

# Distribution of Legal Bristol Bay Red King Crab During the Fishing Season using Daily Fishing Logs



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DFLs from 2005 – 2015

## Funding Sources

Bering Sea Fisheries Research Foundation

Rasmuson Fisheries Research Center Graduate Student Fellowship

National Science Foundation IGERT: Marine Ecosystem Sustainability in the Arctic and Subarctic (MESAS)

# Daily Fishing Logs (DFLs)

## Catch Information

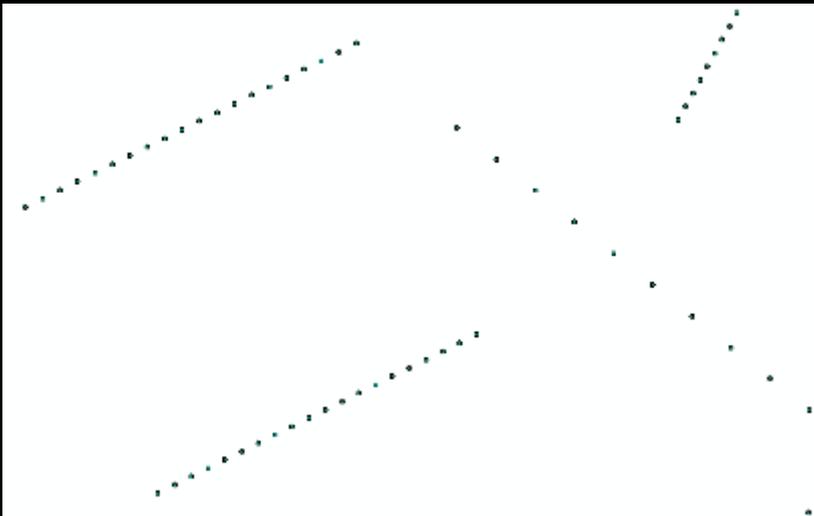
- Coordinates for each string of pots
- # pots per string & catch per string
- Dates set and hauled

## Limitations

- Only legal males
- No data in areas where fishing did not occur

## Assumptions

- CPUE is a proxy of crab abundance



# Data Set

- 11 years of DFL data digitized – 29,222 strings
  - # strings per year variable: 1,308 – 4,578
  - 21,603,851 crabs & 862,360 pot lifts
- ~90% of total crabs caught are represented

# Trimming Data

Pots per string:  $>5$  and  $\leq 100$  (mean 29.5)  
String length  $< 40$  km (mean 9.5 km)

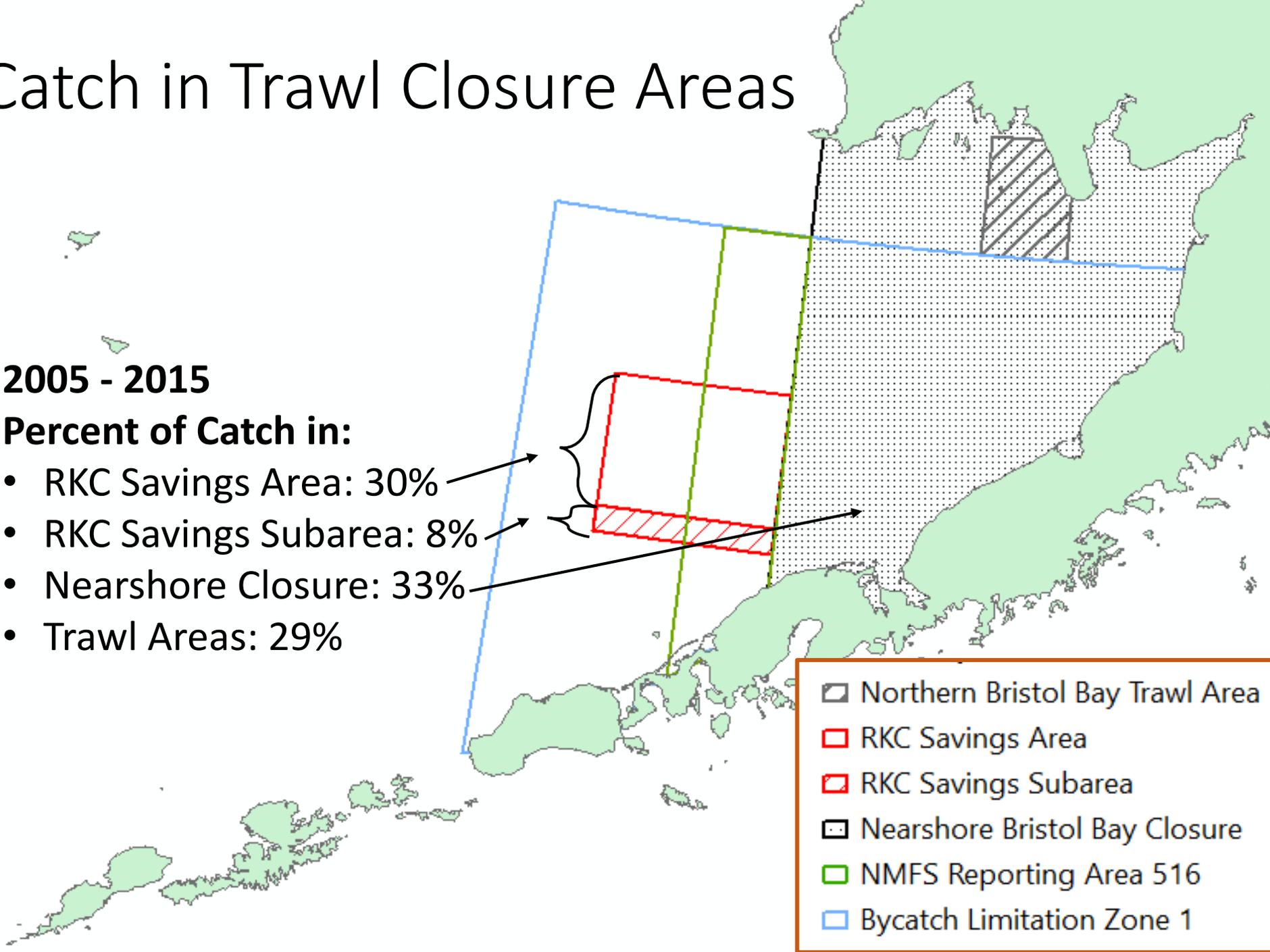


# Catch in Trawl Closure Areas

**2005 - 2015**

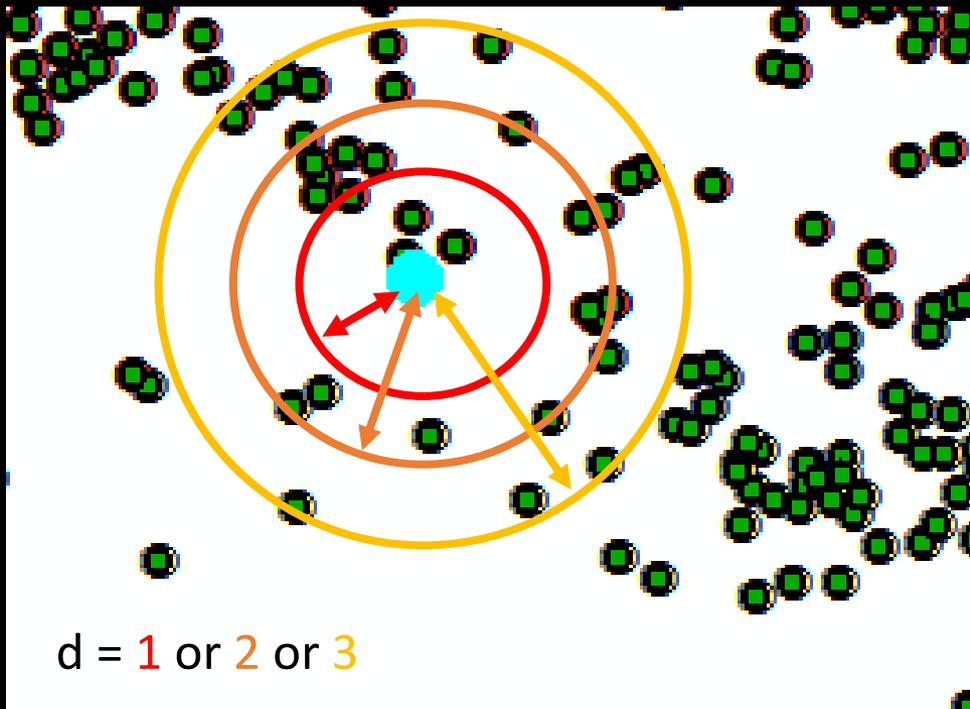
**Percent of Catch in:**

- RKC Savings Area: 30%
- RKC Savings Subarea: 8%
- Nearshore Closure: 33%
- Trawl Areas: 29%



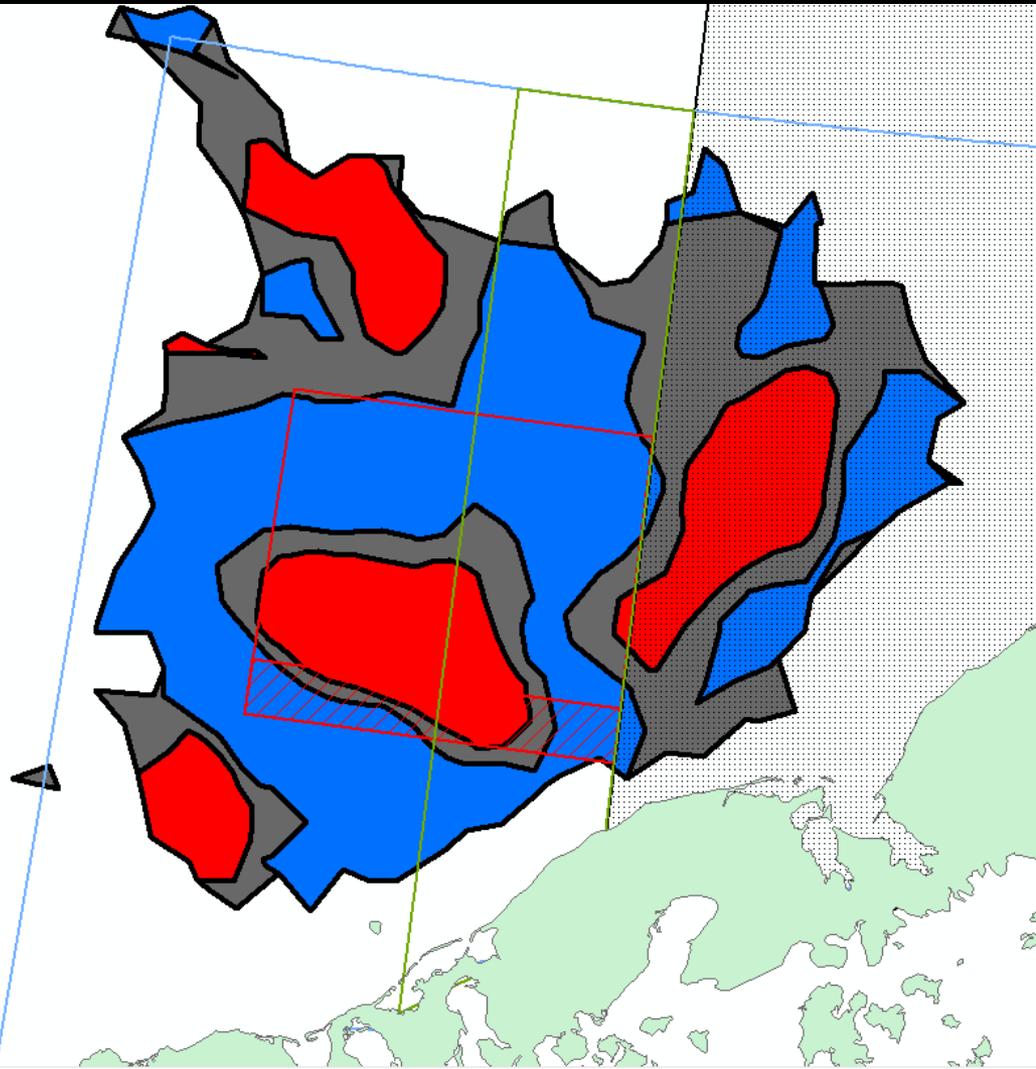
# Hot spot analysis –

Is the value of a point and its neighbors significantly different than the global mean?



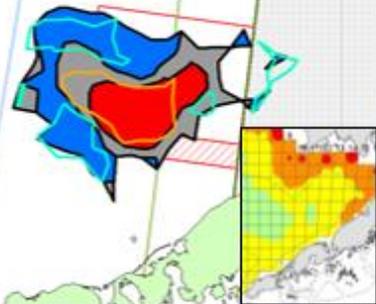
- Hotspot analyses were run on string midpoints
- Neighborhood distance = 20 km

# Hotspot Analysis All Years (2005 – 2015)

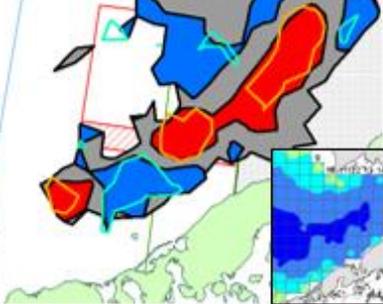


- Red = statistically significant high CPUE (crab abundance)
- Blue = statistically significant low CPUE (crab abundance)
- Gray = No significant clusters

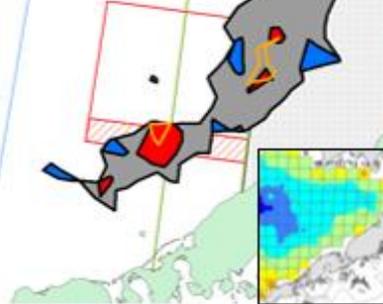
2005



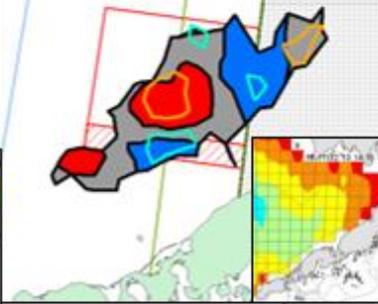
2008



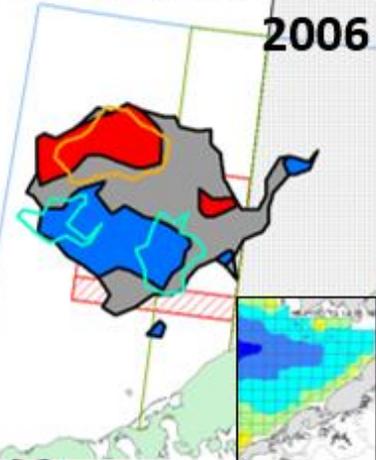
2011



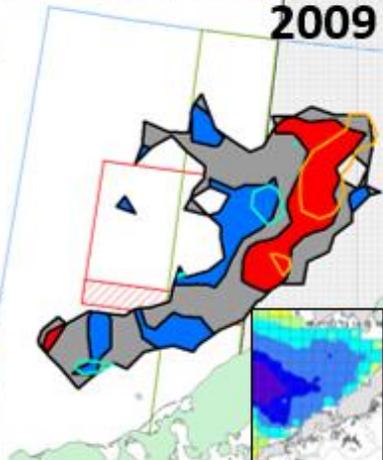
2014



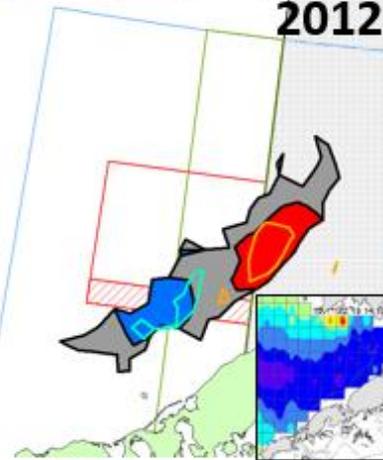
2006



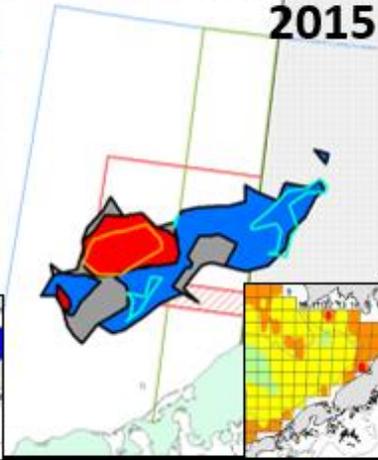
2009



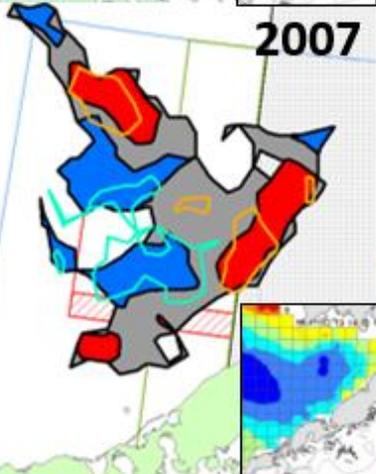
2012



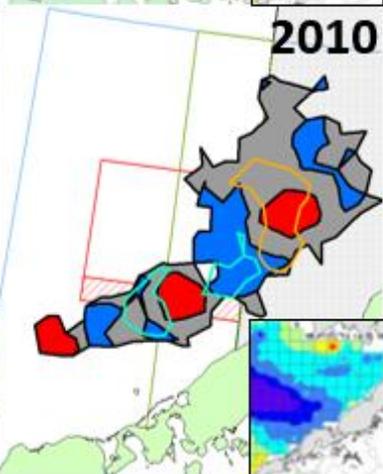
2015



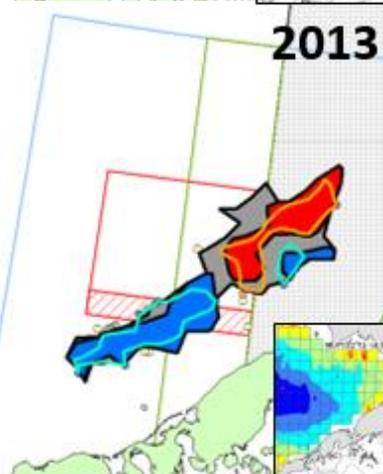
2007



2010



2013



NMFS bottom temperature maps are placed in corners to show differences between warm and cold years



## Hotspots Analyses on CPUE

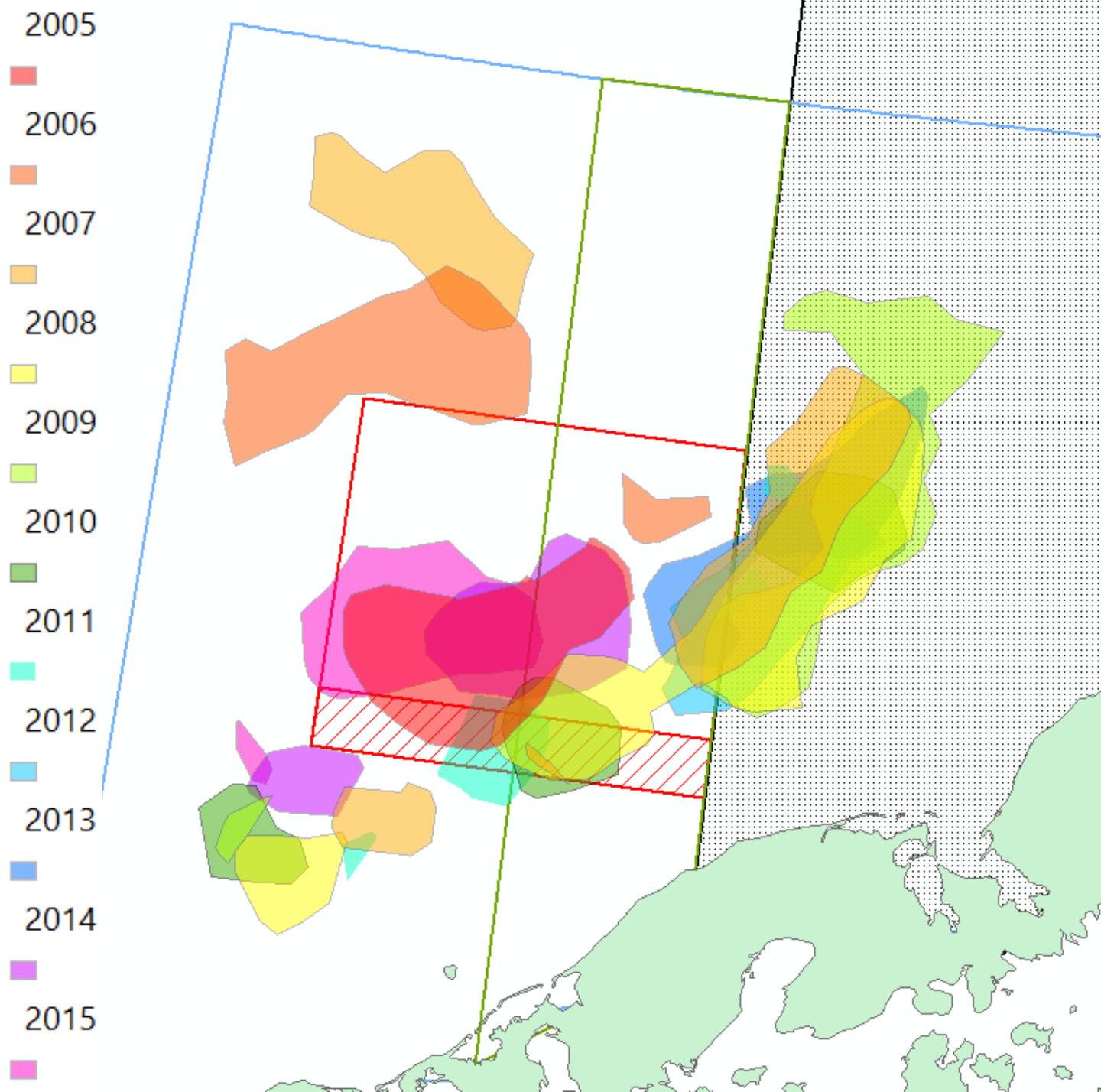
### Daily Fishing Log Data

- RED = high CPUE (crab abundance)
- BLUE = low CPUE (crab abundance)
- GRAY = No Significant Difference

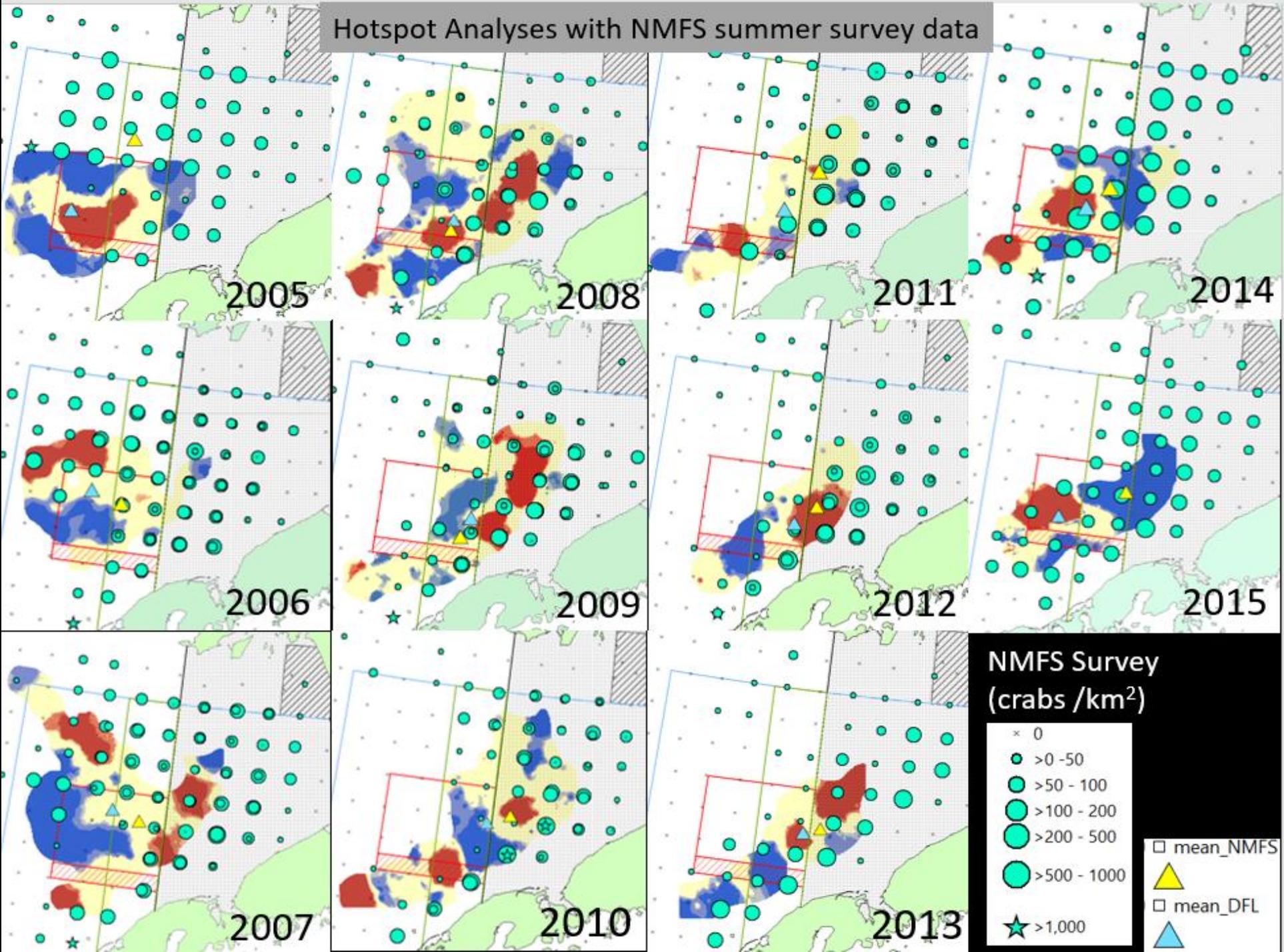
### Observer Data

- ORANGE outline = high CPUE
- TURQUOISE outline = low CPUE

CPUE  
Hot Spots  
2005-2015

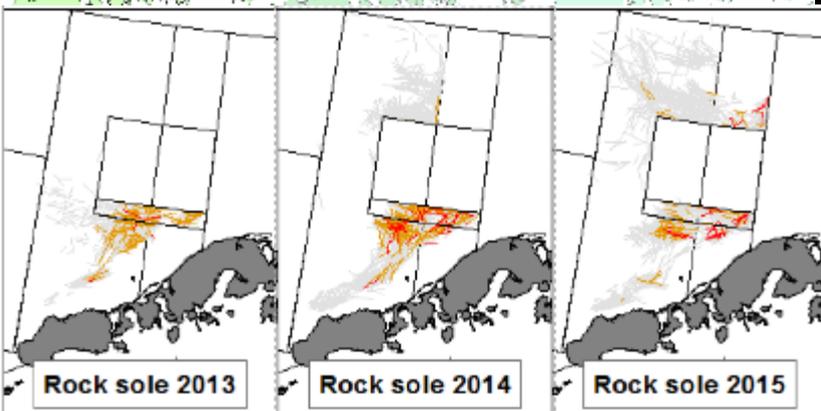
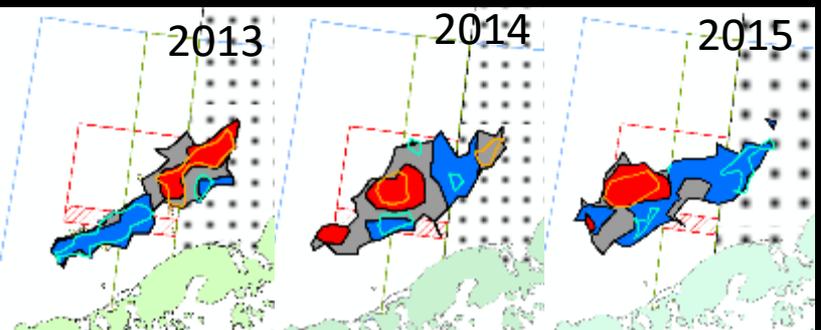
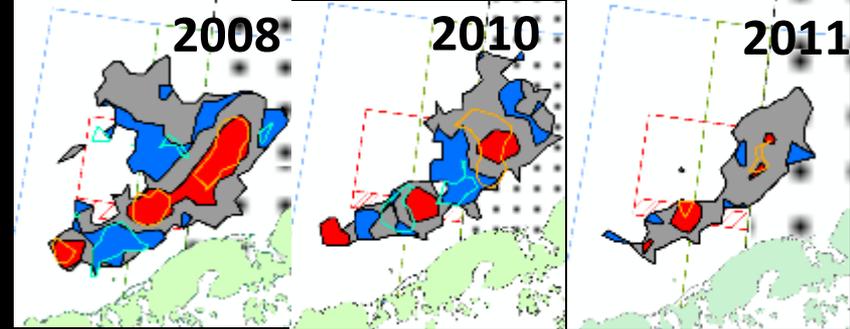


# Hotspot Analyses with NMFS summer survey data



# Summary

- Areas of high crab abundance vary by year
- Patterns appear to vary with temperature (warm vs. cold)
- Catches in subarea do not indicate catches in core RKCSA
  - 2013, 2014, and 2015 did not have hotspots in subarea
  - It would be helpful to see RKC bycatch data in 2008, 2010, and 2011 when RKC hotspot occurred in subarea



## Future Directions

- How do crab distributions in Jan-Apr (during rock sole fishery) compare with distributions in Oct-Nov (during BBRKC fishery)?
- Dynamic RKC closure areas
  - Based on temperature data from NMFS summer survey
  - Based on commercial crab catch patterns → **electronic DFLs**

# EXTRA Slides

# Hot spot analysis — Is the value of a point and its neighbors significantly different than the global mean?

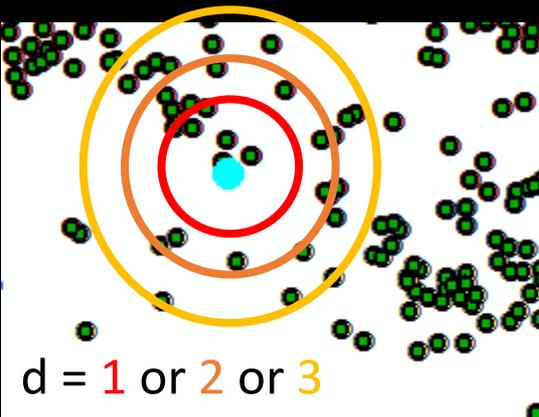
Z-score for point  $i$

Sum of values of neighbors

Global mean

# of neighbors

$$G_i^* = \frac{\sum_{j=1}^n w_{i,j} x_j - \left( \frac{\sum_{j=1}^n x_j}{n} \right) * \sum_{j=1}^n w_{i,j}}{\sqrt{\frac{\sum_{j=1}^n x_j^2}{n} - \left( \frac{\sum_{j=1}^n x_j}{n} \right)^2} * \sqrt{\frac{n \sum_{j=1}^n w_{i,j}^2 - \left( \sum_{j=1}^n w_{i,j} \right)^2}{n-1}}}$$

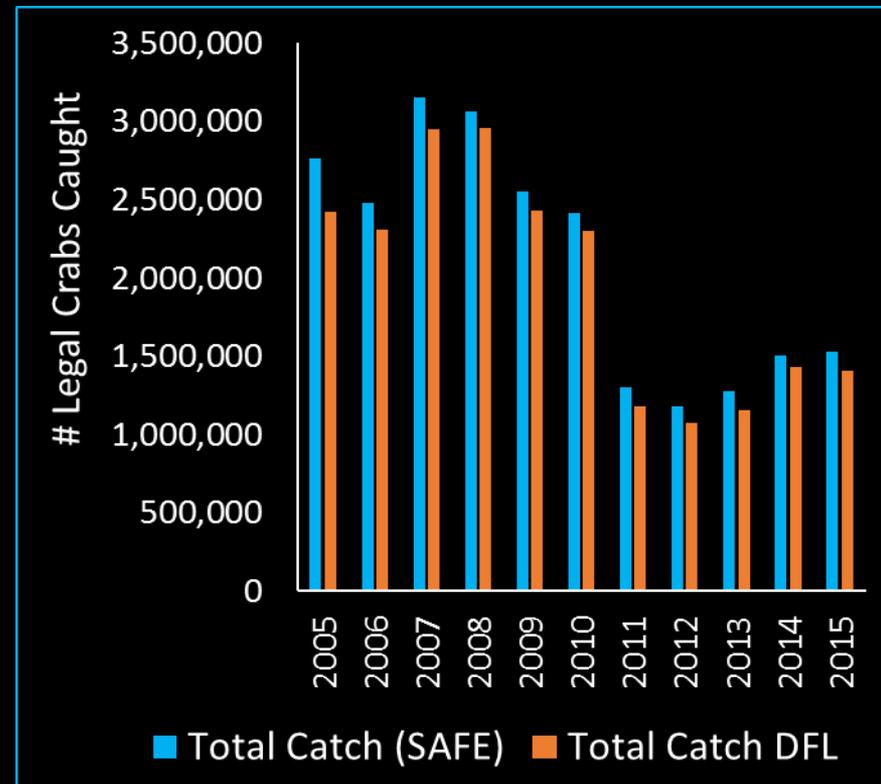
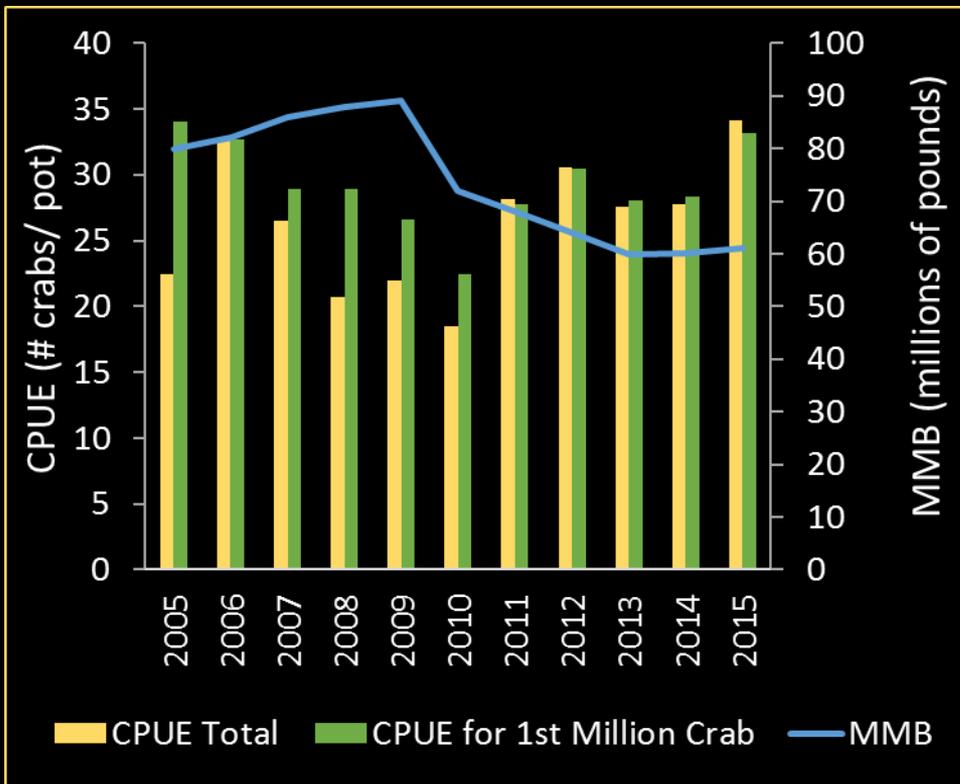


Global Standard Deviation

$$\sqrt{\frac{n(\# neighbors) - (\# neighbors)^2}{n-1}}$$

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Regression: NMFS  
Temperature and  
DFL CPUE for each  
grid cell

- **Red:** Positive Relationship
- **Blue:** Negative relationship
- **Green:** No relationship
- Darker Colors are significant ( $p < 0.05$ )
- Lighter colors are not significant, but  $R^2 > 0.2$

