Potential red tide impacts on the annual spatial distribution of Red Grouper (*Epinephelus morio*) observed from fishery-independent video surveys

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Potential red tide impacts on the annual spatial distribution of Red Grouper (*Epinephelus morio*) observed from fishery-independent video surveys

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Introduction

Currently there are three different stationary video surveys for reef fish conducted in the northern Gulf of Mexico (GOM). The NMFS SEAMAP reef fish video survey, carried out by NMFS Mississippi Laboratory (MS Labs), has the longest running time series (1992-1997, 2002, and 2004+), followed by the NMFS Panama City lab survey (2005+), with the most recent survey being the Florida Fish and Wildlife Research Institute SEAMAP survey (FWRI, starting year 2008). We have used these surveys to provide a standardized index of relative abundance in previous assessments using novel, habitat-based, modeling methodologies (Thompson et al. 2018). These surveys represent the least selective, and widest ranging dataset spatially regarding reef fish, including Red Grouper, in the eastern GOM. As such, this data can be used to address several ecological hypotheses regarding the relative abundance, distribution, habitat associations, and community interactions of managed reef fish species.

Red tide, a naturally occurring and well documented phenomenon in the Gulf of Mexico has been shown to adversely affect the populations of several managed species. Specifically, Red Grouper showed precipitous declines following the major red tide event of 2005 (Sagarese et al. 2018; Thompson et al. 2018). As such, red tide mortality effects have been modeled and included in the previous and current assessment for this species (Chagaris and Sinnickson 2018; SEDAR 2015; Sagarese et al. 2018). Red tide was also prevalent in 2014 in the big bend region of Florida and the current year, 2018, has had a large event as well, however data are not yet available after 2017 (Chagaris and Sinnickson 2018; Sagarese et al. 2018). The specific nature of the population effects of red tide on Red Grouper are unknown. Red tide can potentially cause direct mortality on individuals, force movement away from affected areas, or both. Furthermore, shifts in biomass in response to red tide may also be affecting fishing effort allocation and the overall exploitation rate of the stock. Current efforts to describe red tide effects are model-based with no current, directed empirical work showing population effects.

Discussions at the in-person workshop held as part of this SEDAR indicated that the combined video dataset could provide valuable, empirical insight into potential movements or mortality to the Red Grouper stock as a function of red tide. Therefore, as an initial analysis, we prepared annual plots of Red Grouper abundances throughout the eastern GOM across a time period encompassing several documented red tide events.

Methods

Survey data

As indicated, there are three video datasets available in the GOM for reef fish: NMFS SEAMAP out of Pascagoula, NMFS Panama City, and FWRI. Site selections, overall sampling universe, and habitat mapping vary slightly among the surveys, however the main metric of MaxN (the maximum number of individuals of each species viewed in a single frame within a 20-minute time frame) is the same. Furthermore, camera design and baiting are the same among the labs. For further details regarding the specifics of each survey see Thompson et al. 2018.

Data analysis

To create a dataset that included the most potential overlap with known red tide affected areas and years, we limited analyses to 2010+ as that is the first year all three surveys were able to contribute to the indices of abundance of Red Grouper. This is also the first year that includes southern, nearshore sites sampled by FWRI. We then created a series of bubble plots showing binned MaxN counts of Red Grouper (MaxN levels: 0,1, 2+) for each sampling year. Of the years included, only 2014 had a notable red tide as interpreted by satellite imagery (Sagarese et al. 2018). We then visually examined patterns in count data throughout the years for evidence of displacement of Red Grouper in 2014 compared to other years.

Results and Discussion

Prior to the 2014 red tide event (in particular 2010-2012), Red Grouper were widely distributed throughout the eastern Gulf of Mexico, although areas of higher abundance were observed within the Big Bend (east of Cape San Blas and north of Tampa Bay), nearshore (within ~ 50m depth) waters off of Tampa Bay and Charlotte harbor, and at large reefs with high relief areas such as the Elbow (Figs. 1-3). In 2013 abundances in the Big Bend declined, although sampling effort was reduced during this year (Fig. 4). Similar patterns were observed in 2014 (Fig. 5), indicating that Red Grouper abundances may have declined within this region in response to the 2014 red tide. Abundances remained low until 2016 (Fig. 6-7). Furthermore, abundances in southern or western regions remain relatively constant throughout the entire time frame (Figs. 1-8). This would support the notion that mortality, rather than altered distribution patterns, is the primary contribution factor to observed patterns. However, to explore this more fully, we could incorporate fishery-dependent data on the spatial distribution of fishing effort and regional exploitation rates. As red tide events continue with some regularity, further analyses should be conducted to determine how to best handle these environmental effects as mortality in future assessments of various reef fishes in the region.

Literature Cited

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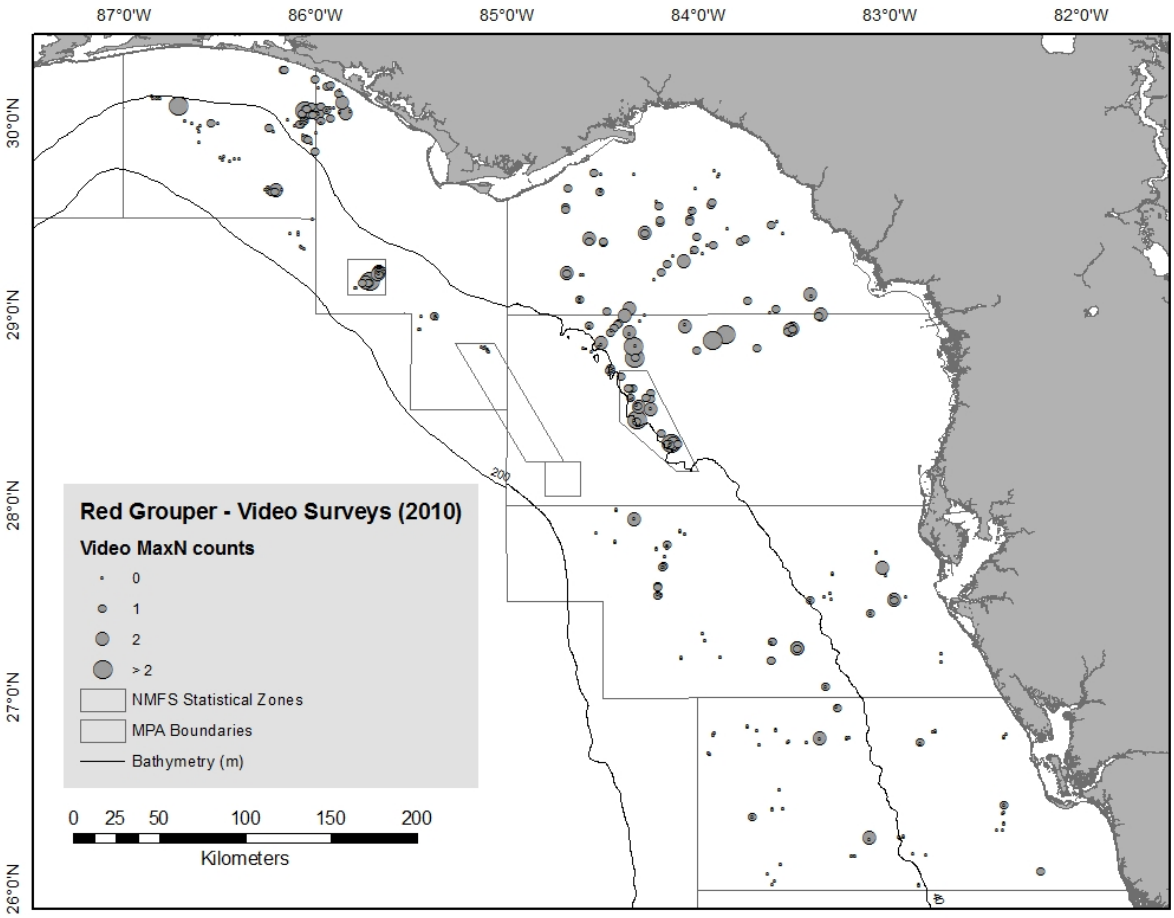

Figure 1. The spatial distribution of MaxN levels of Red Grouper on the West Florida Shelf in 2010.

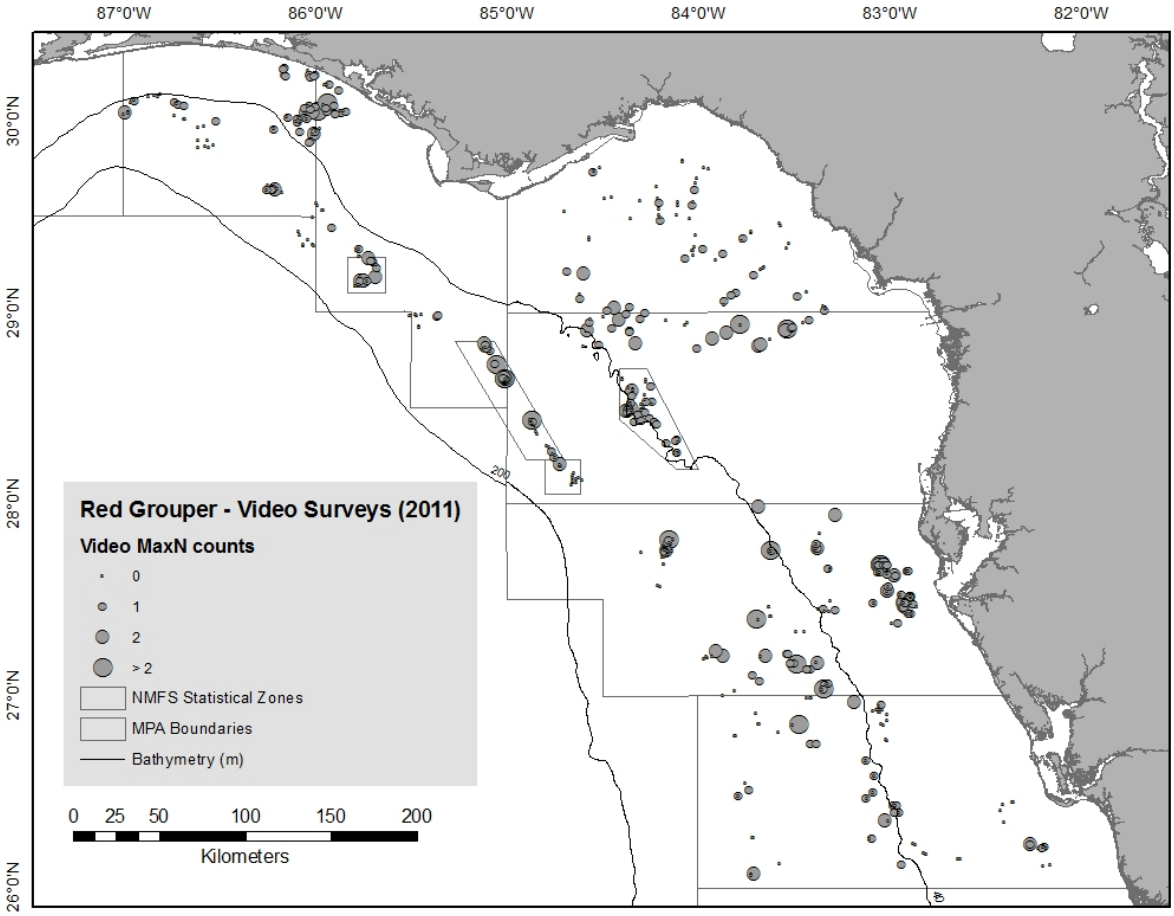

Figure 2. The spatial distribution of MaxN levels of Red Grouper on the West Florida Shelf in 2011.

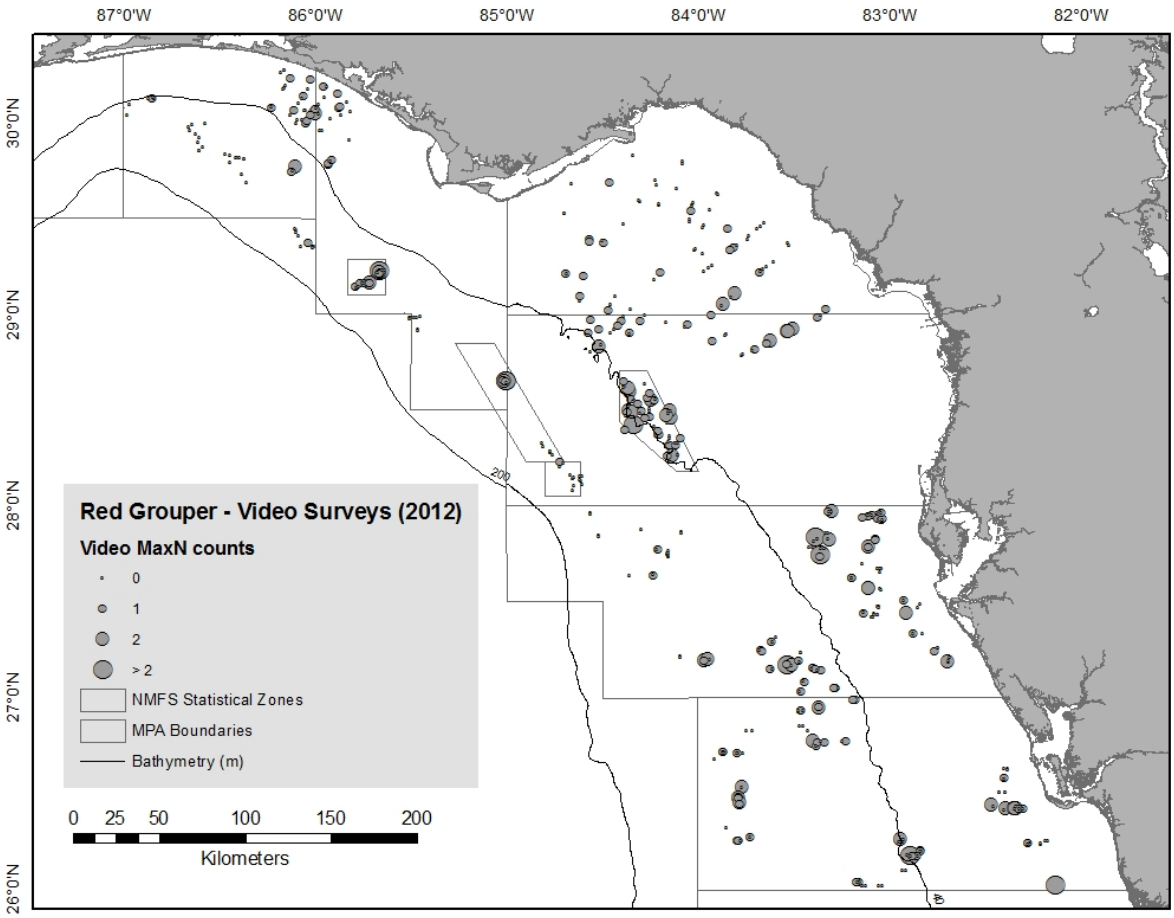

Figure 3. The spatial distribution of MaxN levels of Red Grouper on the West Florida Shelf in 2012.

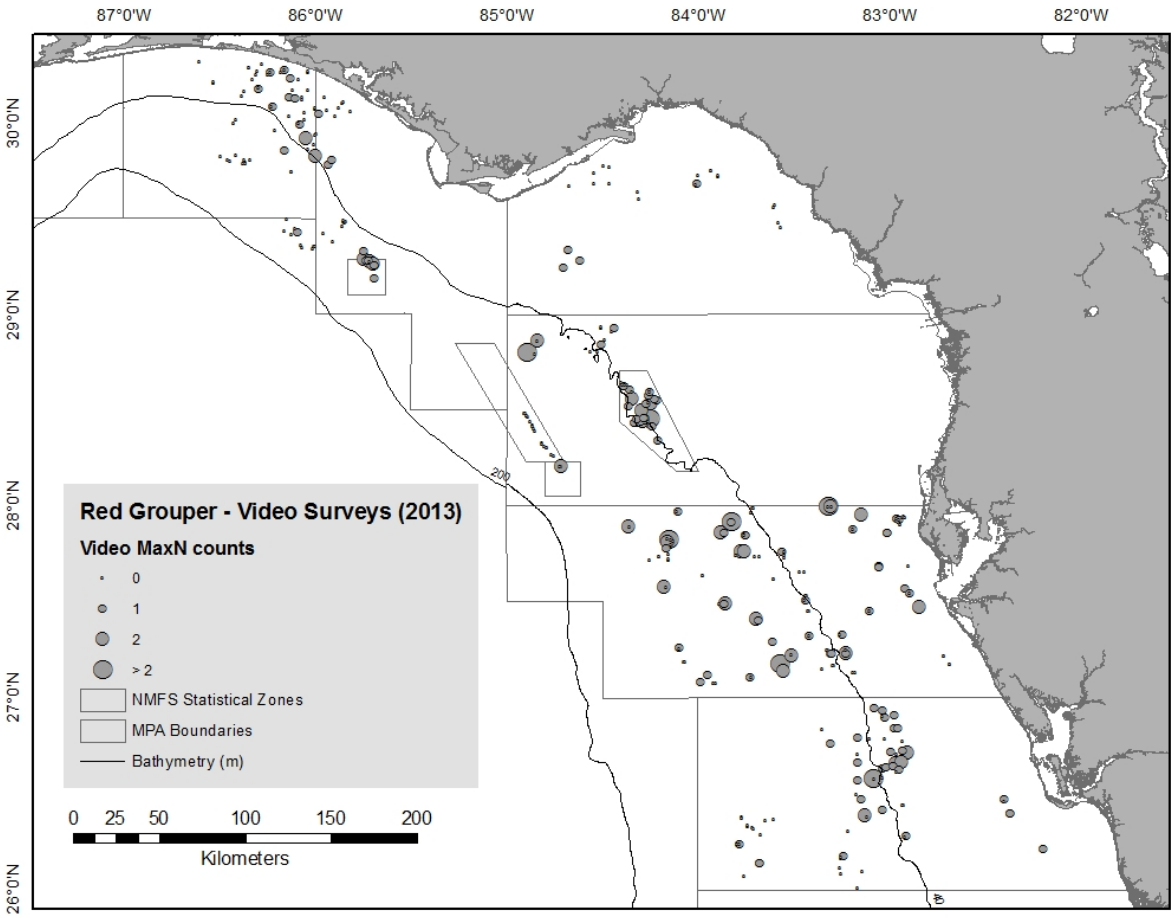

Figure 4. The spatial distribution of MaxN levels of Red Grouper on the West Florida Shelf in 2013.

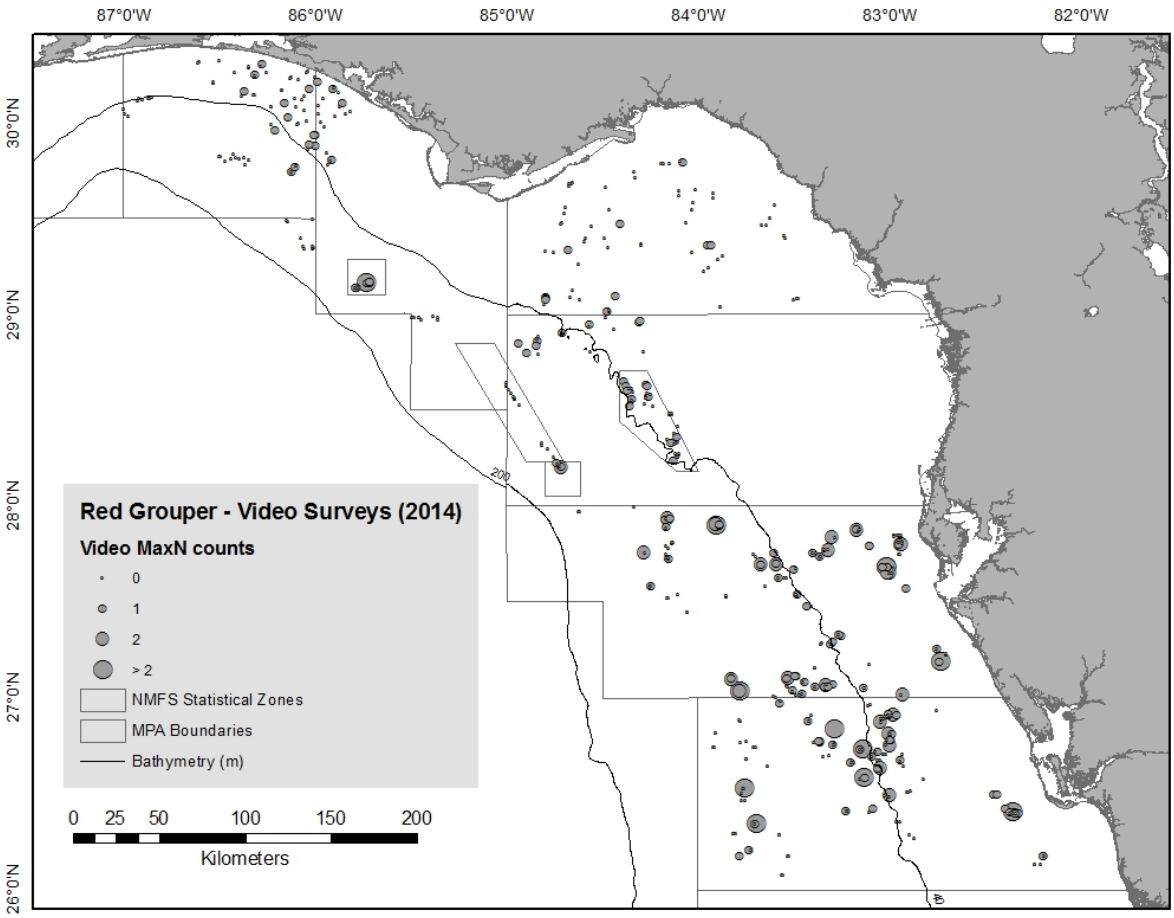

Figure 5. The spatial distribution of MaxN levels of Red Grouper on the West Florida Shelf in 2014.

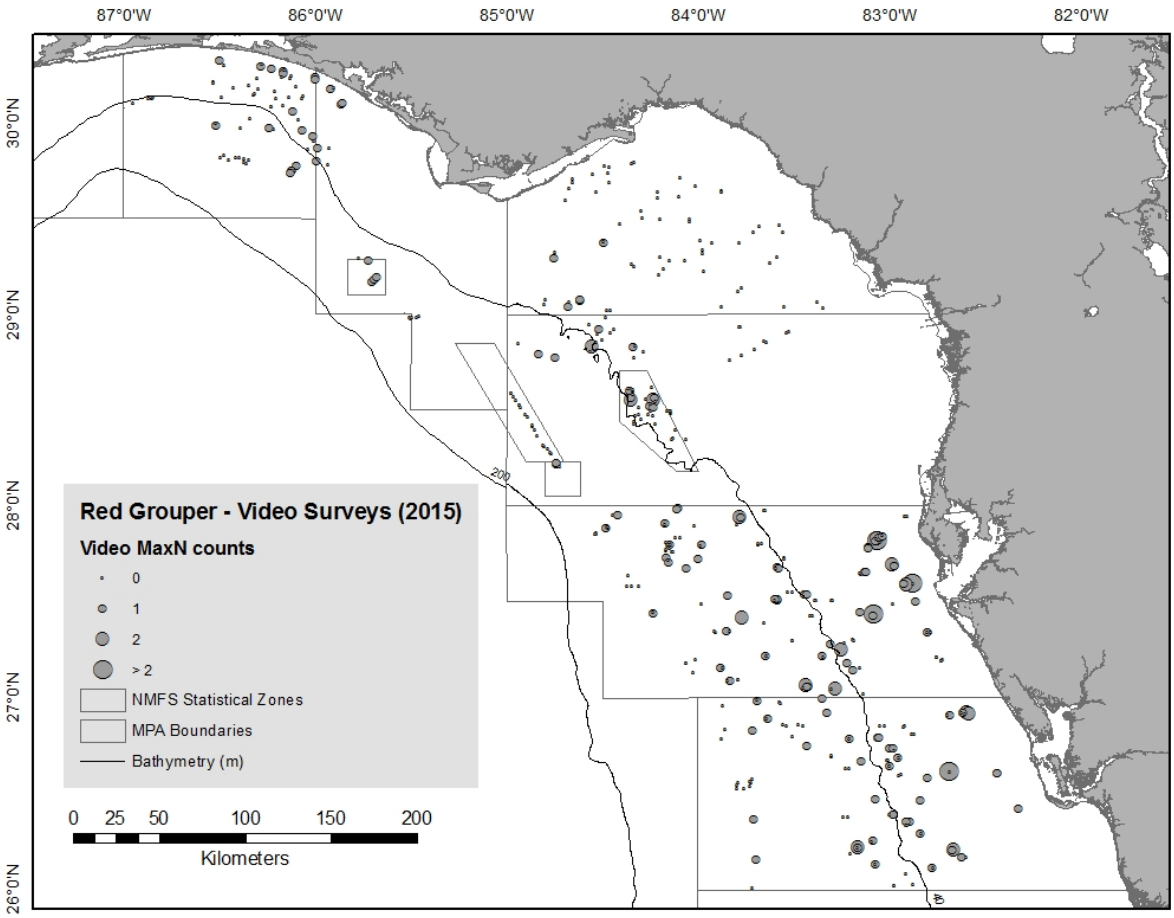

Figure 6. The spatial distribution of MaxN levels of Red Grouper on the West Florida Shelf in 2015.

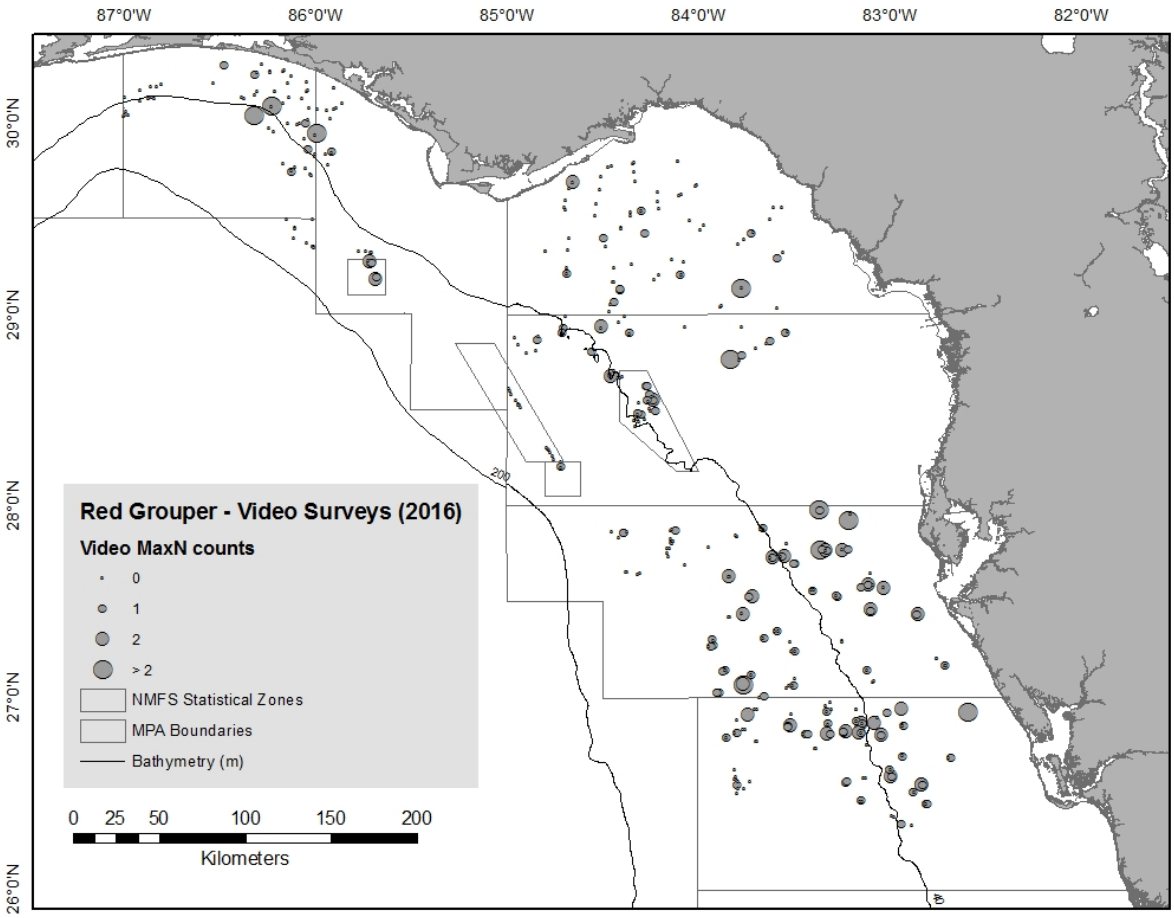

Figure 7. The spatial distribution of MaxN levels of Red Grouper on the West Florida Shelf in 2016.

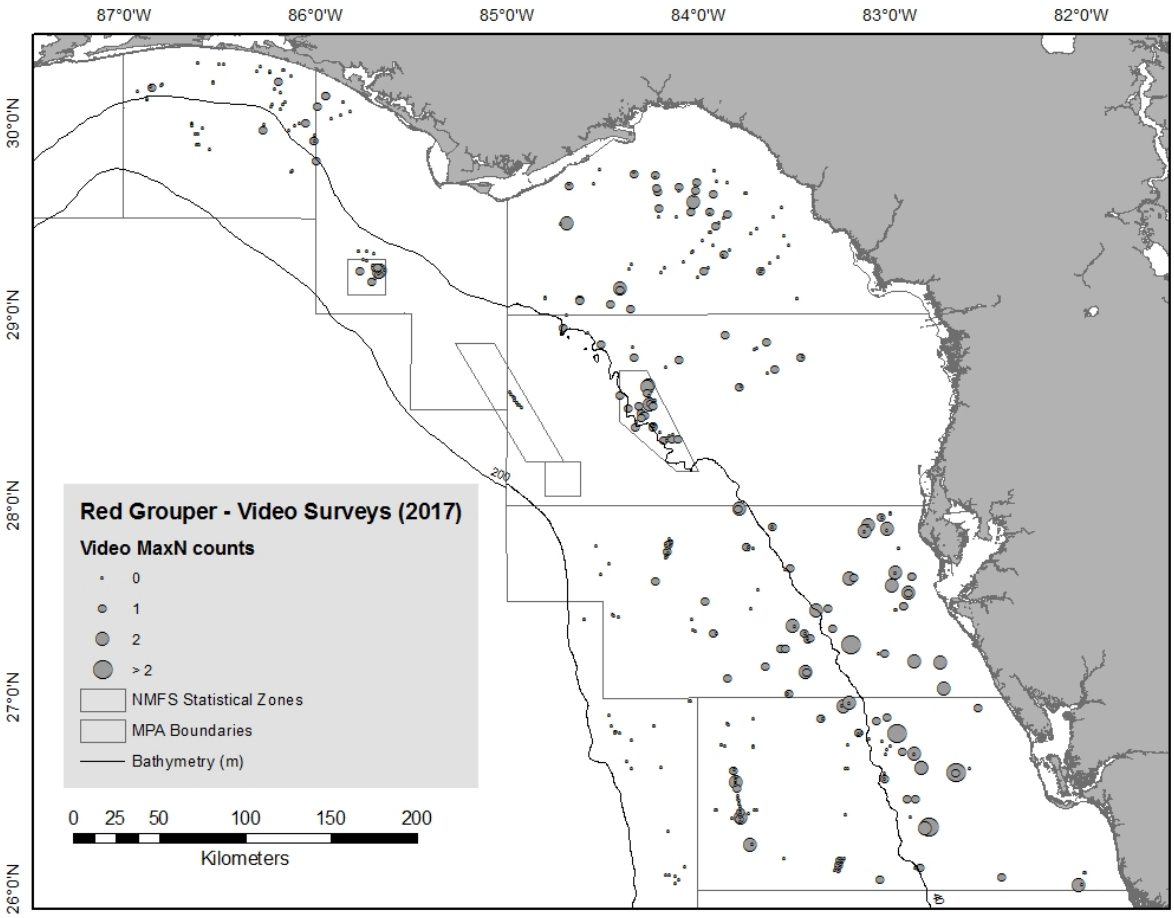

Figure 8. The spatial distribution of MaxN levels of Red Grouper on the West Florida Shelf in 2017.