```
globals [harvest? reproduce? years_passed two_yrs]

breed [snakes snake]

breed [hunters hunter]

snakes-own [snake_length age time reproduce-year]

hunters-own [hunting_season]


to setup

  clear-all

  ask patches

  [

    set pcolor 37          ;; sandy color

  ]



  ;; starting population for adult snakes

  create-snakes round (beginning_snake_number * 0.9)            ;; 90% of starting population will be adult snakes

  [

    set shape "snake"

    set color brown

    setxy random-xcor random-ycor

    set snake_length round random-normal 1118 195       ;; gives our snake length distribution based on raw data

    ifelse snake_length >= 520

    [

      set age round (snake_length / 73)

    ]

    [

     set age round ((snake_length - 228) / 96)          ;; gives a snake's age based on subtracting minimum length (228) from snake length and dividing it by the slope
```

```
  ]
  set time 0
  ifelse random 2 = 0                    ;; set about 50% of the snakes to reproduce this year and 50% to reproduce the next year
  [
    set reproduce-year 0
  ]
  [
    set reproduce-year 1
  ]
  if snake_length >= min_length_of_harvest      ;; if the snake has a length greater than the minimum length of harvest the snake will turn red
  [
   set color red
  ]
 ]

 ;; starting population for baby snakes
 create-snakes round (beginning_snake_number * 0.1)      ;; 10% of starting snake population will be baby snakes
 [
  set shape "snake"
  set color brown                        ;; brown color
  setxy random-xcor random-ycor
  set snake_length  (228 + random 288)          ;; gives our snake length distribution based on actual data
  set age round ((snake_length - 228) / 96)
  set time 0
  set reproduce-year 0
```

```
    if snake_length >= min_length_of_harvest          ;; if the snake has a length greater than the minimum length of harvest the snake will turn red
    [
     set color red
    ]
  ]

  create-hunters hunter_number
  [
    set shape "hunter"
    set size 1
    set color 3                          ;; gray color
    setxy random-xcor random-ycor
  ]

  reset-ticks
end

to go
  move
  reproduction
  harvest
  one-year-of-growth
  update-years
  update-hunting-season
  natural-death
  predator-death
  tick
end
```

```
to move
 ask snakes
 [
   right random 50
   left random 50
   forward 1
 ]



  ask hunters
  [
   if hunting_season >= 45 and hunting_season <= 75        ;; allows hunters to move and catch snakes only during hunting season (april - march)
   [
   right random 50
   left random 50
   forward 1
   ]
   ]
end


to reproduction
  ask snakes
  [
   set reproduce? one-of [0 1 2 3]                                  ;; 25% chance reproduction because half of them are female and the females have a 50% chance of reproducing
   if age >= 3 and reproduce? = 1 and reproduce-year = 1 and time = 237       ;; When the snake is sexually mature, the chance of reproducing is yes, two years have passed,
```

```
  [                                                ;; and the time is Summer (1 time equals 1 day so at 237 days it would be August)
   hatch (5 + random 6)                            ;; then the snakes hatch baby snakes between a random number from 5 to 10
  [
   set snake_length  (228 + random 115)            ;; the baby snake's length is set to a random number from 228 mm
   set age 0                                       ;; to 343 mm (based on research newborn snakes avg 9-13.5 inches or around 228 mm to 343 mm)
   set reproduce-year 0
   set color brown
  ]
  ]
 ]
end


to harvest
 ask hunters
 [
  if ( count snakes-here with [color = red] > 0 ) and ( hunting_season >= 45 and hunting_season <= 75 ) ;; if the snake is red and it is hunting season the snake will be "captured"
  [
   let temp-counter 0
   let temp-pop count ( snakes-here with [color = red] )
   while [(temp-counter < temp-pop) and (count snakes-here with [color = red] > 0) ]   ;; adds the total number of snakes on the patch to the number of snakes harvested. It's done by creating a while loop that repeatedly
   [                                               ;; adds 1 to the amount of snakes harvested until the temp-counter is equal to the number of snakes on the patch (temp-pop).
   if random 1000 <= 70                            ;; based on calculations, there is a .007 chance of a hunter finding a snake in a 1 mi square area
   [
```

```
      ask one-of snakes-here with [color = red]
      [
       set harvest? harvest? + 1
       die
      ]
       ]
     set temp-counter temp-counter + 1
     ]
    ]
  ]
end


to one-year-of-growth
 ask snakes                                ;; has the snakes grow older and longer based on whether the time is
equal to 365 (365 time is equal to 1 year)
  [
   set time time + 1
   if time >= 365
   [
    set age age + 1
    set snake_length snake_length + 77              ;; snake grows 88 mm per year based on calculations from
data
    set time 0
    set reproduce-year  1
    if snake_length >= min_length_of_harvest          ;; if the snake has a length greater than the minimum
length of harvest the snake will turn red
    [
     set color red
    ]
   ]
```

```
  ]
end

to update-years
  set years_passed ticks / 365                    ;; tells how many years have gone by
end

to update-hunting-season
  ask hunters
  [
   set hunting_season hunting_season + 1            ;; keeps track of hunting season (1 hunting season equals 1 day)
   if hunting_season >= 365
   [
    set hunting_season 0                          ;; once it reaches 1 year (365 days) it resets to zero
   ]
  ]
end

to natural-death
  ask snakes
  [
   if age >= 20
   [
    if (70 + age) > random 100                    ;; when the snake reaches 20 yrs old, they have a 90 percent chance of dying. As they get older, the chances of death increase
    [
     die
    ]
```

```
   ]
  ]
end

to predator-death
  ask snakes
  [
   if random 712 = 0                ;; 1 percent chance of dying for per two-year period
   [
    die
   ]
  ]
end
```