The following supplement accompanies the article

Survival, density, and abundance of common bottlenose dolphins in Barataria Bay following the *Deepwater Horizon* oil spill

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R and JAGS code to estimate the spatially-explicit robust design model
The following code is a modified version of code in the supplementary material of (Ergon & Gardner 2014). The method of checking that activity center locations fall in habitat came from (Meredith 2013).

Following is a description of the basic data required to estimate the spatially-explicit robust-design model described in the paper. In the R code implementation below, all basic data objects were stored in a list object named `data`. The named components of `data` were,

- `X` = 2-D matrix with dim(X) = (R, 2) of (X,Y) coordinates of all traps. This is matrix **X** in the paper.
- `H` = 3-D matrix with dim(`H`) = (n, ns.max, np) of trap numbers (indices in X, plus 1) that caught animals. If a value in H[i,j,k] == 1, animal i was not captured during secondary j of primary k. Otherwise, H[i,j,k] is the index in X, plus 1, of the trap that caught the individual. The trap catching the individual was located at `X[H[i,j,k]-1,]`. Thus, values in `H` and order of `X` must match. This is array **H** in the paper.
- `first` = vector of length n containing first primary session in which an individual was seen. This vector contains the indices labeled *f* in the paper, and can be computed from H.
- `hab.mat` = 2-D matrix with dim(`hab.mat`) = (mx, my) of 0-1 indicators that define the geographic habitat mask. Each cell in hab.mat is associated with a geographic pixel, and cells containing 1's define pixels of valid habitat where activity centers can be located. This is matrix **M** in the paper.
- `swCorner` = vector of length 2 containing the (x,y) coordinate of the center of the most southwest pixel of the habitat matrix. No specific notation for this in the paper, but it is used to adjust trap locations in X so that indexing into hab.mat works.
- `gridSpacing` = scalar containing the size of all pixels. Pixels must be same dimension in horizontal and vertical directions, and `hab.mat` grid and trap grid and `strata.mat` grid must all have this cell size. Derived density is in the units of `gridSpacing` squared. For example, if `gridSpacing` = 1000 meters, density is individuals per 1000^2 meters.
- `strata.mat` = 2-D matrix with dim(`strata.mat`) = (mx, my) of geographic strata indices. Each cell in `strata.mat` is associated with a geographic pixel, and must be integers in the set {1, 2, …, nstrata}. Cell (i,j) in `strata.mat` = k, if and only if the pixel associated with cell (i,j) is in geographic strata number k.
- `time.ints` = vector of length (np-1) containing the length of time between primary occasions. To derive annual survival, set `time.ints` to the fraction of a year between primaries.

Implementation notes:

- Initial values for capture parameters (i.e., kappa, sigma, and PL) cannot yield 0 probability (1 is acceptable). Set these initial values accordingly.
- Setting the initial value of PL is difficult because PL reduces total capture exposure (in G) to something reasonable in the interval (0,1). A reasonable range for PL in this problem was 1 - exp(-(1/R)) to 1 - exp(-(5/R)), where R = number of traps.
- Suggested range for sigma is 0 to 2*(std of dispersal distance).
- All dispersal distances must be initialized to 0. Otherwise, activity centers can move at initialization, and they are not checked for validity (i.e., in habitat) at initialization, and potentially OK=1 and pOK = 0 (ones trick fails). At initialization only, pOK must be > 0 always.
- The JAGS code needs to compute the cell index "location" in `hab.mat` of each trap. For this to work, it is essential that traps be a subset of `hab.mat` points. In other words, traps must fall exactly on top of some `hab.mat` points. Here they did, because we constructed the grid topology of `hab.mat` from the grid topology of the traps. Specifically, we made the SW corner of `hab.mat` a (negative) integer multiple of cell size away from the SW corner of the trap grid, and we set grid spacing to be the same.
- The initial activity center locations must be in habitat. Below, initial activity centers are taken to be the centroid of all trapped locations. It is okay if this centroid does not fall exactly on a trap or habitat point, but it must fall somewhere in a cell that is habitat. If the centroid of trapped locations falls in non-habitat, the initial values function (below) will throw an error. Manually override the centroid as initial value and move the initial activity center to a nearby habitat cell.

R and JAGS code to implement the model: see suppl2.R at www.int-res.com/articles/suppl/n033p193_supp2.R

LITERATURE CITED

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