

Introduction

This project was initiated in 2012 to analyze the fish spawning activity surrounding the Scripps Pier and to establish a baseline of egg abundance and species diversity to compare future years to. As the project has progressed, we have incorporated sampling at 5 other sites along the California Coast, Newport Beach (NBP), Santa Monica (SM), San Luis Obispo (CP), and Santa Cruz (SC). This project is being conducted in order to improve fish management and conservation efforts in the future.



Locations of the 6 shore stations (from north to south): Santa Cruz (SC), San Luis Obispo (CP), Santa Barbara (SB), Santa Monica (SM), Newport Beach (NBP), and San Diego (SIO)

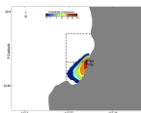
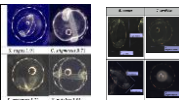


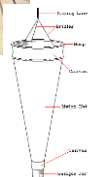
Image showing the probability that fish eggs collected from Scripps Pier originated in the Marine Protected Area



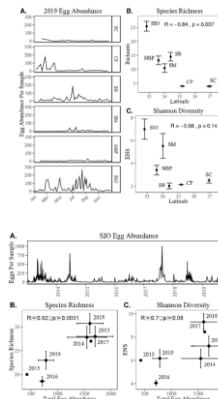
Fish eggs under a microscope

Methods

We collect 2-3 times a week during the summer and once a week during the other seasons using a plankton tow. Once collected, the eggs are separated from the sample. Since most of the eggs are not morphologically identifiable, molecular methods must be used to determine the abundance and species composition of the sample. To do so, we extract the DNA, amplify barcoding genes via PCR, and sequence the PCR products. The resulting DNA sequences are run through a database to determine which species their sequence matches the best.



Results



Fish Found in all Shore Stations



Speckled sandbar



California halibut

Fish Found in all Shore Stations Except SM



White croaker

Since 2012, the peak egg abundance at SIO has repeatedly been during the summer months. However, the summers of 2017 and 2019 had peaks in egg abundance in mid-August, rather than the typical, mid-June observed in all the other years. In addition, the average egg abundance of summer 2019 was depressed compared to the majority of other summers, with the exception of 2015 and 2016, which were the El Nino/Warm Blob years. Following the same pattern as egg abundance, SIO also saw a decrease in species diversity in 2019 as compared to previous years. The 2015 and 2016 SIO years had low species per sample as well as low egg count. In regards to the other shore stations, The egg abundance at SIO is much higher than the egg abundance at other shore stations. In addition, it should be noted that neither SC, SM, nor NBP show any peak in egg abundance at all. CP and SB, on the other hand, do. Of the three locations that do have a peak in egg abundance (CP, SM, and SIO), the two locations in most southern locations have peaks in the summer, while the location in the most northern shore station has a peak in the winter.

Conclusions

- Peak egg abundance at SIO has shifted to around two months later in the year and 2019 had a lower than normal peak abundance and diversity
- CP, SM, and SIO have visible peaks in egg abundance, and SM and SIO have peaks in the summer while CP is in the winter
- SIO and SM continue to have the highest diversity
- SIO having the highest abundance and diversity may be attributed to the MPA that surrounds the pier

Recommendations

- Continue collecting data from the SIO pier and the additional locations to elucidate if these patterns in spawning persist
- Use environmental data available to investigate its role in biodiversity and egg abundance
- Spawning response to episodic events like ENSO are shown and on longer time scales it may be possible to see near-term impacts by climate change
- Investigate the use of eDNA to expand the number of species and taxa monitored at SIO

References:

Duke, E. (2018) Large inter-annual variability of spawning in San Diego's marine protected areas captured by molecular identification of fish eggs. UC San Diego. ProQuest ID: Duke_ucsd_0033M_17192. Merritt ID: ark:/13030/m5gb7198. Retrieved from <https://escholarship.org/uc/item/6g03z4c0>

Harada AE, Lindgren EA, Hermsmeier MC, Rogowski PA, Terrill E, Burton RS (2015) Monitoring Spawning Activity in a Southern California Marine Protected Area Using Molecular Identification of Fish Eggs. PLoS ONE 10(8): e0134647. <https://doi.org/10.1371/journal.pone.0134647>

Emma S. Choi, Erik T. Saberski, Tom Lorimer, Cameron Smith, Unduwap Kandage-don, Ronald S. Burton, George Sugihara (2020) Temperature triggers provide quantitative predictions of multi-species fish spawning peaks bioRxiv 2020.07.10.196923; doi: <https://doi.org/10.1101/2020.07.10.196923>

Acknowledgements:

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