

Parr Ages from Returns By Brood, Osoyoos Lake

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```
library(ggplot2); library (magrittr);  
# /Users/Scott/Documents/Projects/OK SOX 2022/OK SOX Analysis/R functions 2022.R  
  
# /Users/Scott/Documents/Projects/OK SOX 2022/OK SOX Analysis/R functions 2022.R  
source ('R functions 2022.R')
```

Read Returns By Brood Year

This is to examine two phenomena:

1. Parr ages. The freshwater age composition of returns is an indicator of parr and smolt age composition, enabling correct attribution of parr abundance to spawner abundance.
2. Stock-Recruit plot. The integral of survivals through all life stages and associated habitats.

Source

OSO SOX Annual Returns by FW Age by Brood in a Google Sheet prepared by Braden Judson,

https://docs.google.com/spreadsheets/d/1TnXjffizTjVgZROX7xb3YgmV-bWTnAZPmJzCIwtC_RY/edit#gid=

file exists: data/Adult Returns by Brood Year.Rdata

Plot Time Series

```
ggplot(data=returns_BY, aes(x=Brood_Year, y=Total*1e-6)) + theme_bw() + # Custom_Theme() +
  geom_line() +
  geom_label(aes(label = lbl), size=2, label.padding = unit(0.1, "lines"))+
  labs(y="Returns (millions)")
```

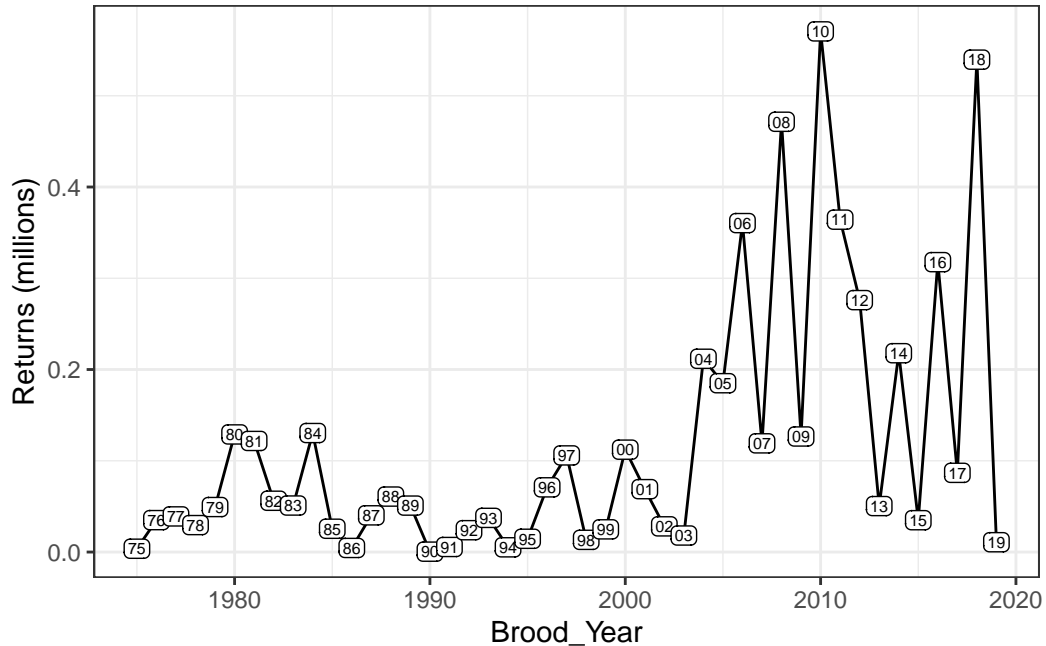


Figure 1: Osoyoos Lake Adult Returns, Total by Brood Year-Parr, 1975-2019

```
# coord_cartesian(xlim = c(0, 200000), ylim=c(0,12))+
# geom_abline(intercept=0,slope=7.587847e-05, colour='blue', linetype='dotted')+

ggplot(data=returns_BY, aes(x=Brood_Year, y=Age_1.x_Fraction*100)) + theme_bw() +
  geom_line() +
  # geom_label(aes(label = lbl), size=2, label.padding = unit(0.1, "lines"))+
  labs(y="Age 1 Returns (percent)", x="Brood Year")+
  coord_cartesian(ylim = c(0, 100))
```

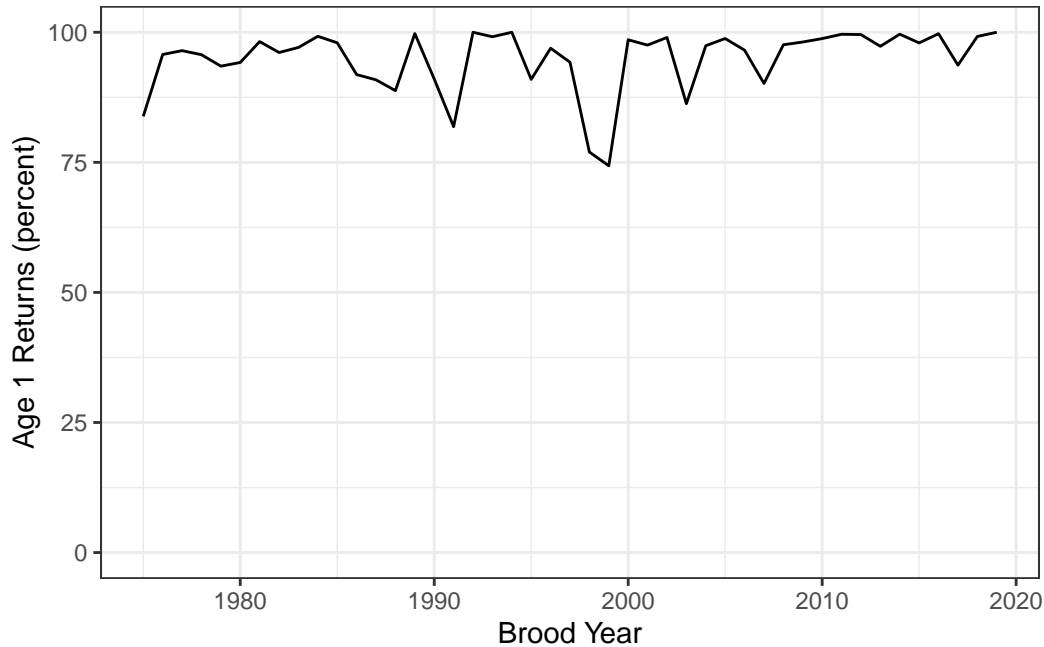


Figure 2: Osoyoos Lake Adult Returns, fraction 1 freshwater year by Brood Year, 1975-2019

```
# geom_abline(intercept=0,slope=7.587847e-05, colour='blue', linetype='dotted')+

```

Fraction of Parr

IF a small abundance of spawners in brood year N , contributing age 0 par to the lake in year $N+1$, follows a large abundance of spawners brood year in year $N-1$, contributing age 1 parr to the lake in year $N+1$,

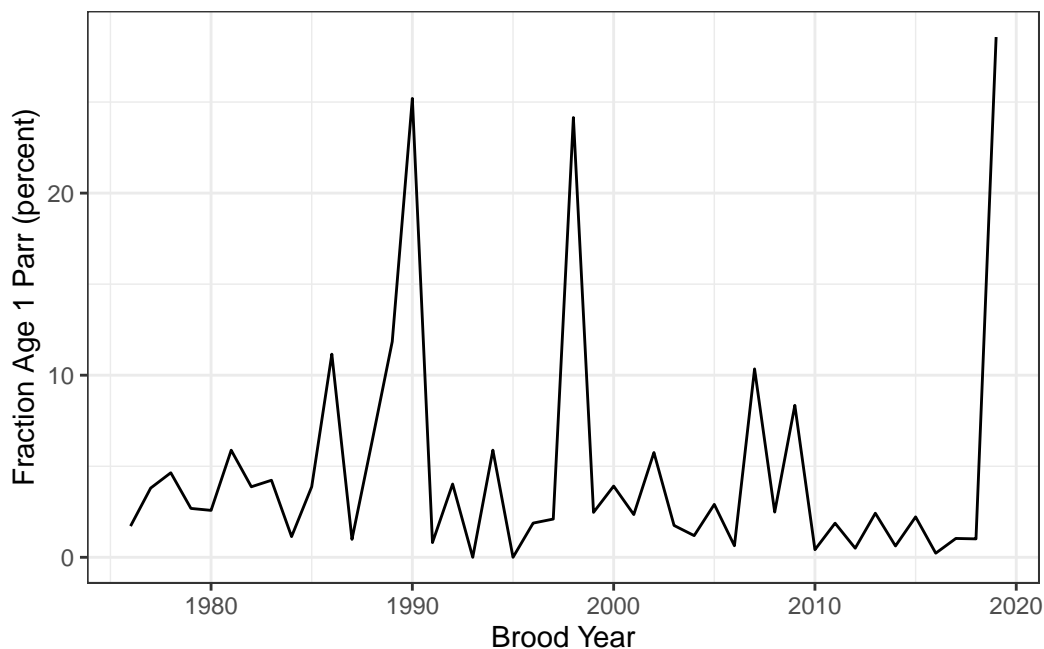
THEN there will be large fraction of of age 1 parr in year $N+1$. Is this effect large enough to impact the regression of spawners in year N to *total parr* in year $N+1$? Will there be *too many parr* per spawner in some years with low spawner abundance?

This hypothesizes the fraction of age 1 in a brood is similar between years. An alternative hypothesis is the fraction of age 1 is larger in large broods, perhaps from slow growth due to competition for food, perhaps from saturation of small-size selective predators.

IF adult freshwater ages by brood have the same ratio as parr ages by brood, then the ratio of age 2.x adults in brood year $N-1$ to age 1.x adults in year N is the ratio of age 1 parr to age 0 parr in the lake in brood year $N-1$.

```
# age 1 parr proxy: age 1 brood N-1 parr in lake year N+1
a = returns_BY$Age_2.x_Abundance [-45]
# age 0 parr proxy: age 0 parr brood N in lake in year N+1
b = returns_BY$Age_1.x_Abundance [-1]
parr_age1_fraction = a/(a+b)
dat=data.frame(Brood=returns_BY$Brood_Year[-1], parr_age1_fraction)
```

```
#| label: plt-ratio_parr_
#| fig-cap: "Osoyoos Lake parr age ratio based on freshwater ages of adult returns,1976-20
ggplot(data=dat, aes(x=Brood, y=parr_age1_fraction*100)) + theme_bw() +
  labs(y="Fraction Age 1 Parr (percent)", x="Brood Year") +
  geom_line()
```



```
# geom_label(aes(label = lbl), size=2,label.padding = unit(0.1, "lines"))+
# coord_cartesian(ylim = c(0, 100))
# geom_abline(intercept=0,slope=7.587847e-05, colour='blue', linetype='dotted')+

```