CHI Appendix

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1 Data

Table 1 shows data used to parameterize matrix model from Raberinary and Benbow (2012). Data was extracted from Figure 7 of this paper using WebPlotDigitizer (https://automeris.io/WebPlotDigitizer/)

Table 1: Data collected in Raberinary and Benbow 2012.

T	Stage1	Stage2	Stage3	Stage4	Total
1	10.40119	5.200594	0.000000	1.1144131	16.71620
2	76.52303	27.860327	2.228826	1.8573551	108.46954
3	57.57801	37.890045	1.857355	0.0000000	97.32541
4	40.49034	50.891531	3.343239	0.0000000	94.72511
5	71.69391	16.716196	8.172363	1.1144131	97.69688
6	121.09955	28.974740	5.572065	2.2288262	157.87519
7	119.98514	52.005944	6.686478	0.7429421	179.42051
8	78.75186	41.604755	14.487370	1.1144131	135.95840
9	118.87073	53.491828	14.487370	1.1144131	187.96434
10	119.98514	39.004458	10.772660	1.1144131	170.87667
11	73.55126	26.374443	4.457652	2.2288262	106.61218
12	NA	NA	NA	NA	NA
13	83.58098	111.069837	21.545320	1.1144131	217.31055

2 Per-stage management scenarios

2.1 METHODS

Examined how increasing the chance of survival of individuals in each stage class would contribute to population health. This was achieved by isolating the growth (G_i) and in-stage survival (P_i) for each stage i. We then increased these parameters by 1% and recalculated the overall eigenvalue of the matrix. We then incorporated into different scenarios with different frequencies of fishing restrictions to examine how temporary closures on blue octopus in certain stages would affect the population.

2.2 RESULTS

Our within stage analysis showed that Stage 1 needed the smallest percent increase in survival to result in overall population growth (Figure 1). Stage 4 and larval survivability would be the highest needed increase, with stage 4 needing a 25% increase and larval needing a 15% increase in order for the overall population to be stable. Further, when examining the different frequencies of fishing closures, we found that, for any scenario, no closure would be effective if it was less frequent than every other month. As exemplified by the previous analysis, closures focusing on either stage 4 or larval individuals required the most increase in survivorship and highest frequencies of closures in order to result in population growth.

2.3 DISCUSSION

The results of our per-stage analysis showed that focusing on protecting individuals in stage 1 would be the most effective form of management if size could be determined before capture in this fishery. It is a common trend that individuals that survive long larval stages that have high death rates are the most valuable in terms of contributions to overall population growth. However, this is not a realistic management suggestion, as it is difficult to assess the size of octopus before catch, which is often fatal to the individual. This could suggest, however, that the establishment of aquaculture of *Octopus cyanea* could have benefits to the overall population if octopus are reared until passing this first stage of development. However, further research is needed on cephalopod aquaculture in order to be effective and reduce pollutants in the surrounding waters (Jacquet et al. 2023).

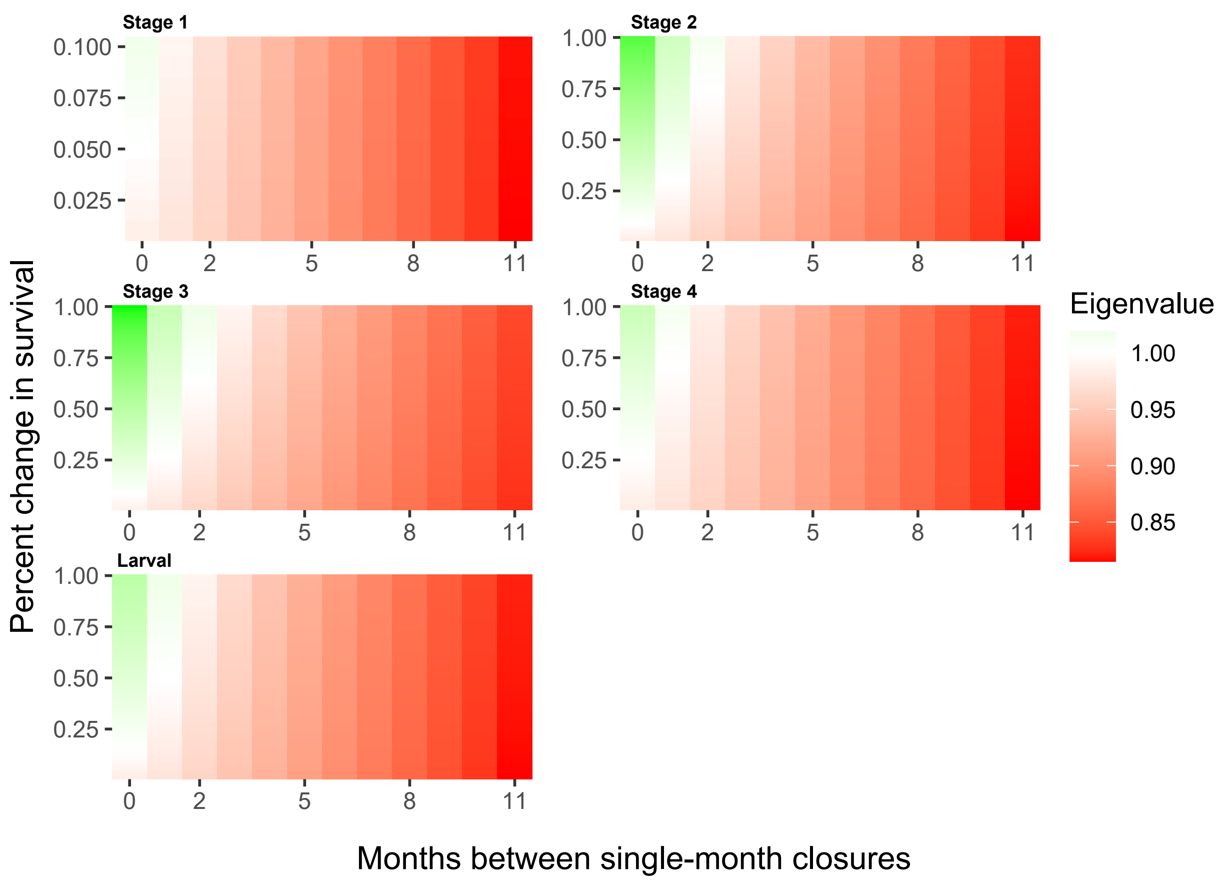

Figure 1: Different fishing scenarios based on increasing survivability of one stage.

Table 2: Life table of *O. cyanea* as calculated from our Lefkovitch matrix.

Age (months)	Survivorship	Proportion of orginal cohort dying	Mortality hazard	Probability of death	Probability of survival	Remaining life expectancy	Per-capita reproduction rate	Expected number of offspring
0	1.0000000	0.0951997	0.0999577	0.0951997	0.9048003	3.546039	0.0000000	0.0000000
1	0.9048003	0.2107642	0.2636471	0.2329401	0.7670599	2.866532	0.0000000	0.0000000
2	0.6940360	0.1996469	0.3359857	0.2876607	0.7123393	2.585199	0.0000000	0.0000000
3	0.4943891	0.1567056	0.3766632	0.3169681	0.6830319	2.427255	0.1801271	0.0890529
4	0.3376835	0.1130954	0.4022801	0.3349152	0.6650848	2.321617	0.4417776	0.1491810
5	0.2245882	0.0778436	0.4192659	0.3466059	0.6533941	2.238925	0.7077949	0.1589624
6	0.1467446	0.0520106	0.4307673	0.3544291	0.6455709	2.161373	0.9405289	0.1380175
7	0.0947340	0.0340773	0.4386006	0.3597150	0.6402850	2.073494	1.1279077	0.1068513
8	0.0606568	0.0220360	0.4439266	0.3632896	0.6367104	1.957489	1.2709528	0.0770919
9	0.0386208	0.0141236	0.4475285	0.3656983	0.6343017	1.789093	1.3761398	0.0531476
10	0.0244972	0.0089981	0.4499474	0.3673119	0.6326881	1.532303	1.4513443	0.0355539
11	0.0154991	0.0057097	0.4515599	0.3683858	0.6316142	1.131614	1.5039407	0.0233097
12	0.0097895	0.0097895	2.0000000	1.0000000	0.0000000	0.500000	1.5400772	0.0150765

3 Rage package analysis

3.1 Age specific Calculations

Table 2 shows age specific life-history traits of *Octopus cyanea* as calculated by the Rage package from our matrix. Expected number of offspring is reported per original cohort number.

Jacquet, Jennifer, Becca Franks, Peter Godfrey-Smith, and Walter Sánchez-Suárez. 2023. "The Case Against Octopus Farming."

Raberinary, D., and S. Benbow. 2012. "The Reproductive Cycle of Octopus Cyanea in Southwest Madagascar and Implications for Fisheries Management." *Fisheries Research* 125-126 (August): 190–97. https://doi.org/10.1016/j.fishres.2012.02.025.