_bar\_data$tc == 'Investment'),]   
flow\_bar\_data[which(flow\_bar\_data$tc == 'Knowledge Transfer'),]   
flow\_bar\_data[which(flow\_bar\_data$tc == 'Water Transfer'),]   
flow\_bar\_data[which(flow\_bar\_data$tc == 'Energy Transfer'),]

## # A tibble: 5 x 4  
## # Groups: tc [1]  
## tc maj\_eff\_taxa count perc\_per\_tc  
## <fct> <fct> <int> <dbl>  
## 1 Tourism Beneficial 5 0.0806  
## 2 Tourism Harmful 34 0.548   
## 3 Tourism Changed 3 0.0484  
## 4 Tourism Mixed 4 0.0645  
## 5 Tourism Not significant or unclear 16 0.258   
## # A tibble: 5 x 4  
## # Groups: tc [1]  
## tc maj\_eff\_taxa count perc\_per\_tc  
## <fct> <fct> <int> <dbl>  
## 1 Trade Beneficial 4 0.111   
## 2 Trade Harmful 20 0.556   
## 3 Trade Changed 3 0.0833  
## 4 Trade Mixed 1 0.0278  
## 5 Trade Not significant or unclear 8 0.222   
## # A tibble: 4 x 4  
## # Groups: tc [1]  
## tc maj\_eff\_taxa count perc\_per\_tc  
## <fct> <fct> <int> <dbl>  
## 1 Species Dispersal Beneficial 2 0.118   
## 2 Species Dispersal Harmful 8 0.471   
## 3 Species Dispersal Changed 1 0.0588  
## 4 Species Dispersal Not significant or unclear 6 0.353   
## # A tibble: 3 x 4  
## # Groups: tc [1]  
## tc maj\_eff\_taxa count perc\_per\_tc  
## <fct> <fct> <int> <dbl>  
## 1 Investment Beneficial 2 0.333  
## 2 Investment Mixed 2 0.333  
## 3 Investment Not significant or unclear 2 0.333  
## # A tibble: 5 x 4  
## # Groups: tc [1]  
## tc maj\_eff\_taxa count perc\_per\_tc  
## <fct> <fct> <int> <dbl>  
## 1 Knowledge Transfer Beneficial 4 0.308   
## 2 Knowledge Transfer Harmful 3 0.231   
## 3 Knowledge Transfer Changed 1 0.0769  
## 4 Knowledge Transfer Mixed 2 0.154   
## 5 Knowledge Transfer Not significant or unclear 3 0.231   
## # A tibble: 3 x 4  
## # Groups: tc [1]  
## tc maj\_eff\_taxa count perc\_per\_tc  
## <fct> <fct> <int> <dbl>  
## 1 Water Transfer Harmful 1 0.25  
## 2 Water Transfer Changed 1 0.25  
## 3 Water Transfer Mixed 2 0.5   
## # A tibble: 4 x 4  
## # Groups: tc [1]  
## tc maj\_eff\_taxa count perc\_per\_tc  
## <fct> <fct> <int> <dbl>  
## 1 Energy Transfer Beneficial 2 0.222  
## 2 Energy Transfer Harmful 2 0.222  
## 3 Energy Transfer Changed 3 0.333  
## 4 Energy Transfer Not significant or unclear 2 0.222

### Paragraph 5 - Percent impact by region

Frequency of Regions, tc repeated (USE ctr\_tc\_count for tc specific numbers)

prop.table(table(ctr\_tc\_raw$bd\_continents))

##   
## Europe Asia South America North America Africa   
## 0.22077922 0.20129870 0.19480519 0.16883117 0.09090909   
## Oceania Antarctica Global   
## 0.07792208 0.01298701 0.03246753

Impact percent for Regions, tc repeated (USE ctr\_tc\_count for tc specific numbers)

cont\_impact[which(cont\_impact$bd\_continents == 'Europe'),]  
cont\_impact[which(cont\_impact$bd\_continents == 'Asia'),]  
cont\_impact[which(cont\_impact$bd\_continents == 'South America'),]  
cont\_impact[which(cont\_impact$bd\_continents == 'North America'),]  
cont\_impact[which(cont\_impact$bd\_continents == 'Oceania'),]  
cont\_impact[which(cont\_impact$bd\_continents == 'Africa'),]  
cont\_impact[which(cont\_impact$bd\_continents == 'Antarctica'),]  
cont\_impact[which(cont\_impact$bd\_continents == 'Global'),]

## # A tibble: 5 x 4  
## # Groups: bd\_continents [1]  
## bd\_continents maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Europe Beneficial 7 0.206   
## 2 Europe Harmful 14 0.412   
## 3 Europe Changed 2 0.0588  
## 4 Europe Mixed 4 0.118   
## 5 Europe Not significant or unclear 7 0.206   
## # A tibble: 5 x 4  
## # Groups: bd\_continents [1]  
## bd\_continents maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Asia Beneficial 2 0.0645  
## 2 Asia Harmful 17 0.548   
## 3 Asia Changed 2 0.0645  
## 4 Asia Mixed 2 0.0645  
## 5 Asia Not significant or unclear 8 0.258   
## # A tibble: 5 x 4  
## # Groups: bd\_continents [1]  
## bd\_continents maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 South America Beneficial 2 0.0667  
## 2 South America Harmful 17 0.567   
## 3 South America Changed 5 0.167   
## 4 South America Mixed 2 0.0667  
## 5 South America Not significant or unclear 4 0.133   
## # A tibble: 4 x 4  
## # Groups: bd\_continents [1]  
## bd\_continents maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 North America Beneficial 3 0.115  
## 2 North America Harmful 7 0.269  
## 3 North America Mixed 3 0.115  
## 4 North America Not significant or unclear 13 0.5   
## # A tibble: 4 x 4  
## # Groups: bd\_continents [1]  
## bd\_continents maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Oceania Beneficial 1 0.0833  
## 2 Oceania Harmful 7 0.583   
## 3 Oceania Changed 1 0.0833  
## 4 Oceania Not significant or unclear 3 0.25   
## # A tibble: 4 x 4  
## # Groups: bd\_continents [1]  
## bd\_continents maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Africa Beneficial 3 0.214  
## 2 Africa Harmful 6 0.429  
## 3 Africa Changed 2 0.143  
## 4 Africa Not significant or unclear 3 0.214  
## # A tibble: 2 x 4  
## # Groups: bd\_continents [1]  
## bd\_continents maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Antarctica Harmful 1 0.5  
## 2 Antarctica Not significant or unclear 1 0.5  
## # A tibble: 2 x 4  
## # Groups: bd\_continents [1]  
## bd\_continents maj\_eff\_taxa count perc\_per\_taxa  
## <fct> <fct> <int> <dbl>  
## 1 Global Beneficial 1 0.2  
## 2 Global Harmful 4 0.8

### Paragraph 6 - Search result

Number of articles from search

nrow(ab\_all)

## [1] 7306

Number of articles in sample

nrow(s2)

## [1] 131

### Paragraph 7 - Flow freq in sample

Number of articles in sample

nrow(s2)

## [1] 131

Flow frequency

tc.count

## tc.list tc.count perc  
## 6 Tourism 57 43.511450  
## 7 Trade 34 25.954198  
## 5 Species Dispersal 17 12.977099  
## 3 Knowledge Transfer 13 9.923664  
## 1 Energy Transfer 9 6.870229  
## 2 Investment 8 6.106870  
## 4 Migration (human) 4 3.053435  
## 9 Water Transfer 4 3.053435  
## 8 Waste Transfer 2 1.526718

Percentage of multiple tc

multiple/nrow(s2)

## TRUE   
## 0.1221374

### Paragraph 8 - Habitat and taxa freq in sample

Habitat freq

prop.table(table(s23\_maj$hab))

##   
## Freshwater Freshwater;Marine   
## 0.167938931 0.007633588   
## Marine Not specified/Global study   
## 0.190839695 0.015267176   
## Terrestrial Terrestrial;Freshwater   
## 0.572519084 0.030534351   
## Terrestrial;Marine   
## 0.015267176

Taxa freq

taxa.count

## taxa.list taxa.count perc  
## 5 Birds 37 28.2442748  
## 7 Invertebrates 31 23.6641221  
## 2 Plants 28 21.3740458  
## 1 Mammals 15 11.4503817  
## 6 Fish 15 11.4503817  
## 3 Reptiles 5 3.8167939  
## 8 Multiple 4 3.0534351  
## 4 Amphibians 1 0.7633588

### Paragraph 9 - Region freq in sample

Table of country freq

ctr\_bio

## # A tibble: 77 x 4  
## biodiv\_countries n continent ctr\_name   
## <chr> <int> <chr> <chr>   
## 1 BRA 19 South America Brazil, Federative Republic of  
## 2 USA 13 North America United States of America   
## 3 CHN 10 Asia China, People's Republic of   
## 4 AUS 8 Oceania Australia, Commonwealth of   
## 5 ESP 8 Europe Spain, Kingdom of   
## 6 ITA 7 Europe Italy, Italian Republic   
## 7 FRA 6 Europe France, French Republic   
## 8 DEU 5 Europe Germany, Federal Republic of   
## 9 GLO 5 Global Global   
## 10 IND 5 Asia India, Republic of   
## # ... with 67 more rows

Table of continent freq, n=131

cont.count

## cont.list cont.count perc  
## 4 Europe 30 22.900763  
## 2 South America 26 19.847328  
## 6 Asia 25 19.083969  
## 1 North America 22 16.793893  
## 3 Africa 11 8.396947  
## 5 Oceania 11 8.396947  
## 7 Antarctica 2 1.526718