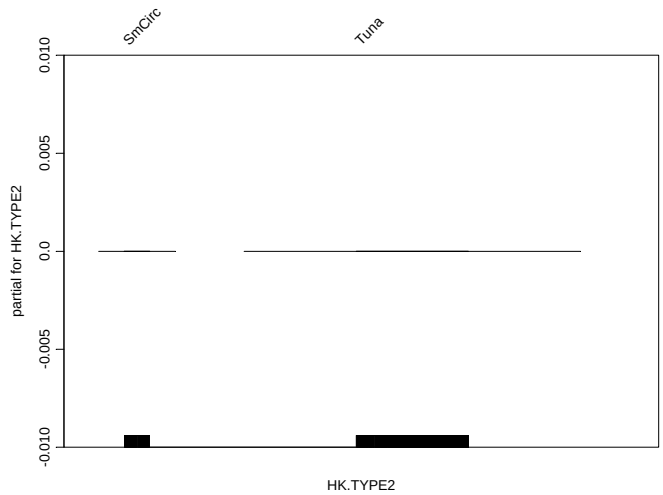
False Killer Whale Take Reduction Team
Data Analysis Update 4 (4/23/2010)
(Information and analyses by Karin Forney, Jamie Marchetti and Dan Curran)

1. *(Dan Curran):* In response to Paul Nachtigall's query about hook type for the two cetaceans taken during the large circle hook experiment:

   - Short finned pilot whale; Injured; Hook type: 3.6 sun tuna hook; Hook# 23;
   - Bottlenose dolphin; Injured; Hook type: 18/0 circle hook; Hook# 20;

2. *(Karin Forney)***: Examine rates of PCBF (false killer whale and 'blackfish') hookings on trips that used only a single hook type, comparing SmCircle vs. Tuna hooks:**



→ No significant difference in GAM model (Error bars refused to print for unknown reasons, but these are not statistically different):

Looking at # PCBF (false killer whale and 'blackfish') takes for each type:

```
                          SmCirc    Tuna
Sets w/o PCBF Takes :       162     709
Sets with PCBF Takes:         4      20

>  4/166 = 2.4% of Pure SmCircle hook sets had takes
> 20/729 = 2.7% of Pure Tuna hook sets had takes

#  Calculate expected # takes for circle vs tuna hooks given proportions of sets:

 166/(166+729) * 24 =  4.45    vs. 4 observed
 729/(166+729) * 24 = 19.55    vs. 20 observed
```

Takes appear distributed almost exactly as expected if hooks are equal.
Don't even need to do a Chi-square or permutation test on this one!

3. *(Karin Forney):* **GAM for Depredation as a function of previous depredation and distance between sets:**

Looking at depredation rates for current set when previous set had /did not have depredation:

```
         Current
Prev      N   Y        PdepY <- 148/(148+934)  = 0.1367837
N     17069 941        PdepN <- 941/(941+17069) = 0.05224875
Y       934 148
```

Examination of depredation rates for PrevDepr=Y vs. N

Observed	**Depredation**	**CurrN**	**CurrY**	**Total**	**% Depr**
	PrevN	17069	941	18010	5.2%
	PrevY	934	148	1082	13.7%
	Total	18003	1089	19092	

Expected	**Depredation**	**CurrN**	**CurrY**	**Total**
	PrevN	16983	1027	18010
	PrevY	1020	62	1082
	Total	18003	1089	19092

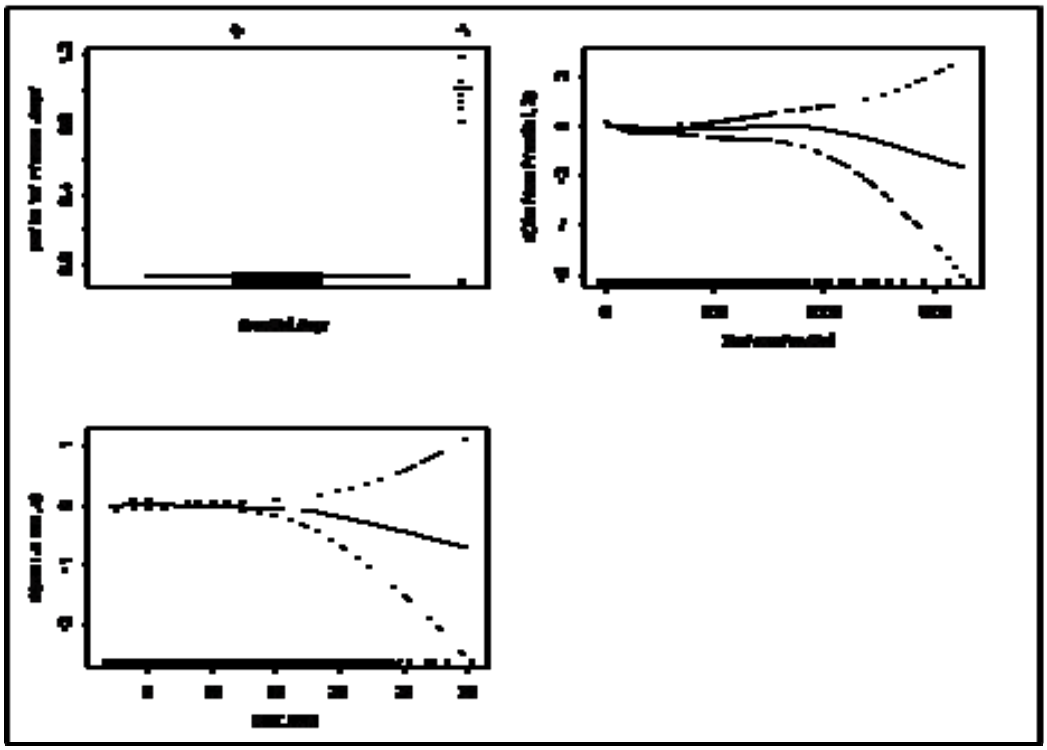
Chi-square	**Depredation**	**CurrN**	**CurrY**	**Total**
	PrevN	0.4	7.2	
	PrevY	7.3	119.3	
		Chi-square=	134.18	
		p=	0.0000	

This is a highly significant difference. The proportion of sets with depredation is 5.2% if there was no depredation on previous set, vs. 13.7% if there was depredation.

How far would you need to move to reduce depredation rate? Does set number within a trip matter (i.e. are later trips more likely to have depredation that early ones?)

```
# GAM MODEL:
#
#  Examine Repeat Depredation as a function of Previous Depredation, Distance,
#  Set number, and interaction between Set# and PreviousDepr.
#
> DS.Depr.gam <- gam(formula = CurrSet.Depr ~ PrevSet.Depr + s(KmFromPrevSet,3)
+  s(SET.NUM,3) + PrevSet.Depr:SET.NUM, family = binomial, data = SetDists03.09DS,
+  na.action =   na.exclude, control = list(epsilon = 0.001,
+  bf.epsilon = 0.001, maxit = 50, bf.maxit = 10, trace = FALSE))
>

> summary(DS.Depr.gam)
 (Dispersion Parameter for Binomial family taken to be 1 )

    Null Deviance: 8348.719 on 19059 degrees of freedom
Residual Deviance: 8233.781 on 19050.3 degrees of freedom

1664 observations deleted due to missing values
Number of Local Scoring Iterations: 4
DF for Terms and Chi-squares for Nonparametric Effects
```

```
                     Df Npar Df Npar Chisq    P(Chi)
         (Intercept)  1
        PrevSet.Depr  1
 s(KmFromPrevSet, 3)  1     2.8   7.541333 0.0497211
       s(SET.NUM, 3)  1     1.9   2.059332 0.3275136
PrevSet.Depr:SET.NUM  1
```

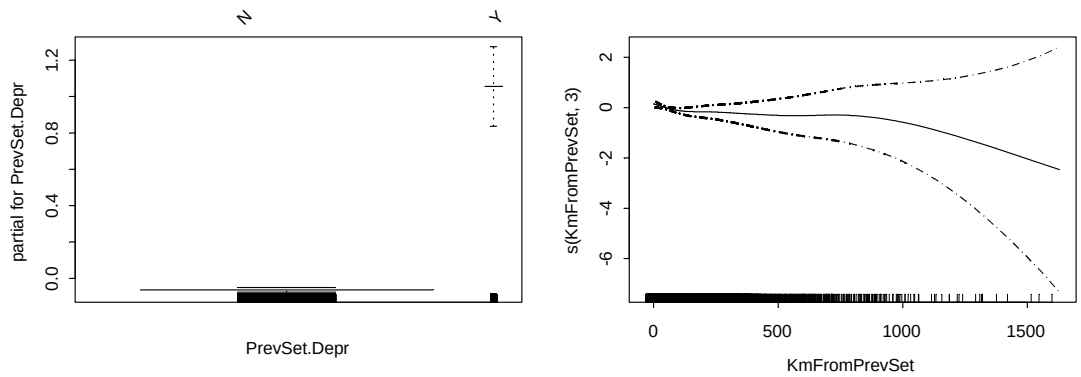


The above shows that depredation rate is higher when previous set had depredation, and that moving less than ~100 km between sets is associated with higher depredation rate (as illustrated by the uptick at left side of top right panel).

Without SET.NUM variable, which was not significant in above model:

```
DS.Depr.gam <- gam(formula = CurrSet.Depr ~ PrevSet.Depr + s(KmFromPrevSet,3) +
+     PrevSet.Depr:KmFromPrevSet, family = binomial, data = SetDists03.09DS,
+     na.action = na.exclude, control = list(epsilon = 0.001,
+     bf.epsilon = 0.001, maxit = 50, bf.maxit = 10, trace = FALSE))
>
> summary(DS.Depr.gam)

Deviance Residuals:
        Min         1Q    Median         3Q      Max
 -0.5863287 -0.3386959 -0.328326 -0.3157232 2.477099
(Dispersion Parameter for Binomial family taken to be 1 )
    Null Deviance: 8348.719 on 19059 degrees of freedom

Residual Deviance: 8236.474 on 19053.16 degrees of freedom
1664 observations deleted due to missing values

Number of Local Scoring Iterations: 4
DF for Terms and Chi-squares for Nonparametric Effects
```

```
                                Df Npar Df Npar Chisq     P(Chi)
                     (Intercept)  1
                    PrevSet.Depr  1
            s(KmFromPrevSet, 3)  1     2.8    7.68457 0.04662148
    PrevSet.Depr:KmFromPrevSet  1

    > par(mfrow=c(2,2))
    > plot(DS.Depr.gam,se=T,scale=T,axes=T)
```



Based on above, examine rates of repeat depredation for distances <100km vs >100km:
Looking at all rates between sets, regardless of whether Prev.Depr = Y:

```
            N   Y
  <100 14982 912              P(depr|stay) = 912/(912+14982) = 0.056
  >100  2989 177              P(depr|move) = 177/(177+2989)  = 0.057
```

→ rates are similar, confirming no need to move if no depredation on initial set

Looking only at sets where depredation occurred on the previous set:

```
        N   Y                 P(depr|stay) =  118/(712+118) = 0.142
        0   0                 P(depr|move) =   30/(30+221)  = 0.119
  <100 712 118
  >100 221  30                P(depr|move)/ P(depr|stay) = 0.841
```

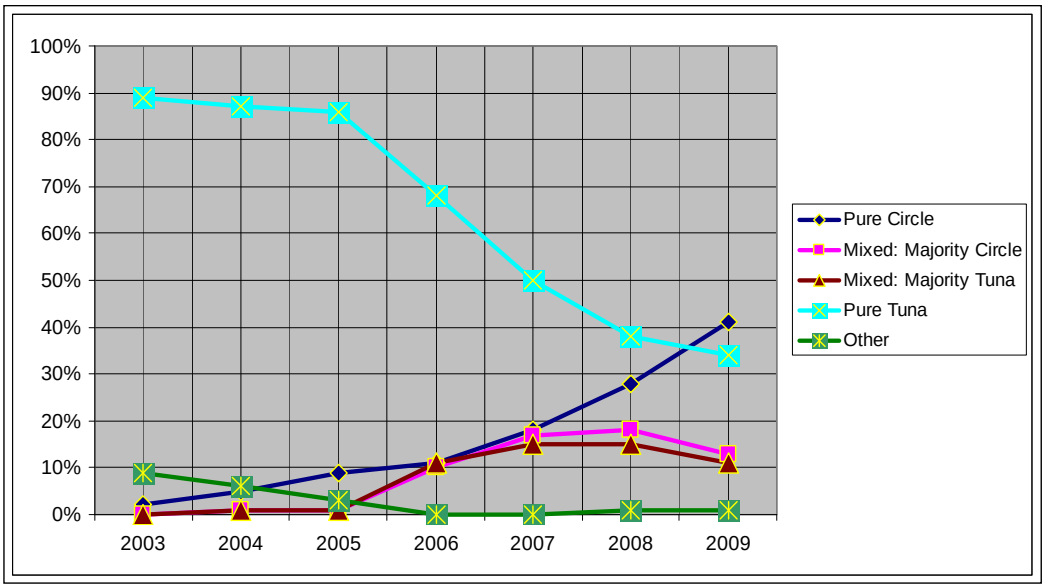
→ Suggests that by moving >100km (60 nmi)after depredation occurs, repeat depredation rate can be reduced by about 16%.

Once depredation occurred, there is a significantly greater chance of getting depredation on the subsequent set. However, this probability is related to distance traveled, such that sets >100km away have about a 12% chance of experiencing depredation while sets that remain within 100km have about a 14% chance. This translates into a 16% lower probability of repeat depredation if the vessel moves at least 100km. Beyond 100km, the depredation risk remains about the same, and 150km is not much different than 100km:

```
        N   Y          P(depr|stay) = 124/(124+755)  = 0.141
        0   0          P(depr|move) = 24/(24+178)    = 0.118
 <150 755 124
 >150 178  24          P(depr|move)/ P(depr|stay)  = 0.842
```

So there is no point in moving >100km; However, the risk of depredation is still ~2x greater than if there had not been any depredation on the initial set.

4. *(Jamie Marchetti):* **Temporal patterns in hook types used (observer data, 2003-2009):**



5. *(Jamie Marchetti):* **Mainline and branchline color for observed sets during 2009:**

- 256 trips were reviewed for this year, 118 with depredation
- 33 of 43 false killer whales (PC) takes had reported colors
- 9 of 15 unidentified blackfish (BF) had reported colors

Main line composition	All		PCBF Takes
Pure Color	61%		81%
Mix Color	39%		19%
Dominant main line color	All	Depred.	PCBF Takes
clear/white	80%	81%	78%
pink	13%	13%	12%
blue	1%	1%	5%
orange	5%	4%	5%
red	1%	1%	0%
Color Mix	All		PCBF Takes
2 colors	78%		83%
3 colors	17%		17%
4 colors	5%		0%
Branch Line	All		PCBF Takes
Takes on Pure Color	88%		93%
Takes on Mix Color	12%		7%
Dominant branch line color	All	Depred.	PCBF Takes
clear/white	87%	87%	86%
pink	10%	10%	9%
blue	3%	3%	5%

→ Does not appear to be any marked difference in takes or depredation based on line colors