

## Background

We analyzed the impact of the 2015 El Niño on Japanese Anchovy and Chub Mackerel, which share habitats and a fishing gear. We examined the relationship between species under changes in ideal temperature. Our hypothesis was that changes in the ideal temperature for the anchovy cause fishers to catch the mackerel instead.

## Methodology

$$\ln(Effort) = \beta_1(\Delta_{JA} \times PS \times H_{JA}) + \beta_2(\Delta_{JA} \times PS \times H_O) + \beta_3(\Delta_{JA} \times PS) + \beta_4(\Delta_{CM} \times PS \times H_{JA}) + \beta_5(\Delta_{CM} \times PS \times H_O) + \mu_y + \theta_{flag} + \gamma_{EEZ} + \epsilon$$

$\Delta_{JA}$  = change in ideal temp for JA

$\Delta_{CM}$  = change in ideal temp for CM

$PS$  = Purse Seines,  $H_{JA}$  = JA habitat,  $H_O$  = habitat overlap,

$\mu_y$  = year fixed effects,  $\theta_{flag}$  = vessel flag fixed effects,

$\gamma_{EEZ}$  = EEZ fixed effects

## Results

When there's a change from the ideal temperature for JA, Purse Seines fished 28.2% less in the JA habitat, but effort wasn't affected in CM habitat. When there's a change from the ideal temperature for CM, Purse Seines fished 22.7% more in the JA habitat, but effort wasn't affected in CM habitat. These results do not entirely follow our hypothesis. However, there is a literature demonstrating a difference in hydrology in Northern and Southern Japan that we believe may affect the anchovy, so we would like to add that to future regressions.

	ln(Fishing Hours)
Purse Seines	-1.133***
Purse Seines: $\Delta_{JA}$	0.172**
JA habitat:Purse Seines: $\Delta_{JA}$	-0.282***
CM habitat:Purse Seines: $\Delta_{JA}$	-0.069
JA habitat:Purse Seines: $\Delta_{CM}$	0.227**
CM habitat:Purse Seines: $\Delta_{CM}$	0.063

Note:

$\Delta_{JA}$  is the change from ideal temperature for Japanese Anchovies (JA)

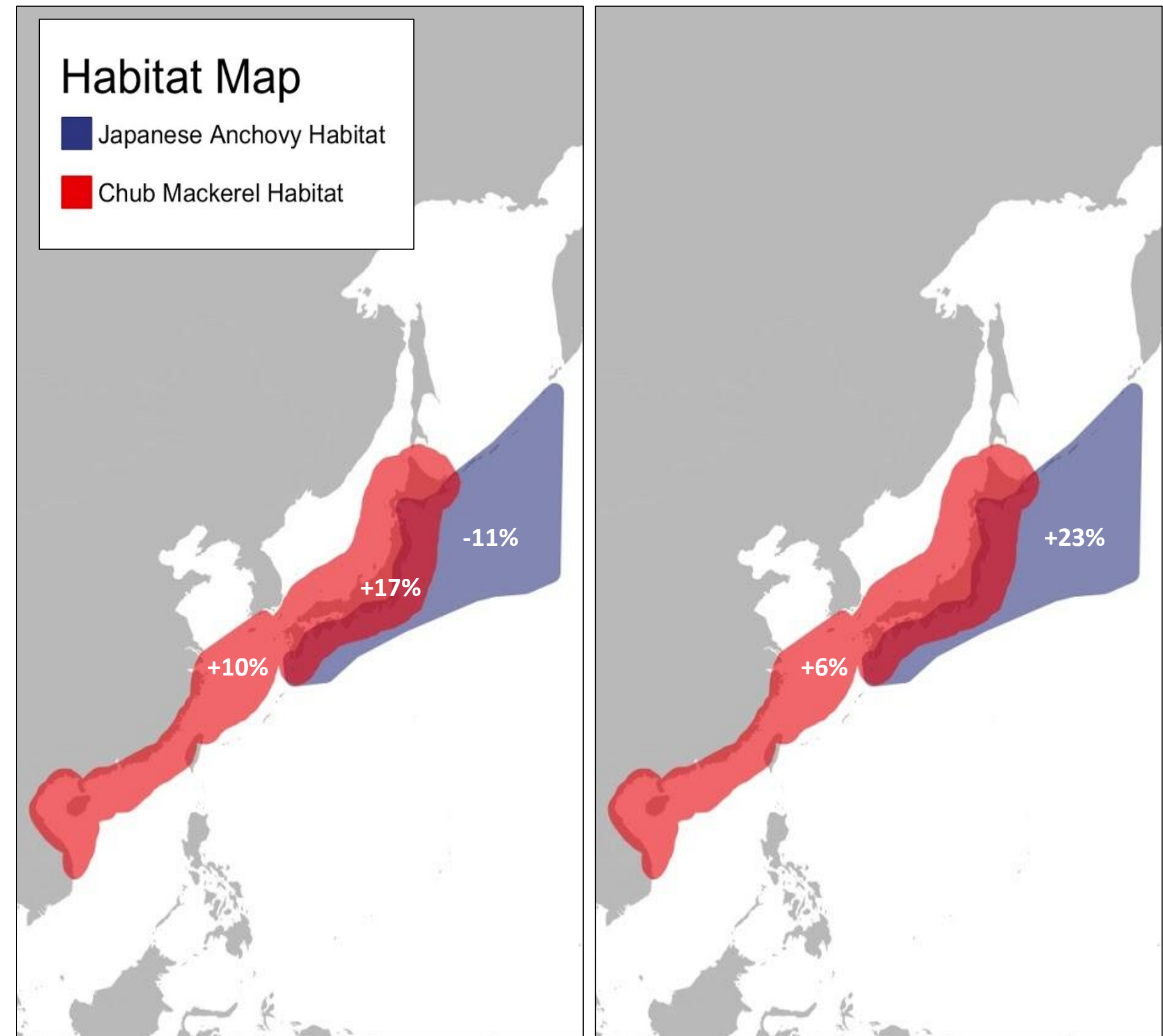
$\Delta_{CM}$  is the change from ideal temperature for Chub Mackerel (CM)

\* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ , \*\* and \*\*\* are statistically significant

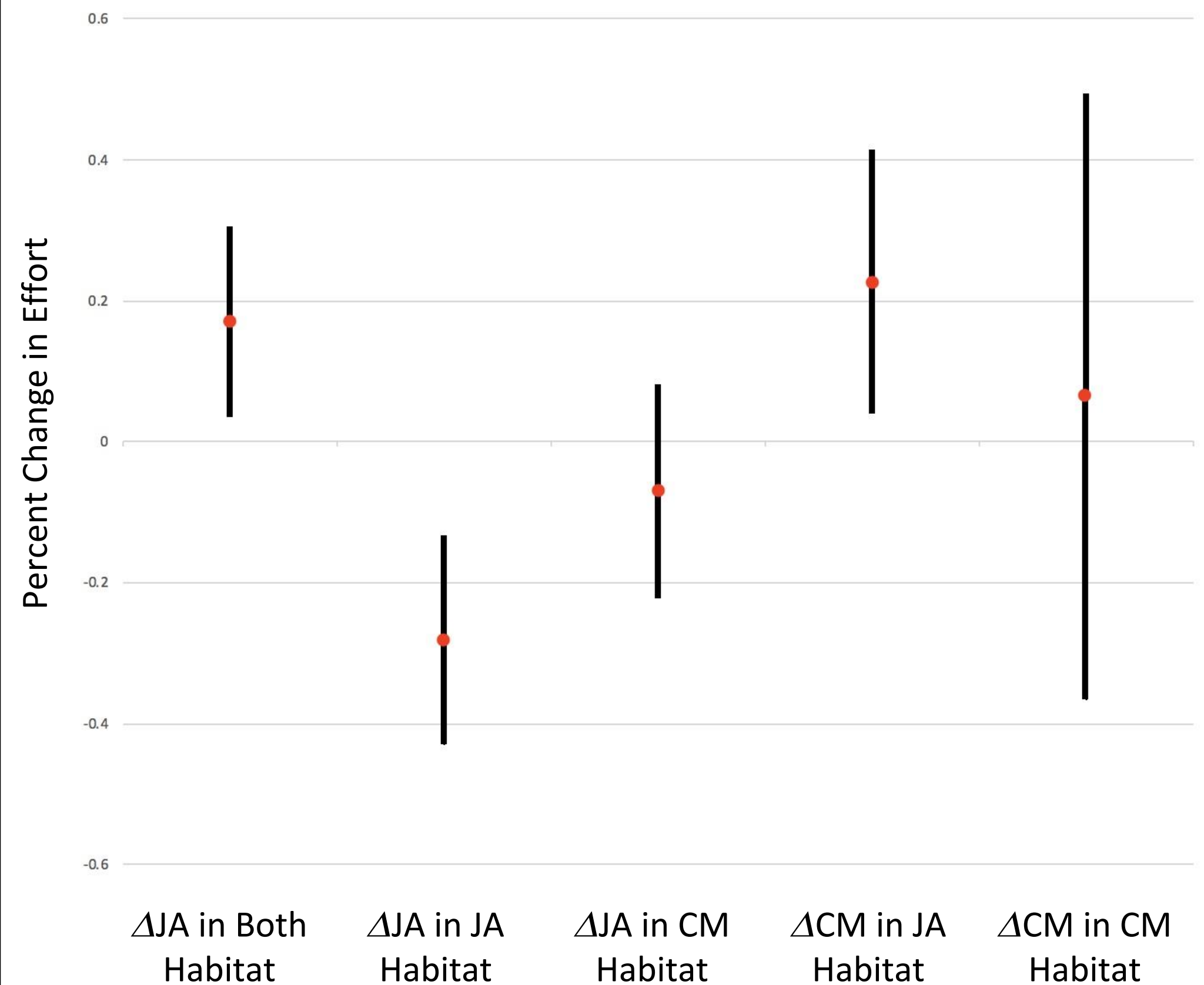
## Conclusion

Change in Fishing Effort Due to Deviations from JA's ideal

Change in Fishing Effort Due to Deviations from CM's ideal



Effect of  $\Delta$  on Purse Seines Fishing Effort



## Citations and Data

Global Fishing Watch. 2019. [www.globalfishingwatch.org](http://www.globalfishingwatch.org)

National Oceanic and Atmospheric Administration. 2019. <http://ftp.cdc.noaa.gov/Datasets/noaa.oisst.v2/sst.wkmean.1990-present.nc>

Dong, Linyao, Congsheng Fu, Jigen Liu, and Pingcang Zhang. "Combined Effects of Solar Activity and El Niño on Hydrologic Patterns in the Yoshino River Basin, Japan." *Water Resources Management* 32, no. 7 (2018): 2421-435. doi:10.1007/s11269-018-1937-1.