Population abundance and apparent survival of the Vulnerable whale shark *Rhincodon typus* in the Seychelles aggregation

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Appendix *R* code for tag loss simulation

```
## Simulation to estimate whale shark tag loss
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## input data
## duration of intervals with tag retention
tag.ret.dur <- c(735,399,773,773,376,143,348,324,314,366,104,361)
tag.ret <- seq(1,length(tag.ret.dur),1)

## duration of intervals with guaranteed tag loss (identification via photo-ID after)
## including second tag type with higher loss rate
#tag.los.dur <- c(1470,377,358,1861,1522,986,755,322,375,320,384,740,356,278,378,338,312,47)

## excluding second tag type
tag.los.dur <- c(1470,377,358,1861,1522,986,755,322,375)
tag.los <- seq(1,length(tag.los.dur),1)

## iterate to calculate confidence intervals for tag retention probability
iter <- 1000
samp.siz <- length(c(tag.ret,tag.los))
#time.max <- max(c(tag.ret.dur,tag.los.dur))
time.max <- max(tag.ret.dur)

y1tagr.pr <- y2tagr.pr <- rep(0,1000)
have.tag.mat <- matrix(data=0,nrow=iter,ncol=time.max)

for (p in 1:iter) {

## choose tags
## random tag sample generation
tag.samp <- rep(0,samp.siz)

## time loop

have.tag.prob <- rep(0,time.max)
for (d in 1:time.max) {

have.tag <- rep(0,samp.siz)
for (s in 1:samp.siz) {

## retained or lost tag?
tag.samp[s] <- round(runif(1,1,2))

if (tag.samp[s] == 1) {
tag.num <- round(runif(1,1,max(tag.ret)))
tag.dur <- tag.ret.dur[tag.num]
have.tag[s] <- ifelse(tag.dur >= d, 1, 0.5)
}

if (tag.samp[s] == 2) {
tag.num <- round(runif(1,1,max(tag.los)))
tag.dur <- tag.los.dur[tag.num]
```

```
have.tag[s] <- ifelse(tag.dur > d, 0.5, 0)
}
} # end s loop

## daily probability of having a tag
have.tag.prob[d] <- mean(have.tag)

print(d)
} # end d loop

day.vec <- seq(1,time.max,1)
plot(day.vec,have.tag.prob,pch=19,type="l",ylim=c(0,1),xlim=c(1,750),ylab="Tag retention probability",xlab="Day")
abline(v=365)
abline(v=2*365)
title(main=p)

have.tag.mat[p,] <- have.tag.prob

## 1-year tag-retention probability
y1tagr.pr[p] <- have.tag.prob[365]

## 2-year tag-retention probability
y2tagr.pr[p] <- have.tag.prob[2*365]

print("iteration")
print(p)
print("------------------")

} # end p loop

## confidence intervals
tag.ret.lo <- tag.ret.mean <- tag.ret.up <- rep(0,time.max)
for (t in 1:time.max) {
tag.ret.lo[t] <- quantile(have.tag.mat[,t],probs=0.025)
tag.ret.mean[t] <- mean(have.tag.mat[,t])
tag.ret.up[t] <- quantile(have.tag.mat[,t],probs=0.975)
}

plot(day.vec,tag.ret.mean,type="l",lwd=2,ylim=c(0,1),xlim=c(1,750),ylab="Tag retention probability",xlab="Day")
lines(day.vec,tag.ret.lo,lwd=1,lty=3)
lines(day.vec,tag.ret.up,lwd=1,lty=3)
abline(v=365)
abline(v=2*365)

y1tagr.pr.lo <- quantile(y1tagr.pr,probs=0.025)
y1tagr.pr.up <- quantile(y1tagr.pr,probs=0.975)
y1tagr.pr.lo; y1tagr.pr.up

y2tagr.pr.lo <- quantile(y2tagr.pr,probs=0.025)
y2tagr.pr.up <- quantile(y2tagr.pr,probs=0.975)
y2tagr.pr.lo; y2tagr.pr.up

abline(h=y1tagr.pr.lo)
abline(h=y1tagr.pr.up)
```