NOAA FISHERIES SERVICE
Northeast Fisheries Science Center
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Observer effects

Chad Demarest
Social Sciences Branch, NEFSC
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Question: *Do vessels behave differently when they have an observer on board relative to when they don't?*

Answer: *At the margin, they probably do.*

So, how can we tell?

Difference in differences model, based on paper by Benoit and Allard (2009).

- Looking for sequences of trips from the same vessel that meet one of two criteria:
  - Three unobserved trips in a row (UUU), or
  - One observed trip sandwiched between unobserved trips (UOU)
- Data restricted to trips w/in 21 days of each other, and triplets may not overlap fishing years

Strata:

- Pre-sector and post-sector fishing years
  - Pre-sector = 2007-2009
  - Post-sector=2010-2011
- Gears
  - Fixed (longline, gillnet)
  - Trawl
  - Hand gears excluded from analysis
- Areas
  - GOM, GB*, SNE/MA (*USCA trips excluded)

Analysis metrics:

1. All landed pounds (y1, delta_k_all)
2. Roundfish pounds (y2, delta_round_lbs)
3. Grounfish pounds (y3, delta_gfish_lbs)
4. Nongroundfish pounds (y4, delta_nongfish_lbs)
5. Cod pounds (y5, delta_cod_lbs)
6. Groundfish total value (y6, delta_gfish_val)
7. Nongroundfish total value (y7, delta_nongfish_val)
8. Reported latitude (y8, delta_lat)
9. Reported longitude (y9, delta_lon)
10. Trip duration (y10, delta_dur)

Steps in the model:

1. From the triplets, pick either a lead or lag trip to compare to the middle trip
   - UOU or UUU becomes UO or UU, by randomly selecting either the first or last trip
2. Subtract the metric value for the lead/lag trip from that of the center trip
3. Divide that value by the mean value for that vessel across strata (year/area/gear)

$$\Delta O_{yfv} = \left(\frac{O - U}{\bar{U}}\right) 100$$

$$\Delta U_{yfv} = \left(\frac{U^1 - U^2}{\bar{U}}\right) 100$$

These equations scale the paired-trip differences by the unobserved mean value for every vessel in the dataset. Vessels with less than three sequences are excluded from the analysis.

Last step:

4. Calculate the difference between the median value for delta_U's and delta_O's

$$M_{\Delta U - \Delta O} = median\{\Delta_U\} - median\{\Delta_O\}$$

Statistical tests

Location differences estimated using bootstrap sampling from Mu and Mo values

Lack of overlap with zero implies that there is a 95% probability that the true median values for each population are significantly different.

Distribution shape differences tested using

- Kolmogorov-Smirnov statistic is used to test for general differences in shape
- Kuiper statistic is used to test for differences in the extremities

Results

VAR	metric	n_u	n_o	delta_med	ci2_5	ci97_5	P_KSA	P_KA	med_u	med_o	med_global
y1	kept_all	16068	2985	**4.67**	2.33	6.78	**0.0000**	**0.0000**	-0.5824	-5.2569	-1.0100
y2	roundfish_lbs	14487	2749	**2.00**	0.30	4.69	**0.0000**	**0.0000**	-0.0493	-2.0508	-0.2053
y3	groundfish_lbs	16068	2985	**2.91**	0.70	5.27	**0.0000**	**0.0000**	-0.4357	-3.3471	-0.6486
y4	nongroundfish_lbs	13686	2621	**1.02**	0.30	2.19	**0.0002**	**0.0001**	0.0000	-1.0191	-0.0925
y5	cod_lbs	12463	2480	**0.00**	0.00	1.55	**0.0000**	**0.0000**	0.0000	0.0000	0.0000
y6	groundfish_val	16068	2985	**3.20**	1.40	5.43	**0.0000**	**0.0000**	-0.6821	-3.8792	-1.0544
y7	nongroundfish_val	13685	2621	**2.99**	0.97	5.60	**0.0001**	**0.0000**	-0.0606	-3.0529	-0.4983
y8	latitude	11840	1724	0.00	0.00	0.00	0.0355	**0.0000**	0.0000	0.0000	0.0000
y9	longitude	11840	1724	0.00	0.00	0.00	**0.0003**	**0.0000**	0.0000	0.0000	0.0000
y10	days_fished	16068	2985	**1.53**	0.01	2.48	**0.0000**	**0.0000**	0.0000	-1.5341	0.0000

Notes: Data for entire time period, FY 2007-2012 to date. CI's computed based on bootstraps w/ 0.5 sampling rate and 1000 replicates.

Results, pre-Sector years

VAR	metric	n_u	n_o	delta_med	ci2_5	ci97_5	P_KSA	P_KA	med_u	med_o	med_global
y1	kept_all	12376	1178	**4.27**	**1.40**	**6.29**	**0.0000**	**0.0000**	-0.6199	-4.8890	-0.8193
y2	roundfish_lbs	10920	988	0.55	0.00	3.68	**0.0000**	**0.0000**	0.0000	-0.5476	0.0000
y3	groundfish_lbs	12376	1178	**2.12**	**0.27**	**4.97**	**0.0000**	**0.0000**	-0.3083	-2.4243	-0.3870
y4	nongroundfish_lbs	10256	989	0.88	0.00	1.89	0.1269	0.1463	0.0000	-0.8805	-0.0059
y5	cod_lbs	9862	870	0.00	0.00	0.00	**0.0000**	**0.0000**	0.0000	0.0000	0.0000
y6	groundfish_val	12376	1178	**3.48**	**1.77**	**6.24**	**0.0000**	**0.0000**	-0.5049	-3.9855	-0.7222
y7	nongroundfish_val	10256	989	1.87	-0.08	4.18	0.2237	0.0841	0.0000	-1.8650	-0.1690
y8	latitude	10222	895	0.00	0.00	0.00	0.0484	**0.0005**	0.0000	0.0000	0.0000
y9	longitude	10222	895	0.00	0.00	0.00	**0.0028**	**0.0000**	0.0000	0.0000	0.0000
y10	days_fished	12376	1178	0.09	0.00	1.75	**0.0007**	**0.0000**	0.0000	-0.0861	0.0000

Notes: Data for time period FY 2007-2009. CI's computed based on bootstraps w/ 0.5 sampling rate and 1000 replicates.

Results, post-Sector years

VAR	metric	n_u	n_o	delta_med	ci2_5	ci97_5	P_KSA	P_KA	med_u	med_o	med_global
y1	kept_all	3692	1807	**5.20**	**1.79**	**9.57**	**0.0001**	**0.0008**	-0.3773	-5.5808	-1.8941
y2	roundfish_lbs	3567	1761	0.75	-2.23	4.78	0.1305	0.2894	-2.3853	-3.1400	-2.6733
y3	groundfish_lbs	3692	1807	2.27	-1.64	6.04	0.0201	0.1145	-1.8806	-4.1551	-2.4858
y4	nongroundfish_lbs	3430	1632	**1.24**	**0.24**	**2.94**	**0.0002**	**0.0002**	0.0000	-1.2445	-0.3467
y5	cod_lbs	2601	1610	-0.43	-4.29	4.93	0.2725	0.1868	-2.0134	-1.5853	-1.8382
y6	groundfish_val	3692	1807	2.02	-0.83	5.47	**0.0023**	0.0082	-1.7217	-3.7413	-2.3474
y7	nongroundfish_val	3429	1632	**4.11**	**0.76**	**7.57**	**0.0010**	**0.0000**	-0.3345	-4.4407	-1.4666
y8	latitude	1618	829	0.00	0.00	0.00	0.9508	0.8108	0.0000	0.0000	0.0000
y9	longitude	1618	829	0.00	0.00	0.00	0.7402	0.6631	0.0000	0.0000	0.0000
y10	days_fished	3692	1807	**2.15**	**0.34**	**3.32**	**0.0000**	**0.0001**	0.0000	-2.1463	-0.0662

Notes: Data for time period FY 2010-2012 through September 1. CI's computed based on bootstraps w/ 0.5 sampling rate and 1000 replicates.

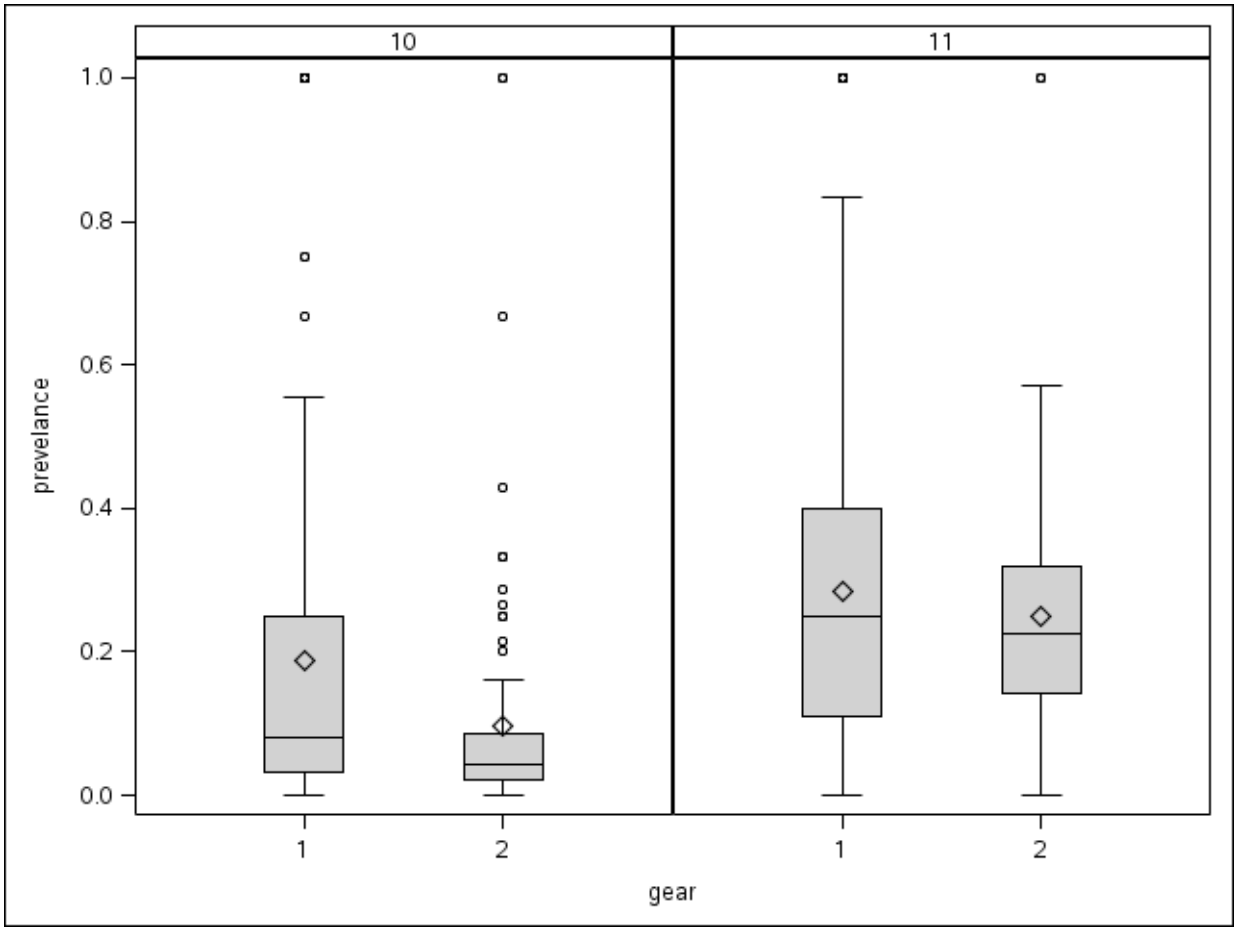
What does this all mean?

- Differences in vessel behavior across several metrics detectable at various strata
- Differences across metrics indicative of behavior change due to observer, but this tells us nothing about discarding behavior

How prevalent is significant behavior change?

How intense?

- Prevalence measured by looking for significant deviations from unobserved mean values on at least one metric
- Intensity measured by number of metrics with significant deviations for each trip pair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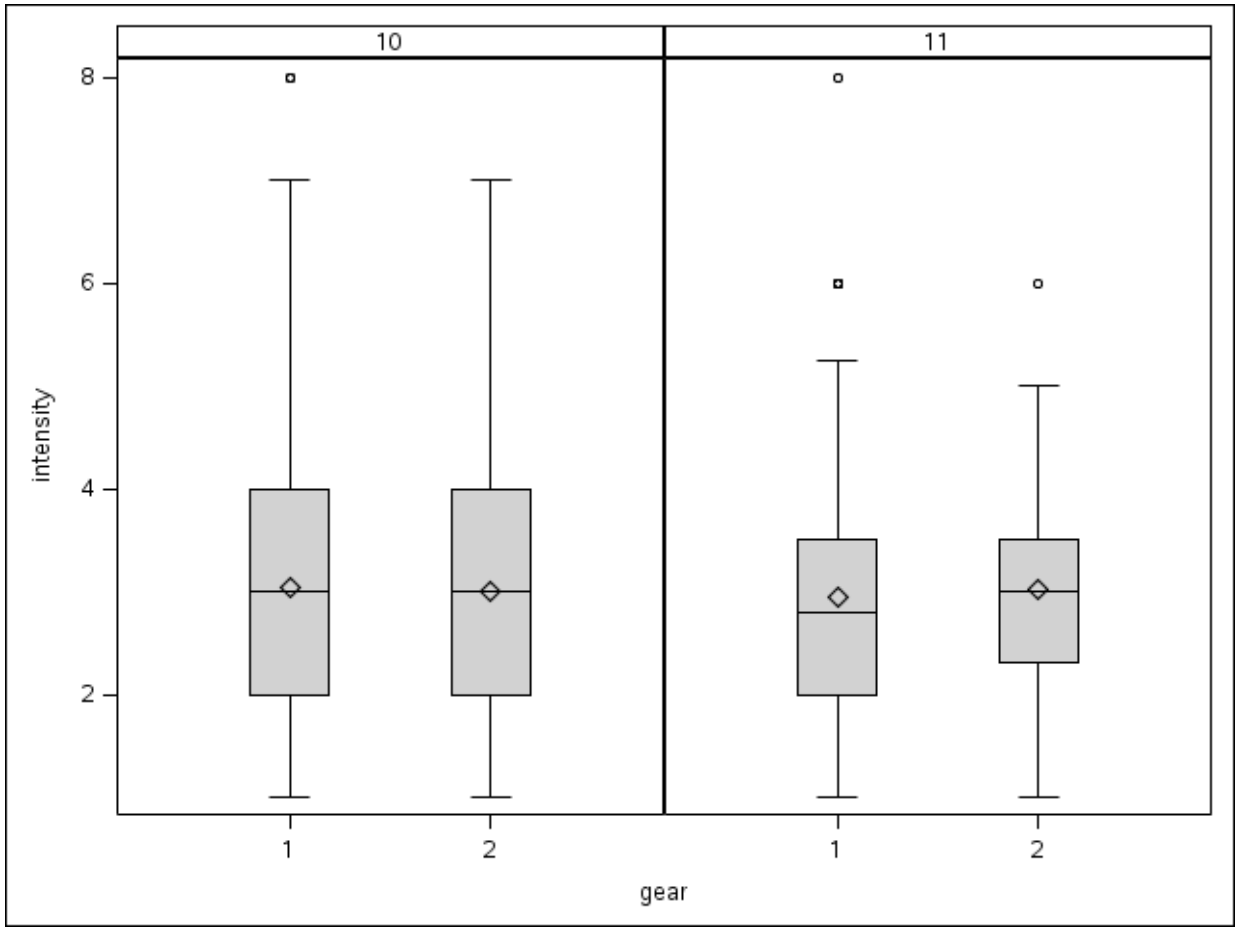
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gear

Even if we know that vessels alter their fishing behavior in response to carrying an observer, *so what?*

- Observer coverage generally thought to improve precision of discard estimates. If those estimates are biased due to behavior change, then precision may be meaningless
- Cannot translate behavior changes to discard estimation bias, but discarding is restricted by underlying tow/stock joint production function

Next steps:

1. Continue developing observer effect analysis, including triangulating with other analytical techniques *(econometric techniques, other diff-in-diff approaches)*
2. Bound range for population of trips likely to be exhibiting significant observer effects
3. Develop understanding of underlying joint production functions to determine stock-specific frontiers for potential unaccounted discards