The Impact of Regulation: A case study of the Leatherback Turtle Conservation Area Closure and the California Drift Gill Net fishery

James R. Hilger and Kristin H. Roll*
NOAA Fisheries and University of South-Eastern Norway

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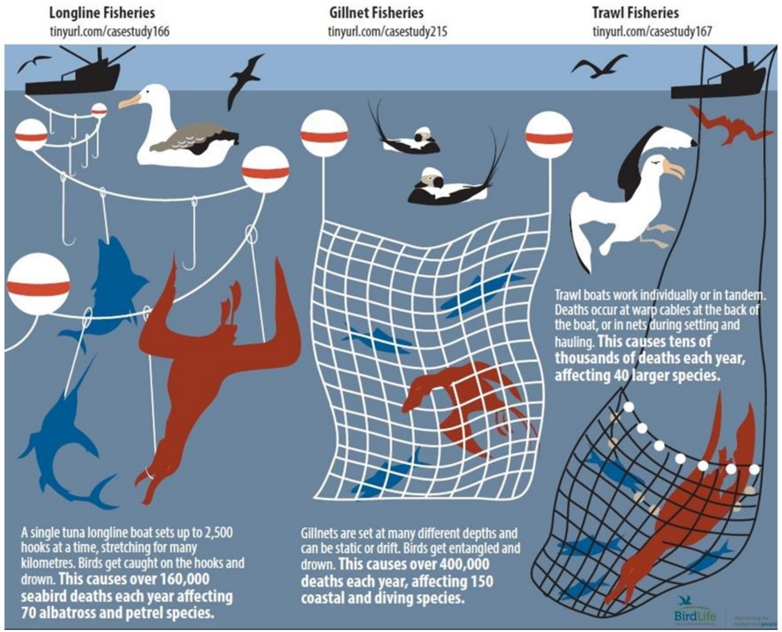
The problem of by-catch

- Fishing operations usually kill some species other than the target species



Regulations to Reduce By-Catch

- Fishery managers have consequently implemented a host of regulations to reduce the incidental catch of non-target species

- A full accounting of the impact of these regulations must include both the costs and benefits of the regulation

  - Regulatory benefits; Reductions in fishery interactions with protected resources and related mortalities

  - Regulatory costs; reductions in productivity, reductions in landings, and reductions in employment of fisheries in terms of target species opportunities.

A Selection of Previous Litteratur

- Abesamis and Russ, 2005; McClanahan and Mangi 2000 investigate the direct long-run benefits of by-catch regulation

- Smith et al. 2009 looks at the indirect cost of the regulation

- This paper focus on the indirect cost of a by-catch regulation:

- What is the regulatory impact of the Pacific Leatherback Turtle Conservation area (PLCA) on California drift gillnet (DGN) swordfish production.

The Californian drift gillnet (CA DNG) fishery

- The CA DGN fleet is comprised of vessels that participate in commercial fishing operations within the U.S. exclusive economic zone (EEZ) off the coast of California.

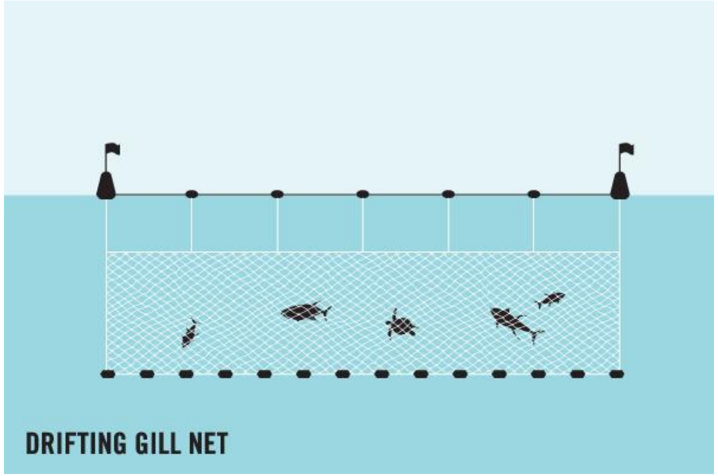
- Primarily use DGN gear to target and land highly migratory species, including swordfish, tuna, thresher and mako shark.

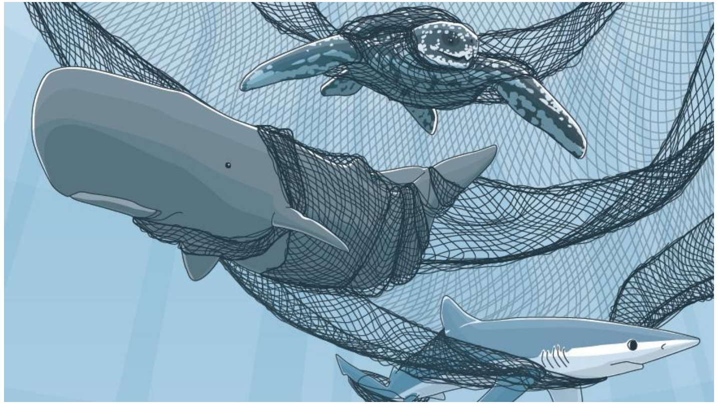
Drift Gillnet Vessel

Drift gillnet fishing

- A DGN is an unanchored panel of stretched mesh positioned vertically in the water by floats along the top and weights along the bottom

- DGN catches, through entanglement, animals that occupy the same area of the water column as the net through its deployment

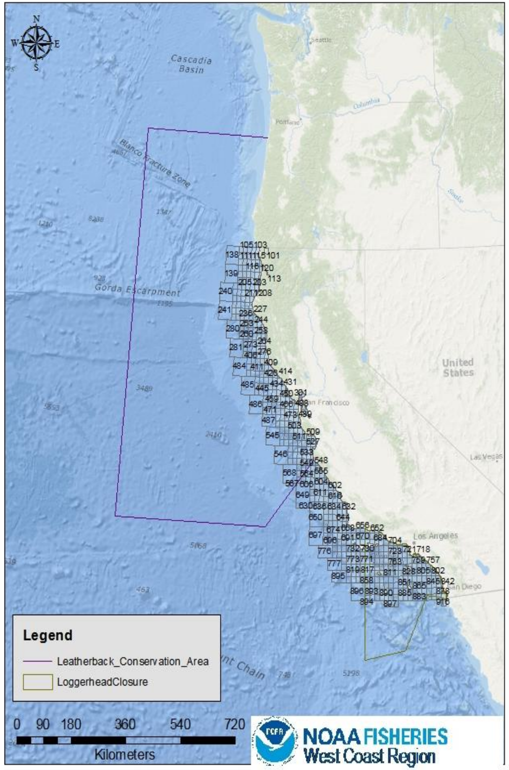




The Pacific Leatherback Conservation Area (PLCA)

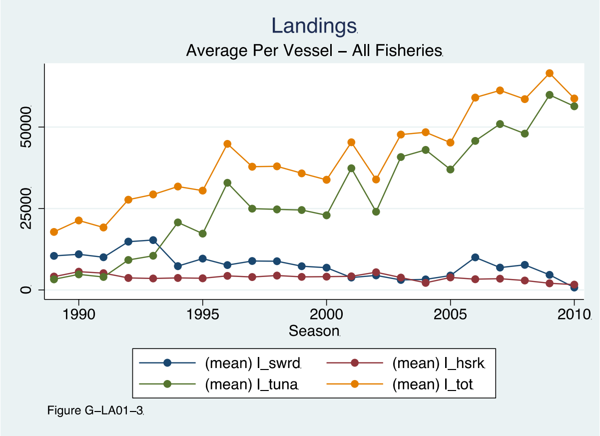
- Due to the unselective nature of DGN, the fishery has been a topic of conservation and management concern for much of its history
  - Mid to late 1990s: Stipulations on mesh size, size of nets, and depth, duration, time of net deployment, and acoustic pinger deployment
  - 2001; The Pacific Leatherback Conservation Area (PLCA) was enacted
    - Prohibits DGN use from August 15 to November 15 in the northern portion of the California swordfish fishing grounds, which consist of roughly 213,000 square miles located north of Point Conception within the U.S. exclusive economic zone (EEZ)

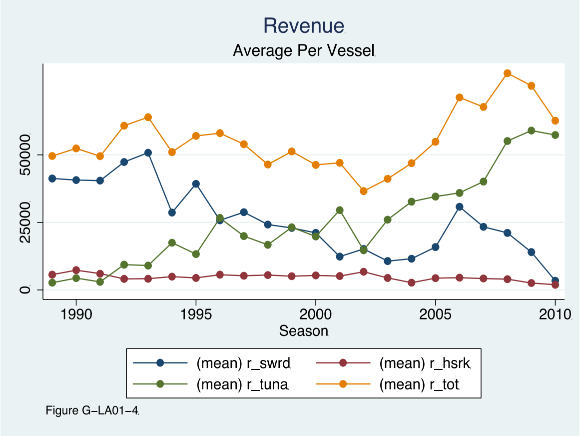
CDFW Blocks and PLCA and Loggerhead Closure-Full Extent



How did the PLCA impact the CA DGN fleet?

- The PLCA closure temporally and spatially coincides with the primary fishing season and grounds for the CA DGN swordfish fleet.
- Over the 1989 to 2010 study period, the number of vessels participating in the fishery declined from 97 in 1989 to a 45 in 2010.





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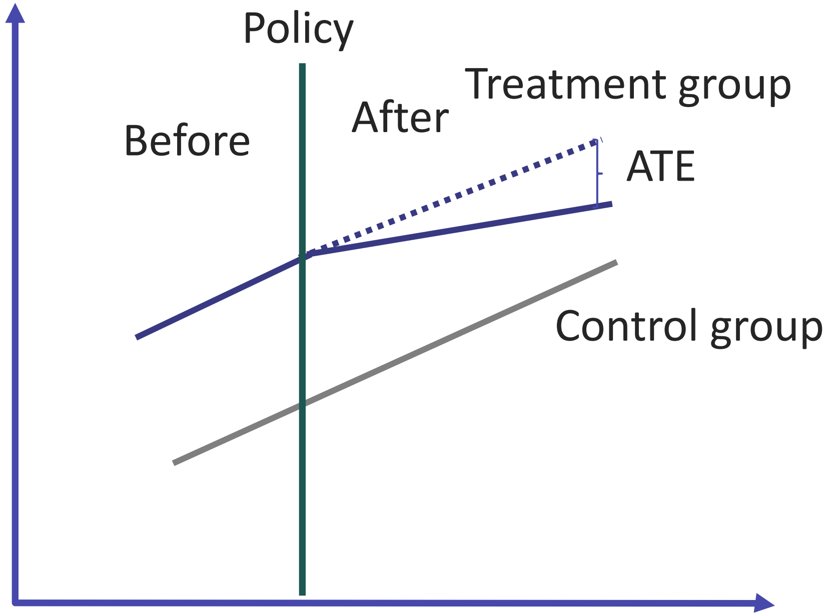
Natural Experiments

- A “**natural experiment”** is an empirical observational study. **“Treatment**” and “**Control”** not determined by investigator; They are determined by nature or other factors / forces.

Empirical Strategy

- Differences-in-Differences



The Model

$$Y = F_1(\mathbf{X}, s, t, g, p, ATE) + u$$

Y - the number of swordfish caught by a specific vessel, *i*, in a specific year, *t*.

X - vessel level input variables (fishing days, vessel length)

s - stock abundance

t - time trend

g - *t*reatment Group (1 = the vessels impacted by the regulation)

p - treatment period (1 = the period after the regulation came into force)

ATE- Average treatment effect (the product of *g* and *p*).

Variables – Summary statistics

Data source: Vessel logbook data

Time frame: 1987-2013

Observations: 1849

Variable	Mean	Std. Dev.	Min	Max
Number of swordfish (Y)	85.300	76.402	1	598
Fishing days (fd)	26.493	19.505	1	106
Vessel length (vl)	48.230	9.666	25	90
Time trend (t)	8.041	6.650	1	26
Vessel id	677.485	114.665	435	924
Treatment Group (g)	0.742	0.439	0	1
Treatment Period – post-regulation period (p)	0.174	0.379	0	1
Average treatment effect (ATE)	0.143	0.350	0	1
Instrumental variables				
• Fuel price	1.081	0.583	0.665	3.738
• Swordfish price	3.503	0.421	2.773	4.499
• Shark price	1.284	0.095	1.046	1.454
• Tuna price	1.029	0.291	0.523	1.975
• Wage rate	72.102	15.298	56.250	114.750
• BAA bond_rate	8.890	1.477	4.940	10.830

Empirical spesification

$$lnY_{it} = \beta_v + \sum_{n=1}^{N} \beta_n lnX_{in} + \beta_s \, lnS + \beta_t t + \beta_g D_g + \beta_p D_p + \beta_{ATE} ATE$$

$$+0.5 \sum_{m=1}^{M} \sum_{n=1}^{N} \beta_{mn} \, lnX_{im} lnX_{in} + 0.5\beta_{tt} t^2 + \sum_{n=1}^{n} \beta_{nt} \, lnX_{in} t$$

$$+ \sum_{n=1}^{n} \beta_{ng} \, lnX_{in} D_g + \sum_{n=1}^{n} \beta_{np} \, lnX_{in} D_p + \sum_{n=1}^{n} \beta_{nATE} \, lnX_{in} ATE$$

$$+\beta_{tg} t D_g + +\beta_{tp} t D_p + \beta_{tATE} tATE$$

Calculated elastiseties

Production elasticities with respect to the input variables:

$$\varepsilon_{Y,n} = \frac{\partial lnY}{\partial lnX_n} = \beta_n + \sum_m \beta_{nm} lnX_{im} + \beta_{nt} t + \beta_{ng} D_g + \beta_{np} D_p + \beta_{nATE} ATE$$

Output elasticity with respect to the time trend (technological change):

$$\varepsilon_{Y,t} = TC = \frac{\partial lnY}{\partial t} = \beta_t + \beta_{tt} t + \sum_n \beta_{nt} lnX_{in} + \beta_{tg} D_g + \beta_{tp} D_p + \beta_{tATE} ATE$$

Output elasticity with respect to the regulation (ATE):

$$\varepsilon_{Y,ATE} = \frac{\partial lnY}{\partial ATE} = \beta_{ATE} + \sum_n \beta_{nATE} lnX_{in} + \beta_{tATE} t$$

Results - Elasticity Estimates

	With regulation	
	Estimate	**St. Error**
F. Days	1.207***	(0.021)
Length	0.481***	(0.072)
RTS	1.688***	(0.072)
TC	0.017**	(0.007)
Stock	0.028	(0.127)
ATE	-0.400	(0.366)

Output elasticity with respect to the regulation (ATE):

$$\varepsilon_{Y,ATE} = \frac{\partial lnY}{\partial ATE} = \beta_{ATE} + \beta_{fdATE}\ln(FishingDays) + \beta_{vlATE}\ln(VesselLength) + \beta_{tATE}TimeTrend$$

$$\varepsilon_{Y,ATE} = -0.026 - 0.001\ln(FishingDays) - 2.171^{***}\ln(VesselLength) - 0.039^{*}\,\mathrm{TimeTrend}$$

$$\varepsilon_{Y,ATE} = -0.400$$

Results - Elasticity Estimates

	With regulation		Without regulation	
	Estimate	**St. Error**	**Estimate**	**St. Error**
F. Days	1.207***	(0.021)	1.207***	(0.025)
Length	0.481***	(0.072)	0.791***	(0.118)
RTS	1.688***	(0.072)	1.999***	(0.124)
TC	0.017**	(0.007)	0.022***	(0.008)
Stock	0.028	(0.127)		
ATE	-0.400	(0.366)		

Conclution

- This research provides an estimate of the regulatory impact of the Leatherback Turtle Conservation area on drift gillnet vessel swordfish production

- Empirical finding did not find support for the hypothesis of decreased productivity for the average vessel
- Larger vessels suffering from the regulation – since size has become less important
- Regulation has made the technological change slow down

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Thank you for the attention!

Question?