Animal movement simulation

Pierre Cottais & An Hoàng

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Contents

1 Generating individual animal step lengths data (utilization distribution)

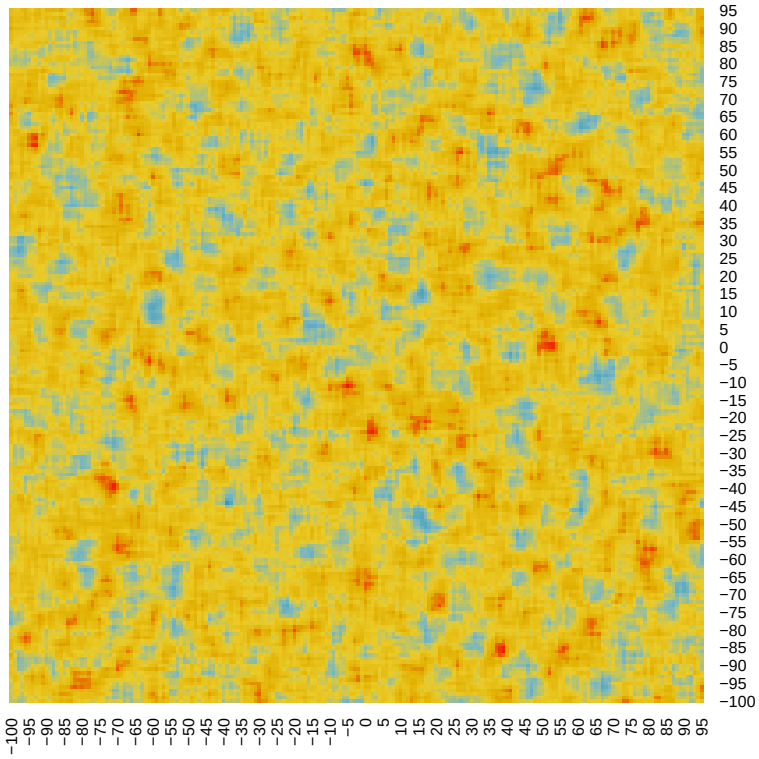
Probability of obtaining a sample at some distance, $l'_{t,i}$ from the previous observed point ($l'_{t,i} = ||x'_{t,i} - x$ is given by the gamma PDF:

$$g(l'_{t,i}|b_1, b_2) = \frac{1}{\Gamma(b_1).b1^{b2}}.l'^{b_1-1}_{t,i}.e^{-\frac{l'_{t,i}}{b_2}}$$

```
# Environment grid ver2
lat <- seq(-100,100, 1)
long <- seq(-100,100, 1)
n <- length(lat)
m <- length(long)
envi <- matrix(data = runif(n*m),nrow = n, ncol = m)
colnames(envi) <- lat
rownames(envi) <- long
```

```
#autocorection
p <- 5 #spatial unit

#sliding window
for (i in 1:(n-p)){
  for (j in 1:(m-p)){
    sub <- envi[i:(i+p),j:(j+p)]
    envi[i,j] = mean(sub)
  }
}
envi <- envi[1:(n-p),1:(m-p)]
```

```
pal <- wes_palette(40401,name = "Zissou1", type = "continuous")
heatmap(envi, Rowv = NA, Colv = NA, col = pal)
```

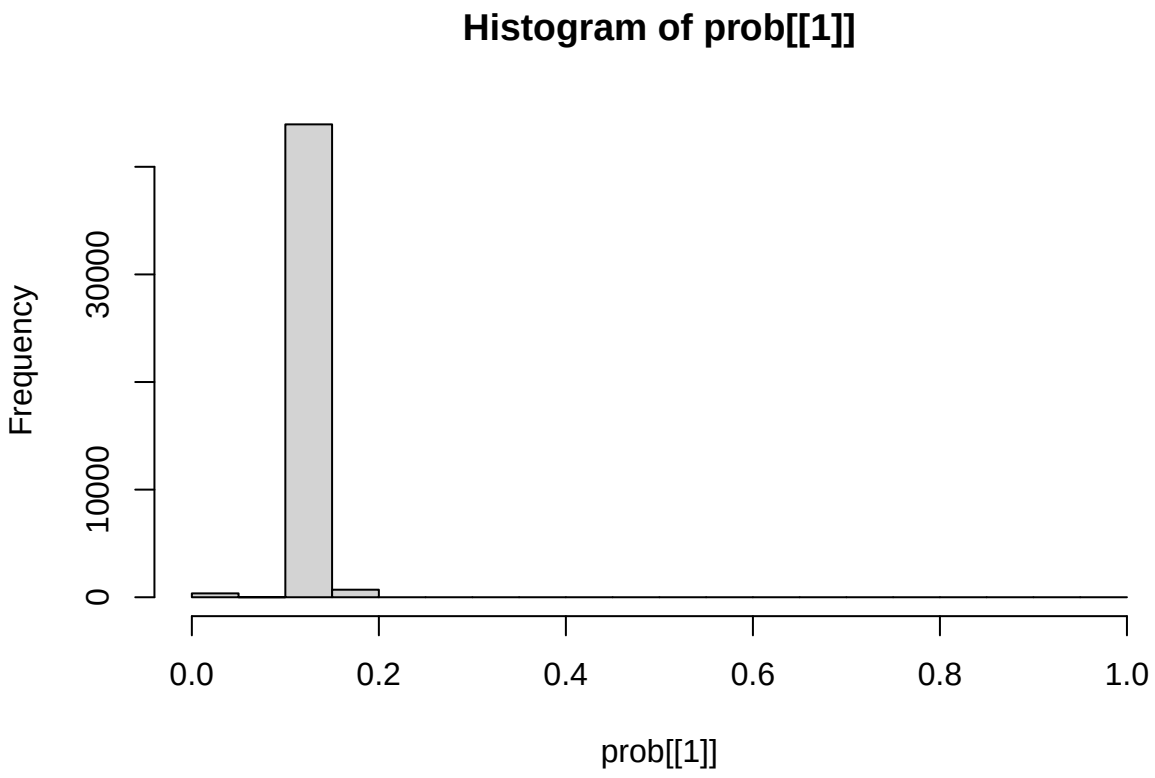



```r
# habitat selection step
mu <- 1.7918
# chose moving length always || x- x(t) || = 1
omega <- 1
#local habitat quality

# apply truncated redistribution calculus kernel to the whole grid-landscape
envi_exp <- exp(omega*envi-mu)

# adding two null columns at the "borders"
envi_exp <- cbind(rep(0, times = nrow(envi_exp)),
                  envi_exp,
                  rep(0, times = nrow(envi_exp)))
# adding two null rows at the "borders"
# adding two null columns at the "borders"
envi_exp <- rbind(rep(0, times = ncol(envi_exp)),
                  envi_exp,
                  rep(0, times = ncol(envi_exp)))
# envi_exp <- as.data.frame(envi_exp)

# number of burn-in steps
step1 <- 2*length(envi)^2
# number of simulate steps
step2 <- 10^5
# # starting point
# bird <- which(envi == max(envi), arr.ind = TRUE)
```

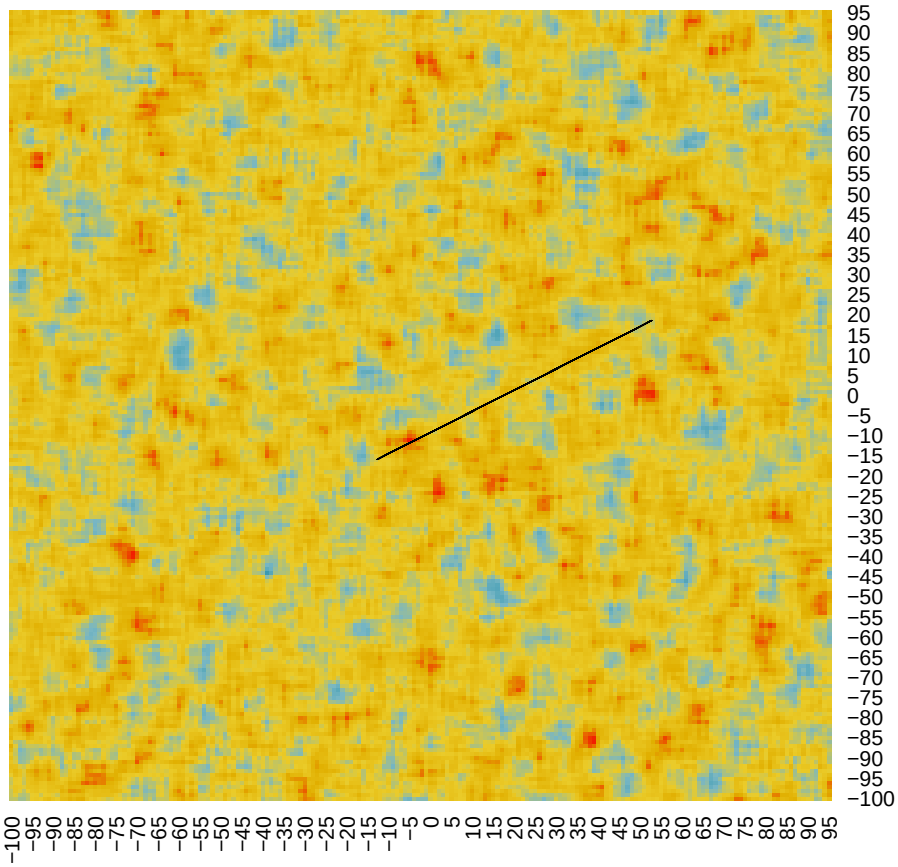
```r
moves <- function(steps){
  # declare vectors to be returned in a list
  coordinates <- cbind(rep(0, steps+1), rep(0, steps+1))
  prob_avail <- matrix(0, nrow = steps+1, ncol = 9)
  num_cell <- rep(0, steps+1)

  # matrix of avaible movements
  code <- cbind(rep(c(-1, 0, 1), 3), rep(c(-1, 0, 1), each = 3))

  # starting point (deterministic)
  coordinates[1,] <- which(envi_exp == max(envi_exp), arr.ind = TRUE)
  # coordinates[1,] <- c(2, 197)
  latitude <- coordinates[1,1]
  longitude <- coordinates[1,2]
  prob_avail[1,] <- c(0, 0, 0, 0, 1, 0, 0, 0, 0)
  num_cell[1] <- 5


  for(i in 1:steps){
    # print(dim(kernel))
    latitude <- coordinates[i,1]
    longitude <- coordinates[i,2]

    kernel <- envi_exp[(latitude-1):(latitude+1),
                       (longitude-1):(longitude+1)]

    probs <- kernel/sum(kernel)
    prob_avail[i+1,] <- c(probs)

    num_cell[i+1] <- which(rmultinom(1, 1, prob_avail[i+1,])==1)
    move <- code[num_cell[i+1],]
    coordinates[i+1,] <- c(latitude+move[1], longitude+move[2])
  }
  coord_dt <- as.data.frame(coordinates, row.names = FALSE)
  colnames(coord_dt) <- c("row", "col")
  list_avail <- list(prob_avail, num_cell)
  return(list(coord_dt, list_avail))
}
```

```r
nb_steps <- 5000
res <- moves(nb_steps)
coord <- res[[1]]
prob <- res[[2]]
```

```r
hist(prob[[1]])
```




```
heatmap(envi, Rowv = NA, Colv = NA, col = pal, cexRow = 0.8, cexCol = 0.8,
        margins = c(2, 1))
lines(envi[coord$row-1, coord$col-1], lwd = 0.2)
```

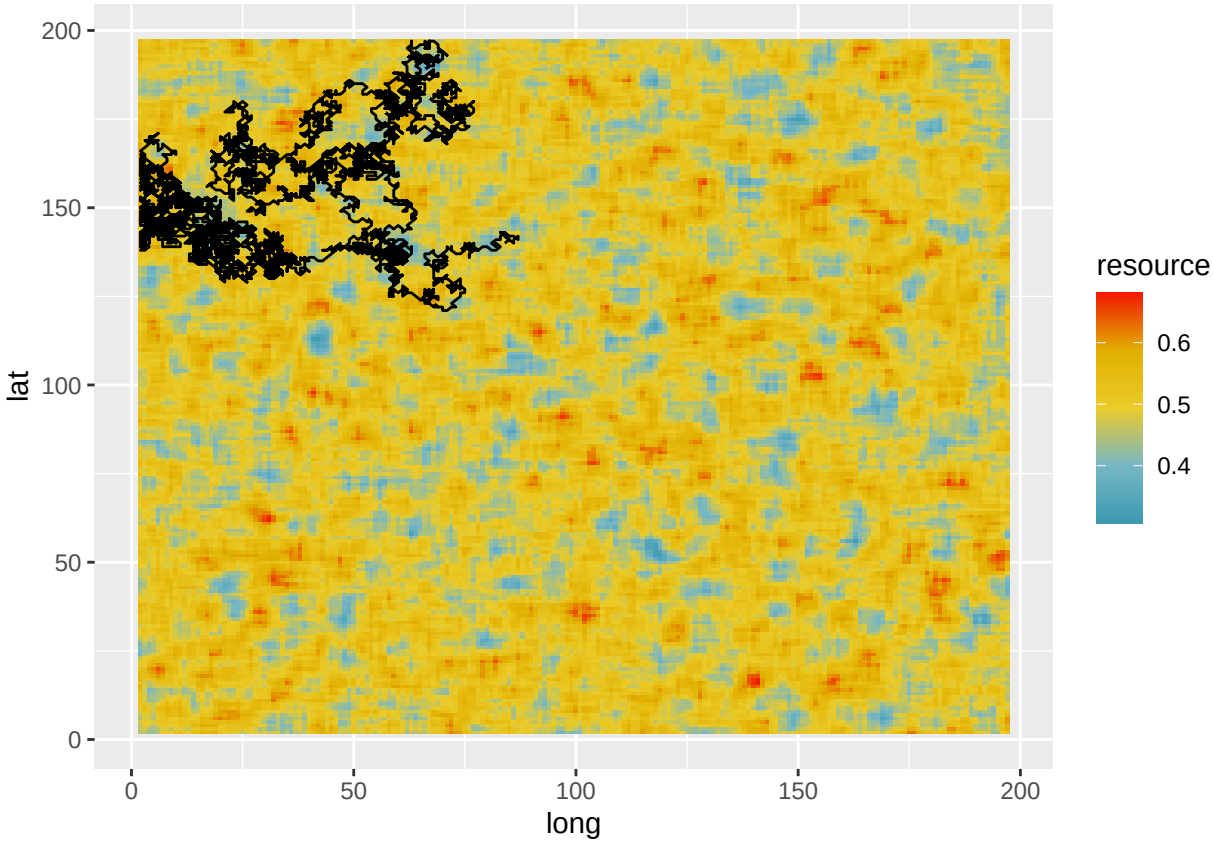



```
# points(envi_exp[coord$row, coord$col], lwd = 0.1, pch = 3, cex = 0.2)
```

```
head(coord)
tail(coord)
```

Avec ggplot2...

```
envi_dt <- cbind(rep(2:197, times = 196),
                 rep(2:197, times = rep(196, 196)),
                 c(envi)) %>% as.data.frame()

colnames(envi_dt) <- c("lat", "long", "resource")


p_move <- envi_dt %>%
  ggplot() + geom_tile(aes(x = long, y = lat, fill = resource)) +
  scale_fill_gradientn(colours = pal) +
  geom_path(data = coord, aes(x = row, y = col)) ; p_move
```




```
# png("figures/moves.png",width=9,height=6.5,units="in",res=300)
# par(omi=c(0.65,0.25,0.75,0.75),mai=c(0.3,2,0.35,0),mgp=c(3,3,0), las=1)
# p_move
# dev.off()
```

```
# seal <- read.csv("https://www.datarepository.movebank.org/bitstream/handle/10255/move.451/Grey%20seal
```

```
# seal %>%
#   mutate(timestamp = ymd_hms(timestamp)) %>%
#   select(timestamp)
```

```
# seal %>%
#   filter(tag.local.identifier == 106705) %>%
#   ggplot() + aes(x = location.long, location.lat) +
#   geom_point() +
#   geom_line()
```