



Red Hind Spawning Aggregation timing: Update from western Puerto Rico

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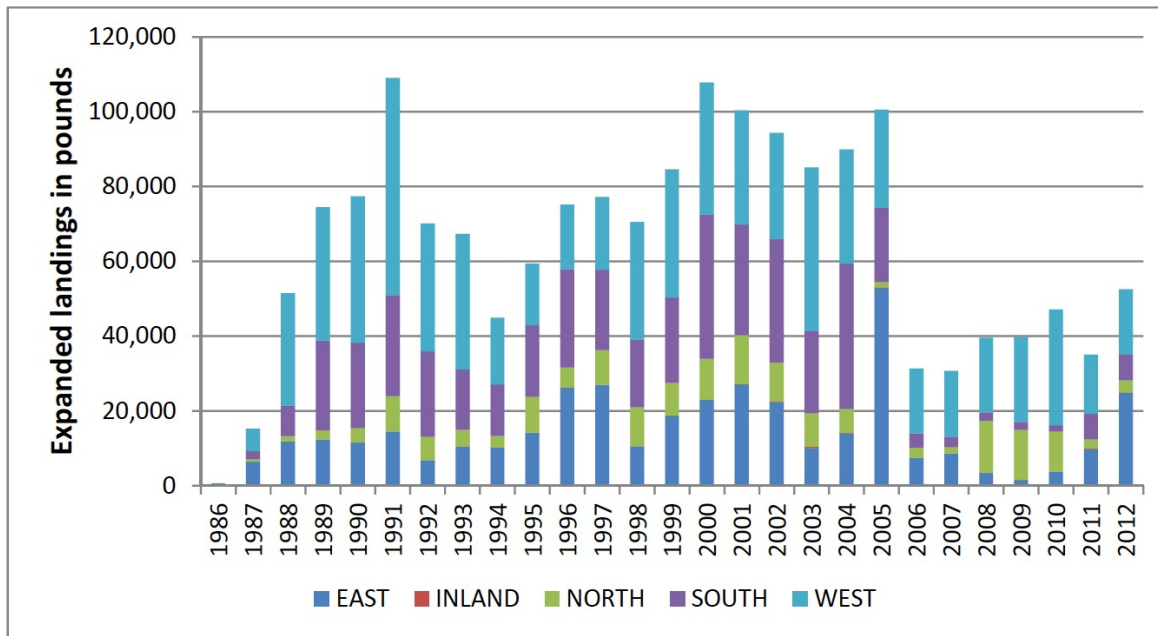
Boquerón, Puerto Rico

Collaborators

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 High proportion of landings from west Puerto Rico (SEDAR 35, 2014)

B.



Epinephelus guttatus - Red hind



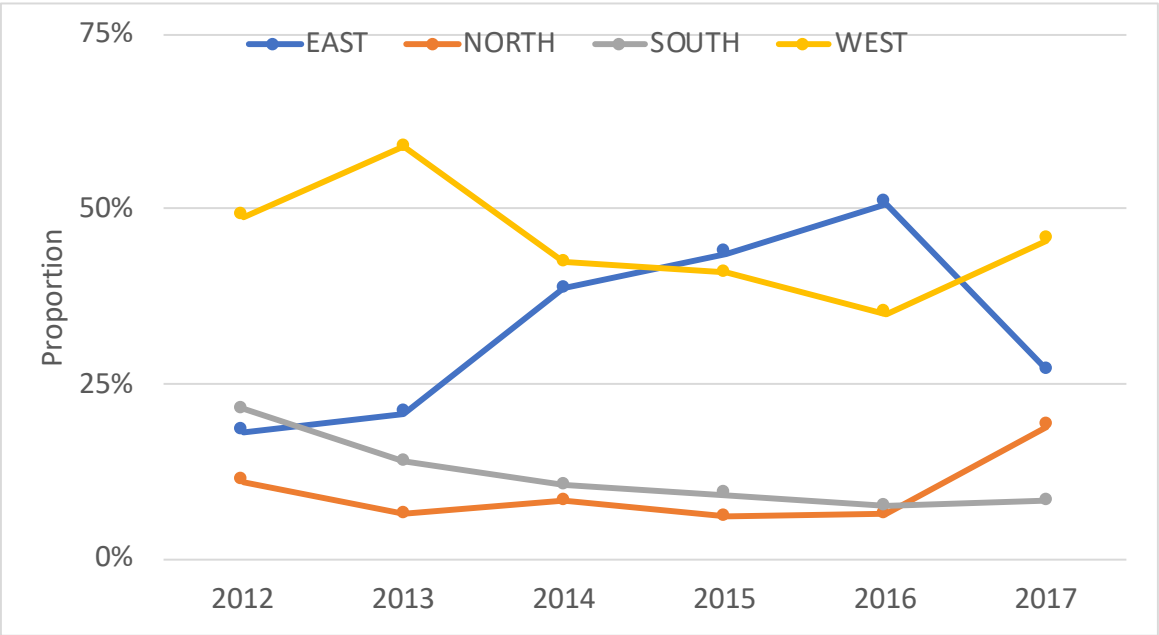
Figure 3.5.1. A. Puerto Rico yearly commercial fishery landings of Red Hind, expansion factors applied, by gear. B. Puerto Rico yearly commercial fishery landings of Red Hind, expansion factors applied, by coast.

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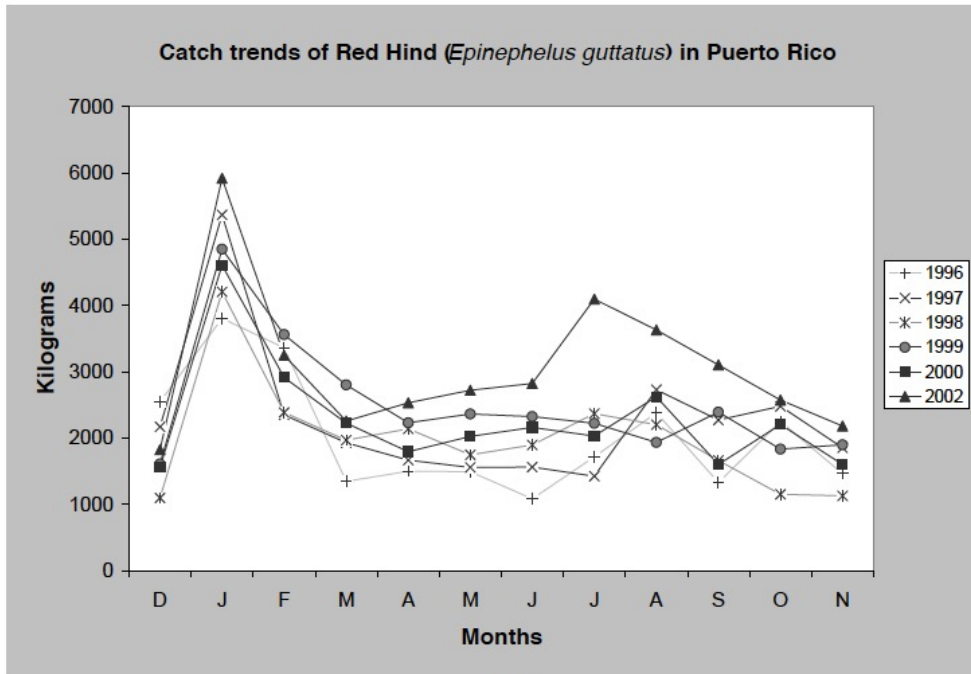
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Epinephelus guttatus - Red hind



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(b)

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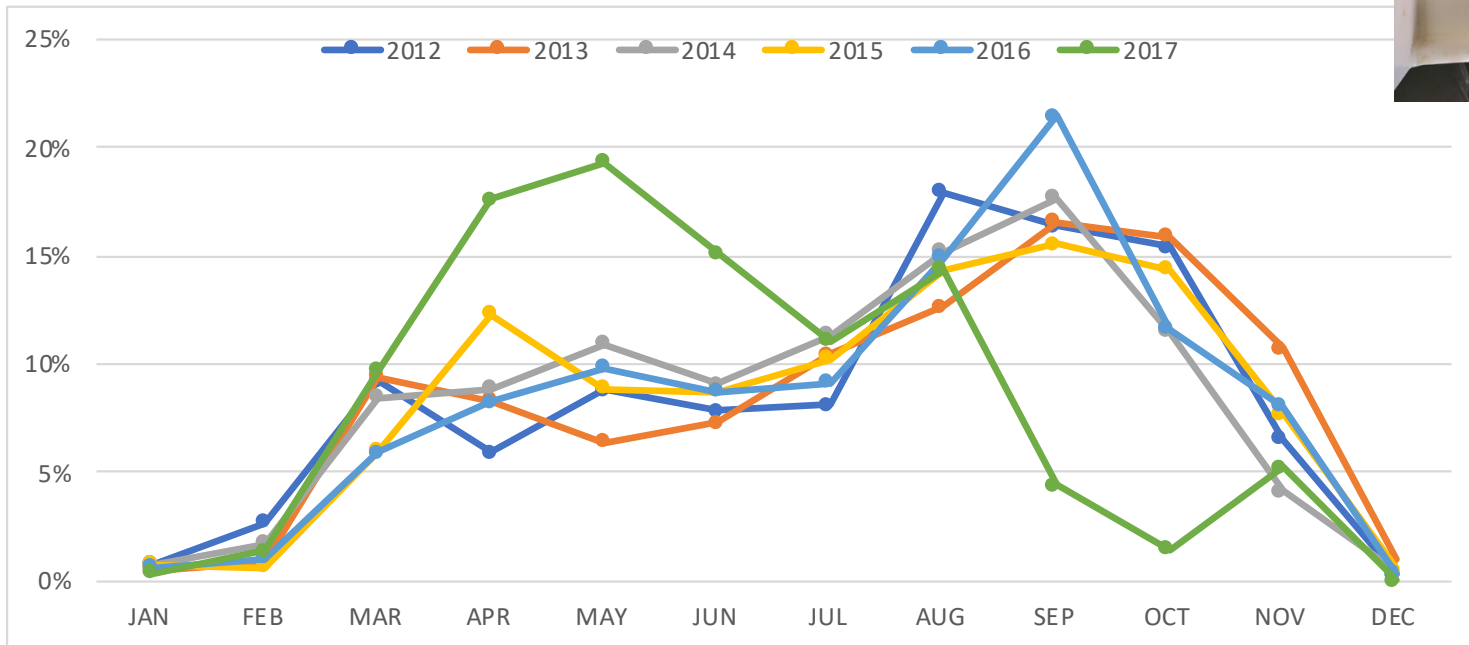
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Monthly proportion of recently reported landings (DNER, 2018)

Epinephelus guttatus - Red hind



Research of grouper spawning aggregations in western Puerto Rico EEZ west of longitude line 67 10'

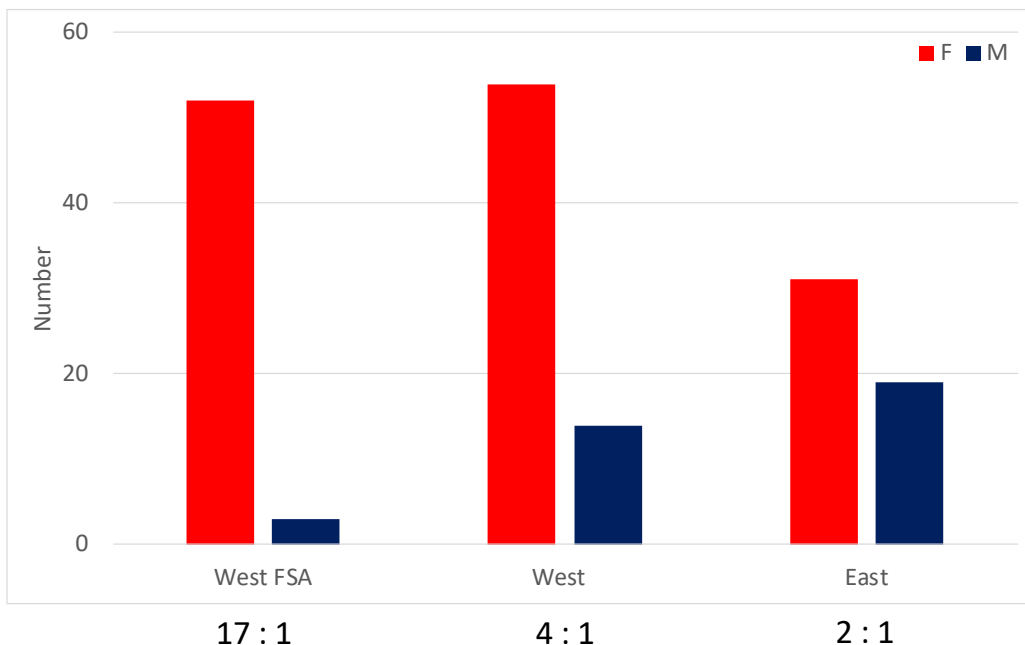


Green shaded areas are Puerto Rico jurisdictional waters

Methods

- Diver surveys at FSA
- Acoustic tagging (Nassau grouper- BDS)
- Collection of red hind (PR, STT & STX)
 - Size & Age
 - Gonadosomatic Index & Fecundity
 - Sex Ratios
- Passive acoustic monitoring (2010-2021)
 - Courtship associated sounds
 - Sound pressure levels
 - Glider deployment
- Grouper sightings reporting pilot project

Biology and reproductive ecology of red hind



Preliminary results of sex ratio at FSA, west and east PR fishing areas (N=210)

Red hind are a sex changing species 'protogynous hermaphrodite' where females are smaller than males

Females change to males at ~ 28 cm (~ 11 inches) fork length

Complex social structure and reproductive behaviors (FSA)

Males arrive first, defend territories, and are more vulnerable than females during 3 lunar cycles at FSA

Female fecundity increases with size, but sufficient males needed to fertilize eggs

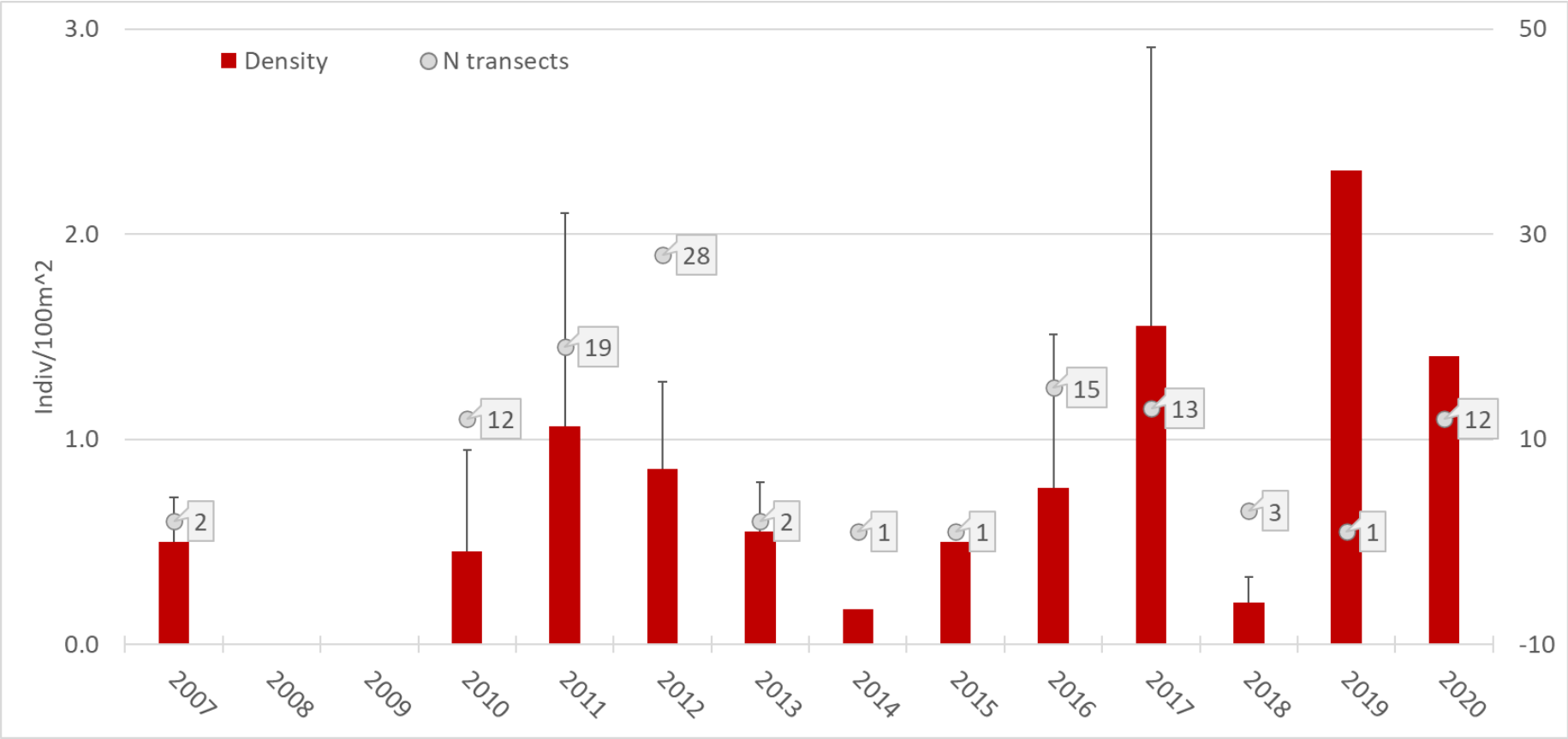
Males and large females remain at FSA longer and then migrate back to their home range

USVI sex ratios at FSA (Nemeth et al. in prep.)

STT, Red Hind Bank 3 : 1

STX, Lang Bank 9 : 1

Density of red hind during FSA at Buoy 6 (Abrir la Sierra) over the years



Passive acoustic monitoring of grouper sounds associated with known behaviors

Sound types

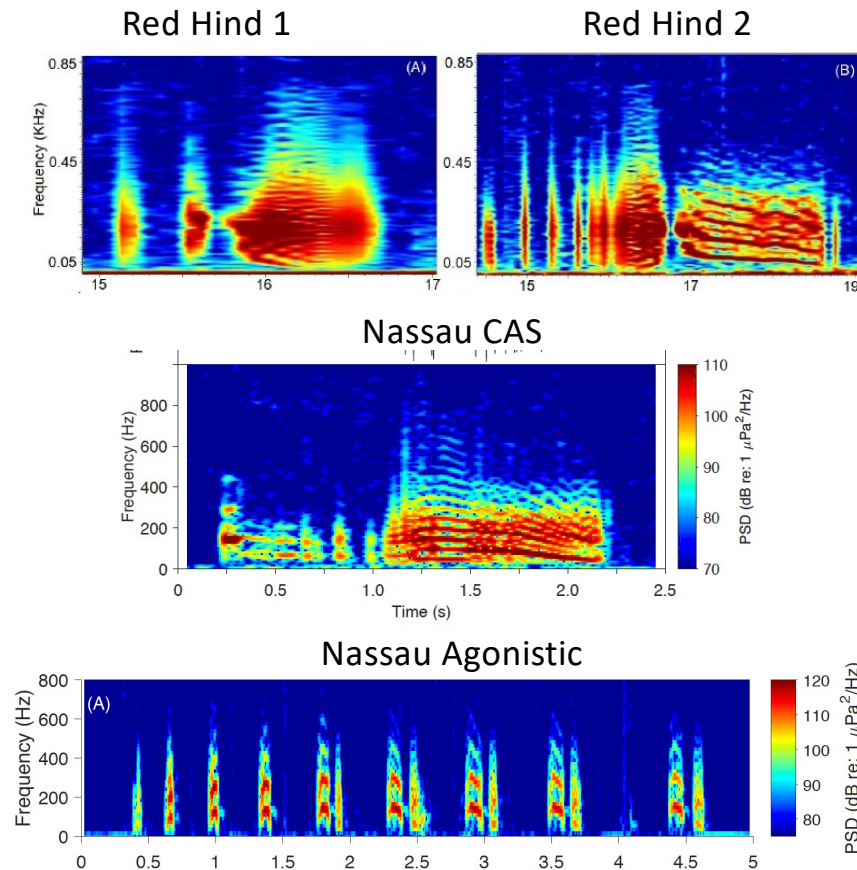
During the FSA two main types of courtship associated sounds are produced by male red hind that are different in structure from Nassau

Sounds occur during interactions between fish either territorial, courtship or competition for mates

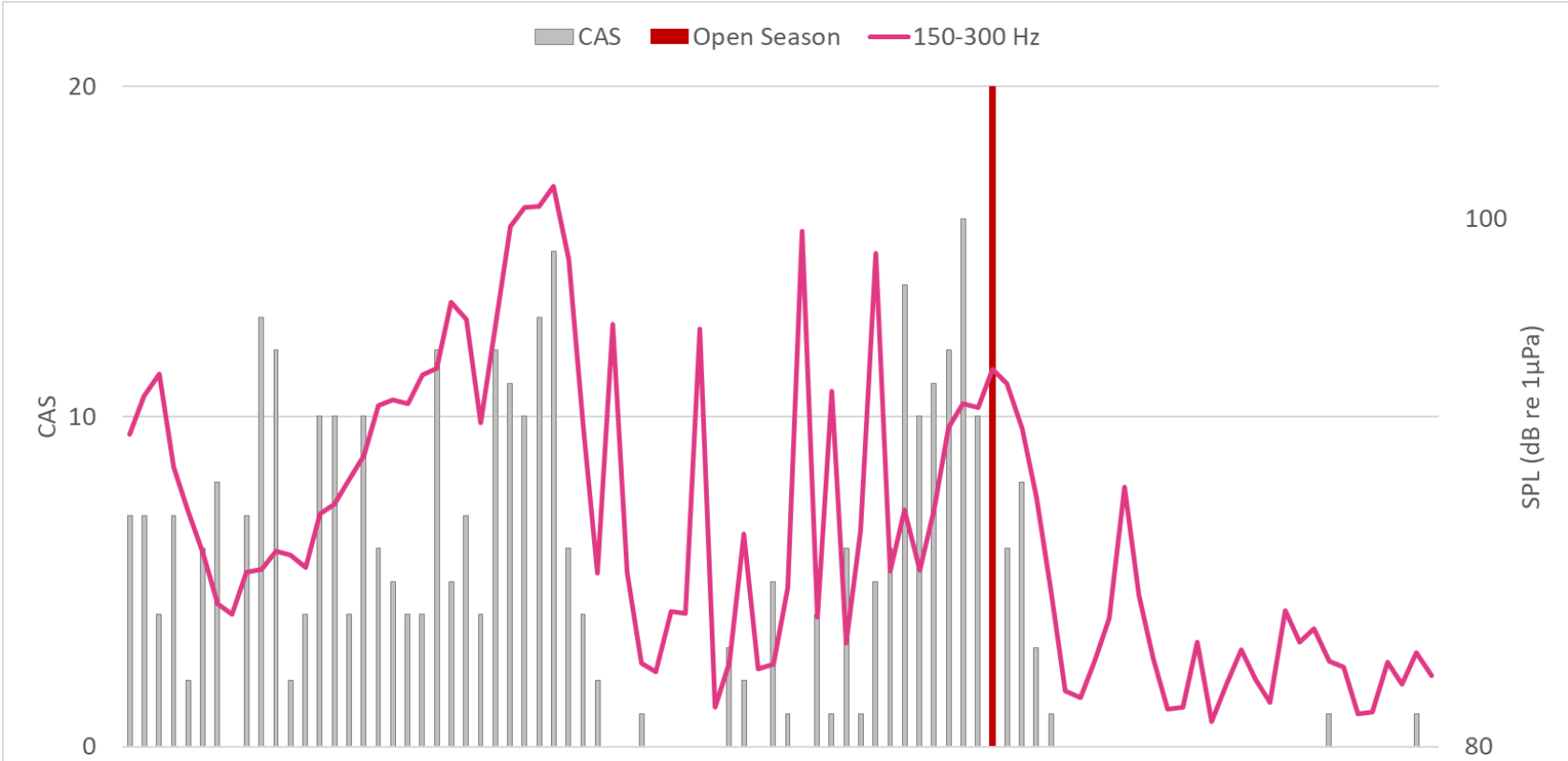
Most sound production occurs at sunset or dawn

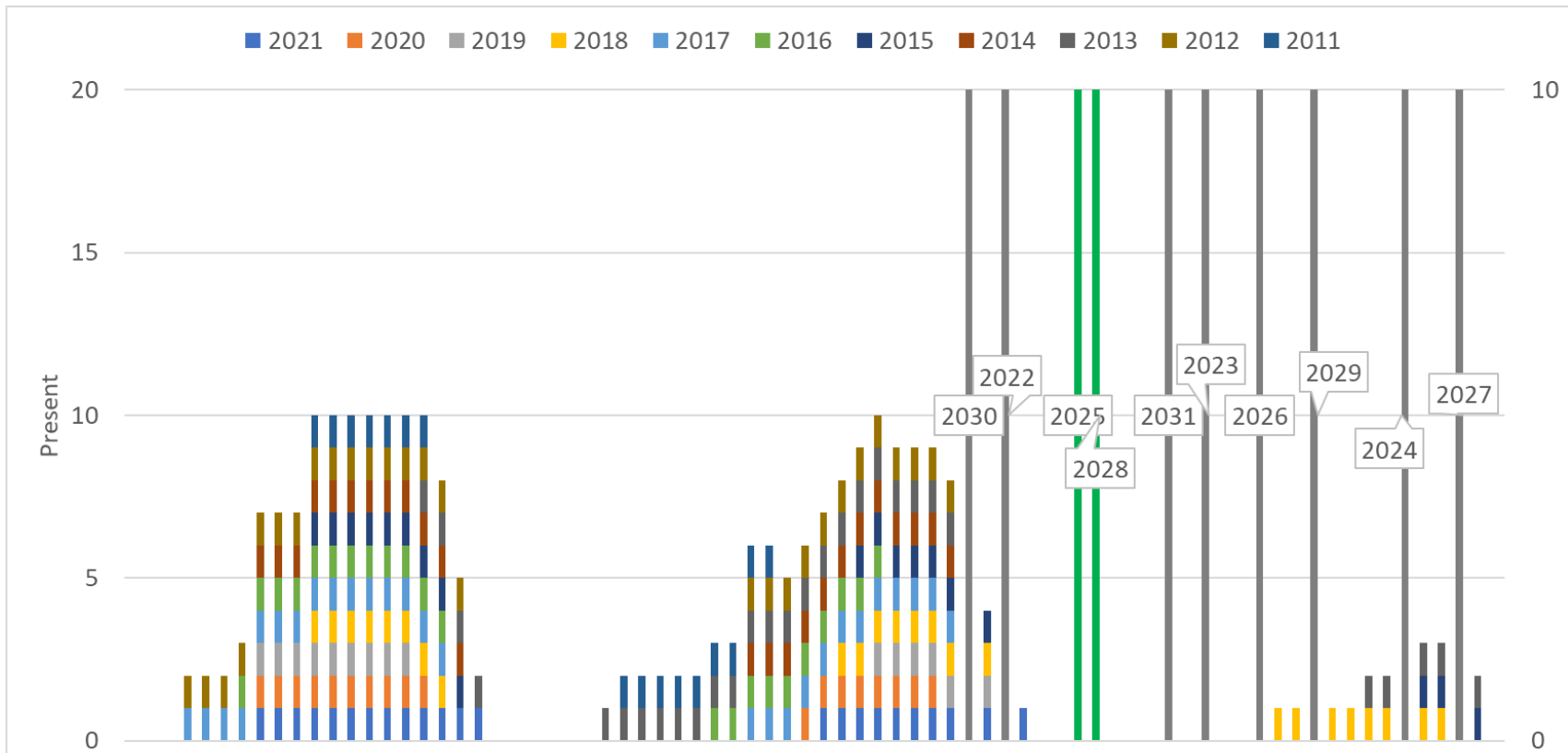
Sound pressure levels of the 150 - 300 Hz frequency band include the sounds of red hind and Nassau grouper

Recordings 6 months 24/7 but only 18:00 AST hour is used to quantify mean SPL daily to produce time series



Passive acoustic monitoring SPL vs CAS time series





| Year | L-0 | L-1 | L-2 | L-3 | FSA March |
|------|-----|-----|-----|-----|--------------|
| 2011 | 1 | 1 | 0 | 0 | 0 |
| 2012 | 0 | 1 | 1 | 0 | 0 |
| 2013 | 0 | 0.5 | 1 | 0.5 | 1 |
| 2014 | 0.5 | 1 | 0.5 | 0 | 1 |
| 2015 | 0 | 1 | 1 | 0.5 | 1 |
| 2016 | - | 1 | 1 | 0 | 0 |
| 2017 | 0.5 | 1 | 1 | 0 | 0 |
| 2018 | - | 1 | 1 | 0.5 | 1 |
| 2019 | - | 0.5 | 1 | 0.5 | 1 |
| 2020 | - | 1 | 1 | 0.5 | 1 |
| 2021 | - | 1 | 1 | 0.5 | 1 |

| Year | L-0 | L-1 | L-2 | L-3 | FSA March |
|------|-----|-----|-----|-----|--------------|
| 2022 | | * | * | | 1 |
| 2023 | | * | * | * | 1 |
| 2024 | | * | * | * | 1 |
| 2025 | | * | * | | 0 |
| 2026 | | * | * | * | 1 |
| 2027 | | * | * | * | 1 |
| 2028 | | * | * | | 0 |
| 2029 | | * | * | * | 1 |
| 2030 | | * | * | | 1 |
| 2031 | | * | * | | 1 |

Conclusion of red hind FSA in western Puerto Rico

Few years with red hind present at FSA prior to December 15

63% of the past 11 years red hind were present at FSA after March 15

Red hind closed season during the next decade may fall short 80% of the years

Shifts in FSA timing may be due to low abundances, hyperstability, temperature/current variations

Recommendations to improving the grouper fishery in Puerto Rico

- Shift the 90-day closed season in US EEZ waters of western Puerto Rico to:
15 December to 15 March
- Monitor fish spawning aggregations of grouper species
 - Ensure closed seasons provide protection at vulnerable times
 - Document effectiveness of seasonal closures at MPAs
 - Demonstrate benefits of the 90-day no-fishing red hind sacrifice
- Revise the closed seasons and MPAs for grouper that aggregate to spawn
 - Black grouper
 - Yellowfin grouper
 - Tiger grouper
 - Nassau grouper (avoid incidental capture mortality due to barotrauma)
- Enforce closed seasons at sea and on land (throughout the supply chain)
- Educate regarding the critical importance of FSA for sustainable fisheries

