Initial cross-system data comparison

2022-01-21

General summary

- 849 fish were tagged across the four groups (coastal Massachusetts and the Hudson, Delaware, and Potomac Rivers) from 2014-2019
- 2016 was the only year where fish were concurrently tagged by each group
- Types of data collected were tag date, transmitter ID, external ID, in-house ID, total length, fork length, wet weight, scale age, sex, general area of tagging
- All tagging groups collected the date of tagging, age, and total length
  - Hudson fish are in the process of being aged
  - 15% Potomac fish have scales collected for ageing, but these have not yet been processed
- Hudson, Delaware, and Potomac River systems have sex data; coastal Massachusetts does not
- Hudson and Potomac have weights; Delaware and Massachusetts do not

```
library(ggplot2); library(data.table)
```

```
all_info <- fread('embargo/derived/combined_tag_info.csv',
                  na.strings = '')
all_info[, yr := as.factor(year(tagdate))]
all_info[, system := as.factor(system)]

all_info
```

```
##         tagdate    tl    sex scales   age fishid exttag tagginglocationrkm
##          <IDat> <int> <char> <char> <int> <char> <char>                <int>
##   1: 2016-04-15   580      M      x     5  SK005      5                  118
##   2: 2016-04-15   656      M      x    NA  SK003      3                  118
##   3: 2016-04-15   575      M      x     5  SK004      4                  118
##   4: 2016-04-15   950      M      x    11  SK001      1                  118
##   5: 2016-04-15   552      M      x     5  SK002      2                  118
##  ---
## 845: 2018-04-12  1079      F   <NA>    NA   <NA>   <NA>                   NA
## 846: 2018-04-12  1003      F   <NA>    NA   <NA>   <NA>                   NA
## 847: 2018-04-12  1041      F   <NA>    NA   <NA>   <NA>                   NA
## 848: 2018-04-12  1067      F   <NA>    NA   <NA>   <NA>                   NA
## 849: 2018-04-12   978      F   <NA>    NA   <NA>   <NA>                   NA
##      taglocation    transmitter  system actagsn finclip  notes   lat   lon
##           <char>         <char>  <fctr>   <int>  <char> <char> <num> <num>
##   1:  Lower Zone A69-1601-54015      DE      NA    <NA>   <NA>    NA    NA
##   2:  Lower Zone A69-1601-54016      DE      NA    <NA>   <NA>    NA    NA
##   3:  Lower Zone A69-1601-54017      DE      NA    <NA>   <NA>    NA    NA
##   4:  Lower Zone A69-1601-54018      DE      NA    <NA>   <NA>    NA    NA
##   5:  Lower Zone A69-1601-54019      DE      NA    <NA>   <NA>    NA    NA
```

```
##  ---
## 845:  Pt Lookout  A69-9002-6770 Potomac      NA    <NA>   <NA>    NA    NA
## 846:  Pt Lookout  A69-9002-6769 Potomac      NA    <NA>   <NA>    NA    NA
## 847:  Pt Lookout  A69-9002-6774 Potomac      NA    <NA>   <NA>    NA    NA
## 848:  Pt Lookout  A69-9002-6773 Potomac      NA    <NA>   <NA>    NA    NA
## 849:  Pt Lookout  A69-9002-6772 Potomac      NA    <NA>   <NA>    NA    NA
##        wgt     yr
##      <int> <fctr>
##   1:    NA   2016
##   2:    NA   2016
##   3:    NA   2016
##   4:    NA   2016
##   5:    NA   2016
##  ---
## 845: 17700   2018
## 846: 13200   2018
## 847: 16800   2018
## 848: 15600   2018
## 849: 13000   2018
```

Systems

```
addmargins(xtabs(~  system, addNA = T, data = all_info))
```

```
## system
##       DE   Hudson MA Coast  Potomac      Sum
##      298      100      272      179      849
```

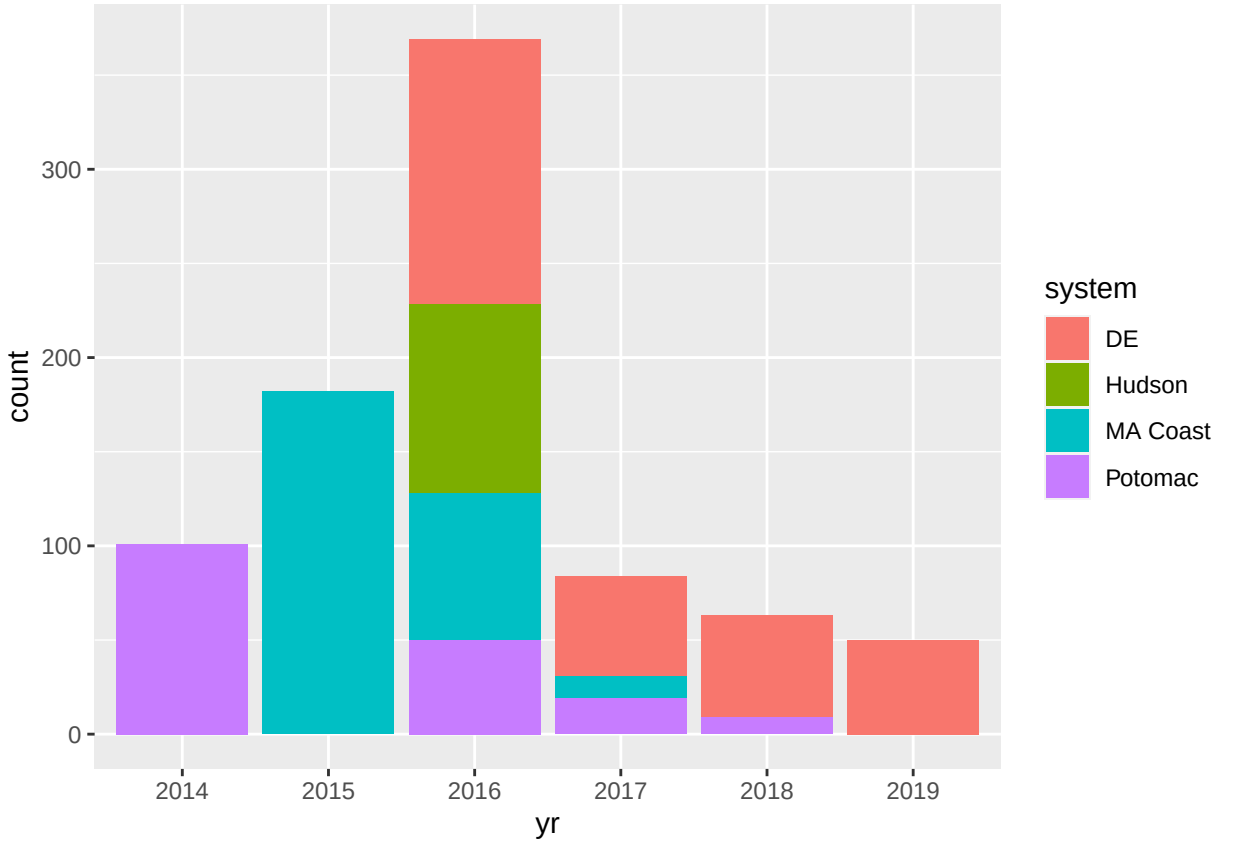
Year tagged

- Potomac tags skew older, Delaware tags skew younger, Massachusetts tags are in the middle, and Hudson were only tagged in 2016
- 2016 is the only year that had fish tagged in all systems

```
addmargins(xtabs(~ yr + system, addNA = T, data = all_info))
```

```
##       system
## yr      DE Hudson MA Coast Potomac Sum
##   2014   0      0        0     101 101
##   2015   0      0      182       0 182
##   2016 141    100       78      50 369
##   2017  53      0       12      19  84
##   2018  54      0        0       9  63
##   2019  50      0        0       0  50
##   Sum  298    100      272     179 849
```

```
ggplot(data = all_info) +
  geom_bar(aes(x = yr, fill = system))
```



Age

- Hudson River and a subset of Potomac-tagged fish have not yet been, but are planning to be, aged. There will likely wind up being no Hudson River *NA* and 1 Potomac River *NA*.

```
# Cross-tabulation
addmargins(xtabs(~ age + system, addNA = T, data = all_info))
```

```
##       system
## age     DE Hudson MA Coast Potomac Sum
##   3      0      0        10       5  15
##   4      8      0        41      10  59
##   5     19      0        56       7  82
##   6     22      0        38      26  86
##   7     30      0        33      38 101
##   8     23      0        23      21  67
##   9     23      0        21      14  58
##   10    39      0         9      16  64
##   11    23      0         8       9  40
##   12    19      0         8       2  29
##   13    21      0         5       3  29
##   14    14      0         1       0  15
##   15     7      0         0       0   7
##   16     3      0         0       0   3
```

```
##   17     1      0        0       0   1
##   18     2      0        0       0   2
##   19     1      0        0       0   1
##   <NA>  43    100       19      28 190
##   Sum  298    100      272     179 849
```

```
# Range of ages
all_info[, .(min = min(age, na.rm = T),
             median = median(age, na.rm = T),
             max = max(age, na.rm = T)),
         by = system]
```

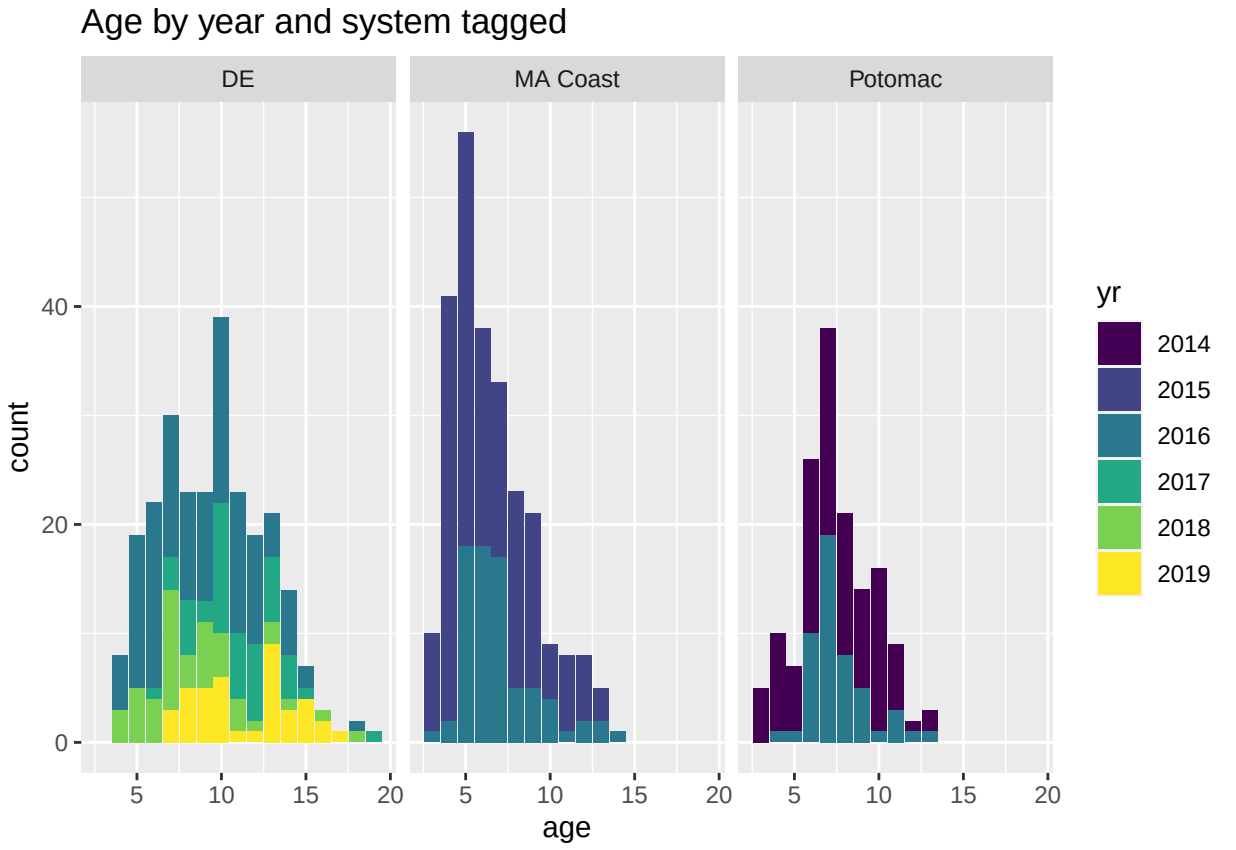
```
##      system   min median   max
##      <fctr> <int>  <num> <int>
## 1:       DE     4     10    19
## 2: MA Coast     3      6    14
## 3:  Potomac     3      7    13
## 4:   Hudson    NA     NA    NA
```

- Delaware fish are oldest, followed by Potomac, then Massachusetts.

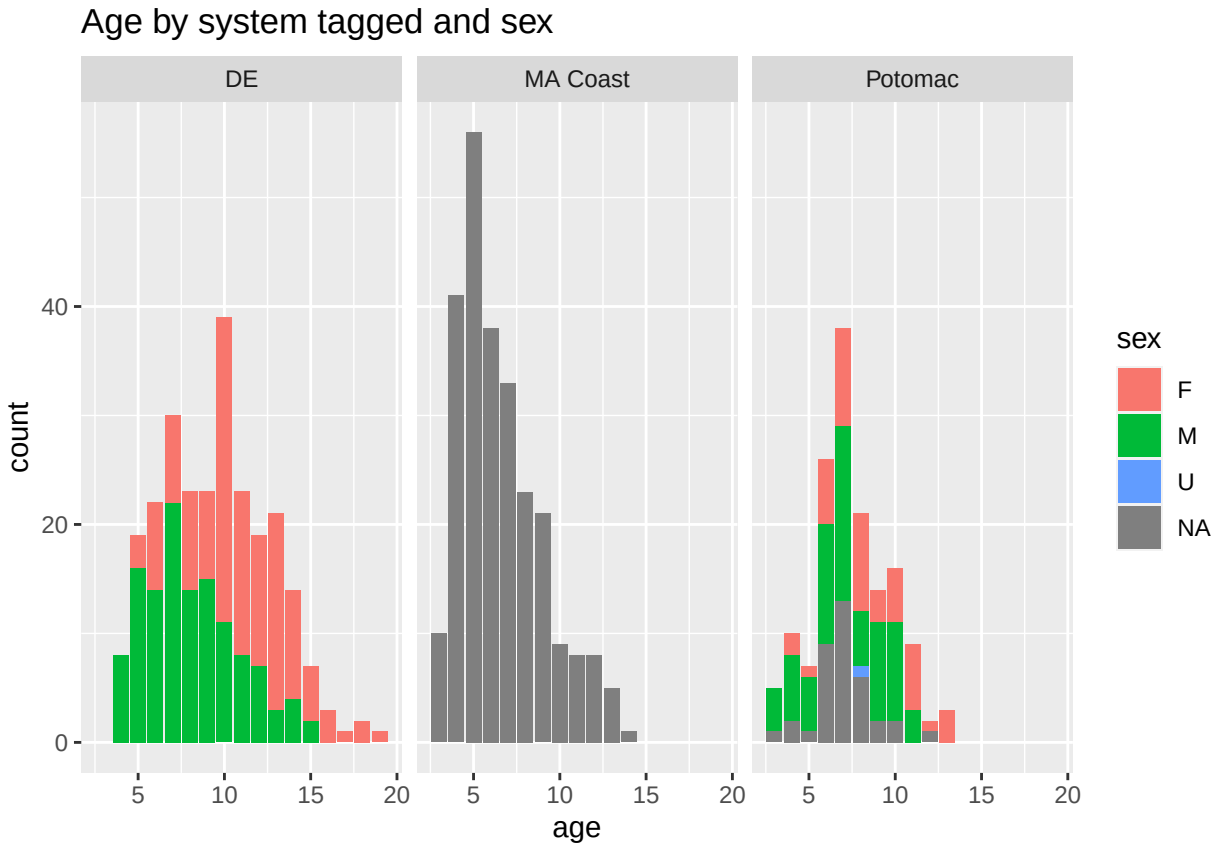
```
TukeyHSD(aov(age ~ system, data = all_info))
```

```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = age ~ system, data = all_info)
##
## $system
##                         diff        lwr       upr     p adj
## MA Coast-DE      -2.9524917 -3.5099446 -2.395039 0.0000000
## Potomac-DE       -2.0396052 -2.6846816 -1.394529 0.0000000
## Potomac-MA Coast  0.9128864  0.2668624  1.558910 0.0027352
```

```
ggplot(data = all_info[!is.na(age)]) +
  geom_bar(aes(x = age, fill = yr)) +
  scale_fill_viridis_d() +
  facet_wrap(~ system) +
  labs(title = 'Age by year and system tagged')
```




```
ggplot(data = all_info[!is.na(age)]) +
  geom_bar(aes(x = age, fill = sex)) +
  facet_wrap(~ system) +
  labs(title = 'Age by system tagged and sex')
```



Sexes

Fish collected off the Massachusetts coast and 21% of Potomac fish were not sexed. "*NA*" means that sex was not recorded, while "*U*" means that the sex was not able to be determined.

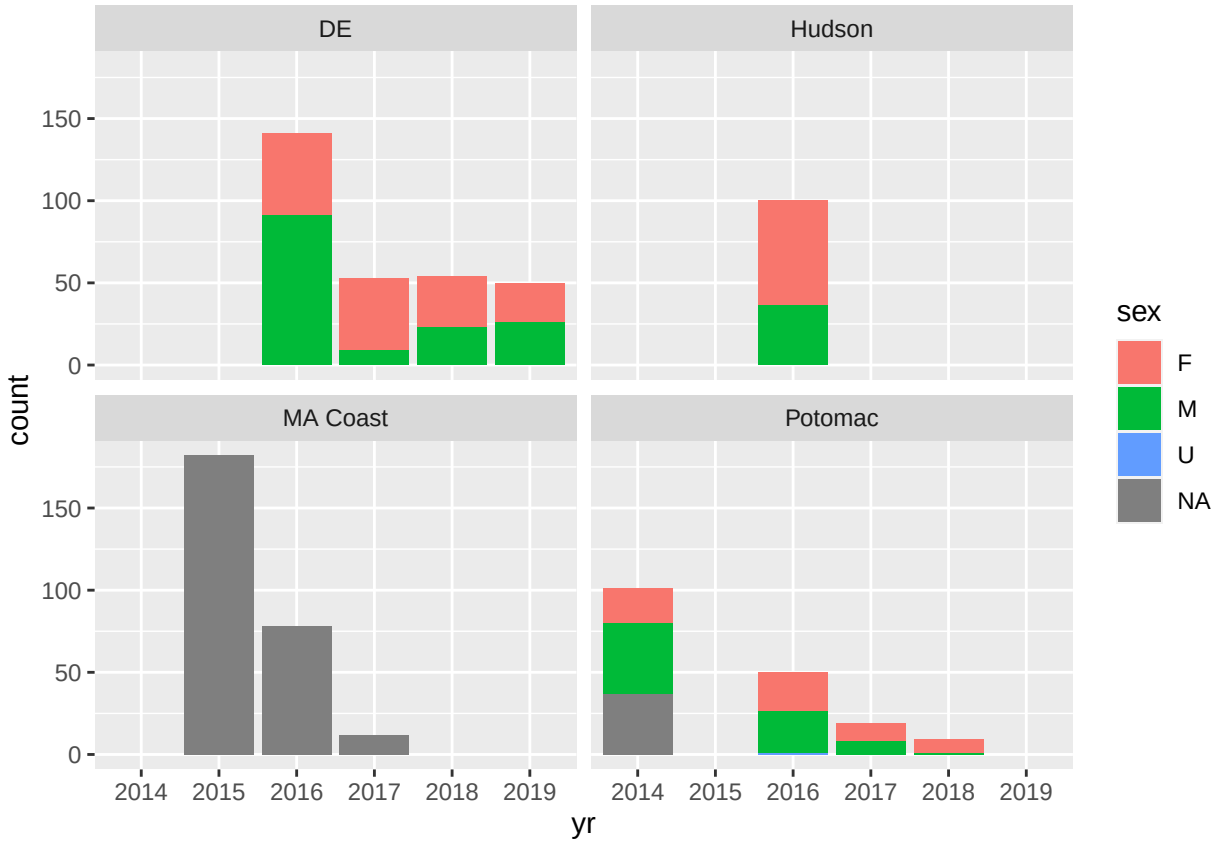
```
# Cross-tabulation
addmargins(xtabs(~ sex + system, addNA = T, data = all_info))
```

```
##       system
## sex     DE Hudson MA Coast Potomac Sum
##   F    149     64        0      64 277
##   M    149     36        0      77 262
##   U      0      0        0       1   1
##   <NA>   0      0      272      37 309
##   Sum  298    100      272     179 849
```

```
# Dirty chi-squared test
summary(xtabs(~ sex + system, addNA = T, data = all_info))
```

```
## Call: xtabs(formula = ~sex + system, data = all_info, addNA = T)
## Number of cases in table: 849
## Number of factors: 2
## Test for independence of all factors:
##  Chisq = 738.9, df = 9, p-value = 3.047e-153
##  Chi-squared approximation may be incorrect
```

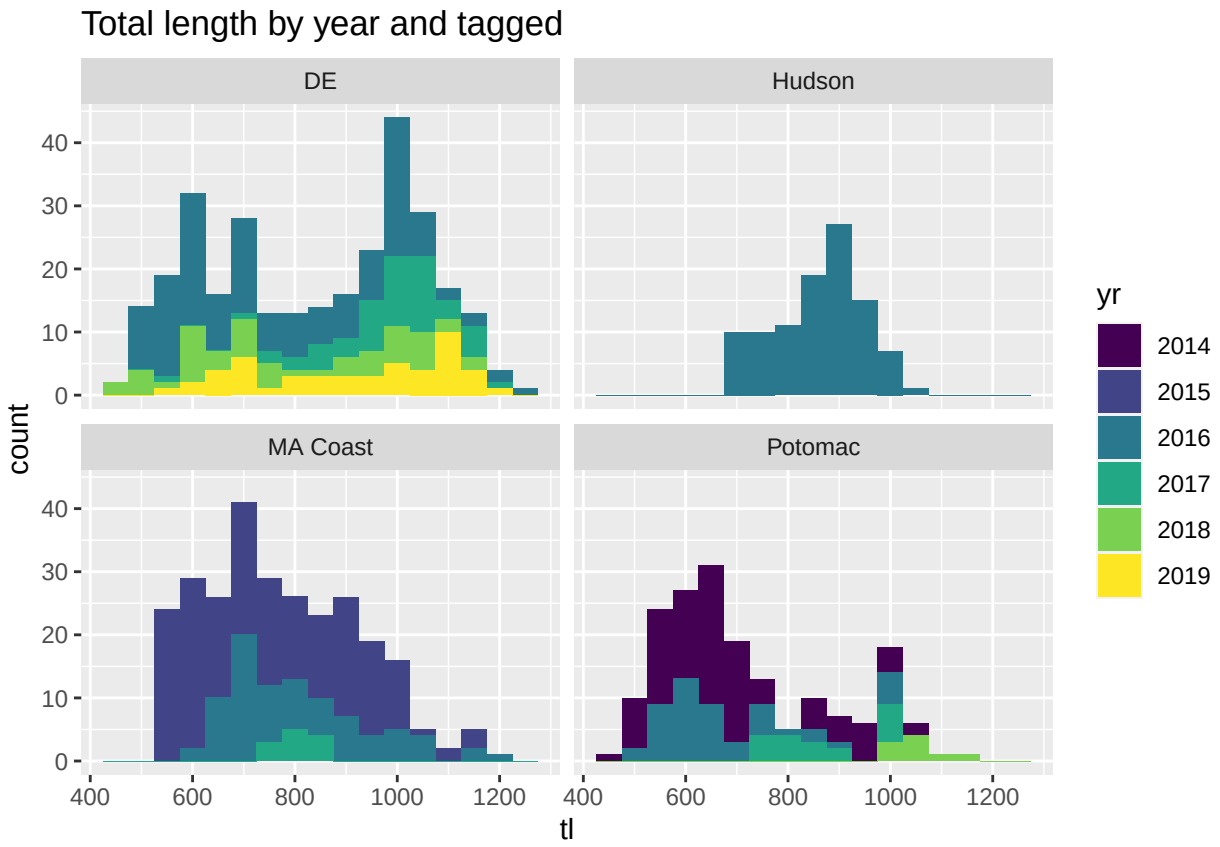
```
ggplot(data = all_info) +
  geom_bar(aes(x = yr, fill = sex)) +
  facet_wrap(~ system)
```



Lengths

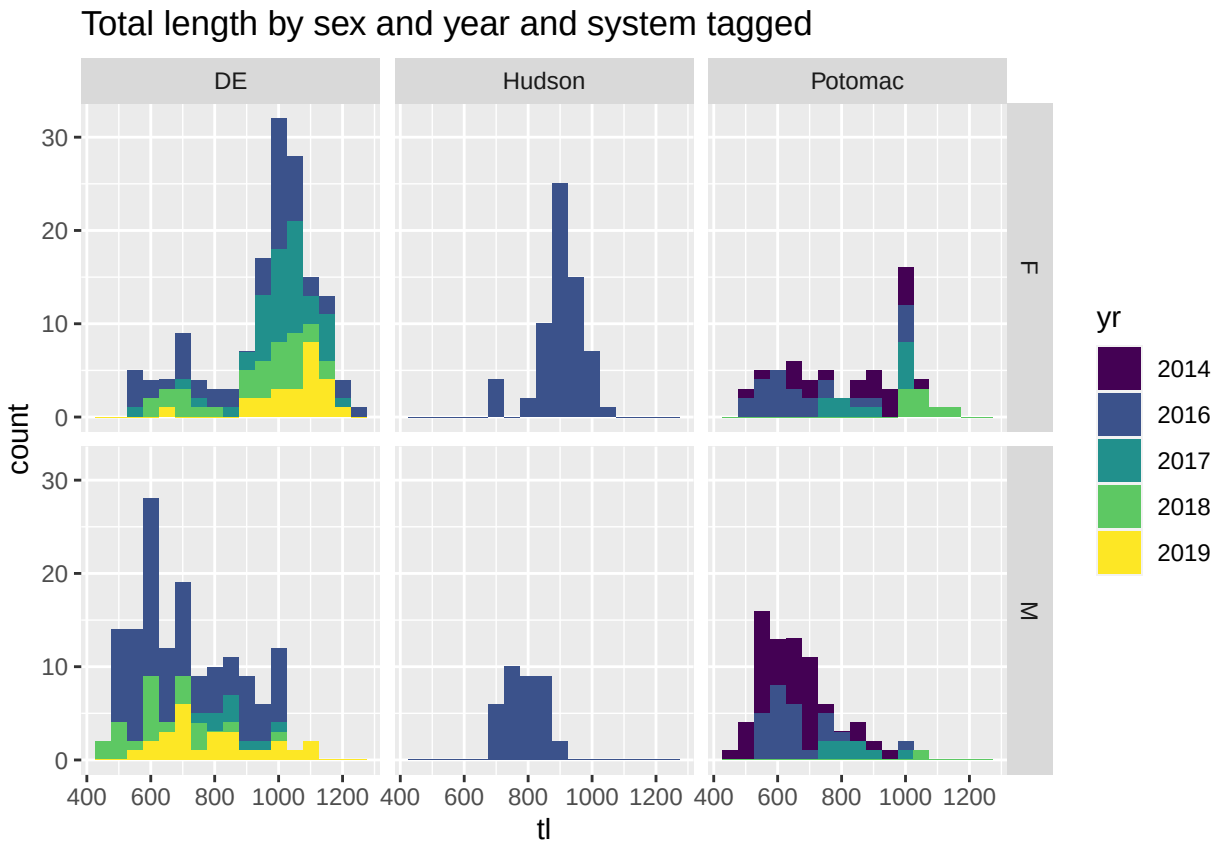
All fish collected have total lengths, while only Hudson fish have fork lengths. Seems TL is the way to go here.

```
ggplot(data = all_info) +
  geom_histogram(aes(x = tl, fill = yr), binwidth = 50) +
  scale_fill_viridis_d() +
  facet_wrap(~ system) +
  labs(title = 'Total length by year and tagged')
```



- Potomac and MA coast fish skew smaller, Hudson skews larger, and DE is bimodal (related in part to sex, see below)

```
ggplot(data = all_info[!is.na(sex) & sex != 'U']) +
  geom_histogram(aes(x = tl, fill = yr), binwidth = 50) +
  scale_fill_viridis_d() +
  facet_grid(sex ~ system) +
  labs(title = 'Total length by sex and year and system tagged')
```



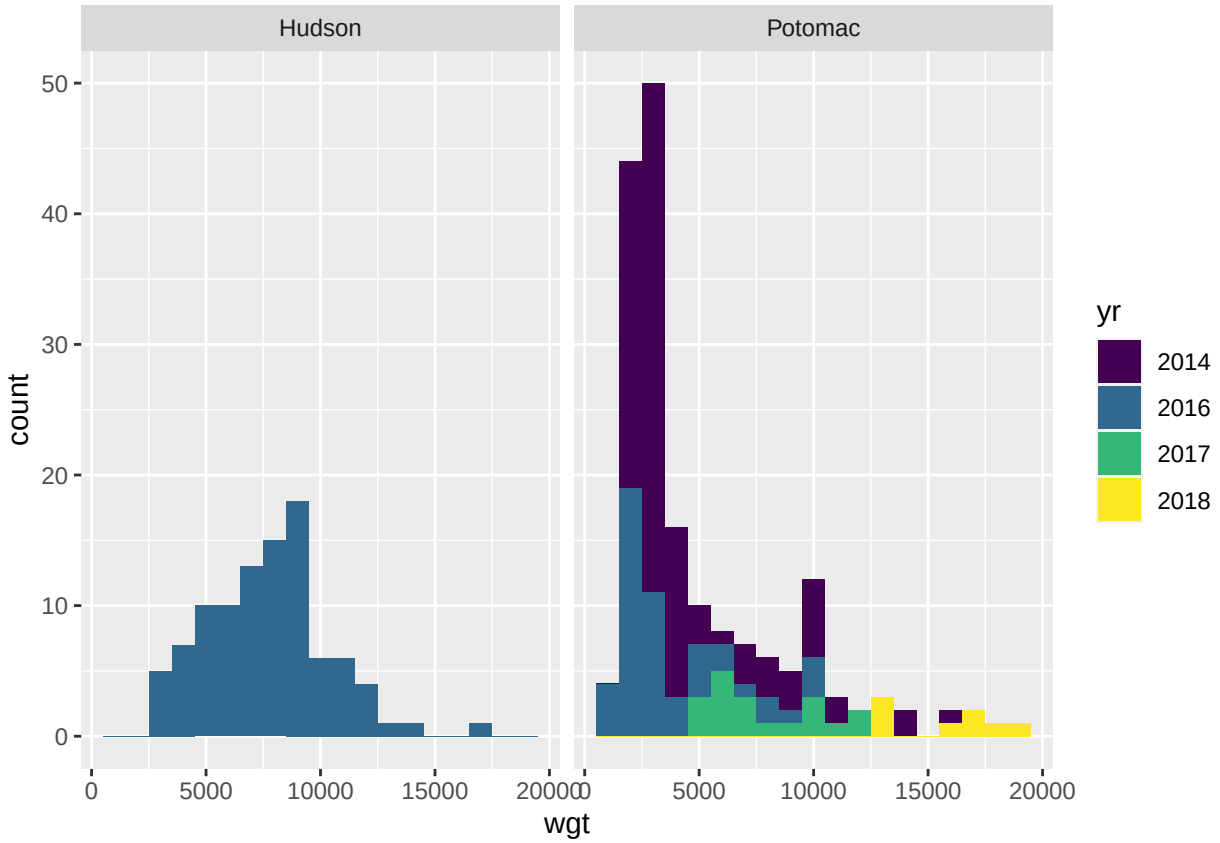
Weights

Only Potomac and Hudson fish have recorded weights, with Potomac fish skewing much lighter.

```
all_info[!is.na(wgt), .N, by = system]
```

```
##     system     N
##     <fctr> <int>
## 1: Potomac   178
## 2:  Hudson    97
```

```
ggplot(data = all_info[!is.na(wgt)]) +
  geom_histogram(aes(x = wgt, fill = yr), binwidth = 1000) +
  scale_fill_viridis_d() +
  facet_wrap(~ system)
```


Hudson
Potomac
count
wgt
0
10
20
30
40
50
0
5000
10000
15000
20000
yr
2014
2016
2017
2018