Analysis of the Revised Final Environmental Impact Statement

by the Pet Industry Joint Advisory Council regarding Issuance of Commercial Aquarium Permits and Commercial Marine Licenses for the West Hawaiʻi Regional Fishery Management Area

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The Pet Industry Joint Advisory Council (PIJAC) submitted a Revised Final Environmental Impact Statement (RFEIS) based on their analysis of the ecological and cultural impacts of issuing aquarium collection permits for the West Hawaiʻi Regional Fishery Management Area. Our review focuses on the scientific integrity and validity of data and conclusions provided by PIJAC in the RFEIS. We are also illustrating the full data that are available to PIJAC in graphical form so these data can be considered by all parties in the review of this RFEIS. We do not address cultural or other non-scientific issues in our review.

Summary Findings

The RFEIS has not provided enough information to correctly assess the impacts of aquarium collection. The main issues include the following and are explained in this report.

- The RFEIS does not present the available monitoring data fully and properly.
- The RFEIS provides proposed annual catch limits, which in some cases for specific species, are higher than previous years. However, catch limits for all of the proposed species have not been calculated using best available methods.
- The RFEIS does not include a proper reporting of Hawai'i-specific findings needed to assess the impacts of aquarium fishing in West Hawaiʻi.

I. Fish population trends have not been analyzed sufficiently

The RFEIS presents fish data from only two time points, but a trend analysis can not be done on two points in time. Despite access to the full WHAP and CREP (now referred to as PIFSC-ESD in the RDEIS and RFEIS) datasets over the total length of survey years (WHAP: 1999-2019, PIFSC-ESD: 2010-2019), these data were not used for the analysis or presented. The reduced whitelist of eight proposed species is chosen based on a purported trend of "stable or increasing populations" (page 16 of PDF), in which the RFEIS compares 1999/2000 data to 2017/2018 surveys of the WHAP data (Table 5-7, page 137 PDF), a small subset of the entire dataset. There are issues in doing this:

1. Analysis of annual, long-term data across both datasets is needed to understand population trends, not a comparison of a few years. All available survey years of data for Hawaiʻi Island should be considered to determine whether populations are stable or increasing. The RFEIS has presented annual data for only a few species - Yellow Tang (Figure 5, page 140 of RFEIS PDF) and Kole (Figure 6, page 142 of RFEIS PDF). In our review, we plot all available data for West Hawaiʻi from WHAP and PIFSC-ESD (**Figure 1**), and we plot trends across "open" and "protected" areas from year to year. Doing so emphasizes that the actual trends are different depending on the dataset being considered. Of note, the two top aquarium fish species, Yellow Tang and Kole, both show decreases in abundance between 2016 and 2019 in PIFSC-ESD surveys in "open" collection areas (**Figure 1**).

2. Only WHAP data have been used in the RFEIS to indicate whether aquarium fish trends are stable or increasing. However, the WHAP data represent selected reef sites based on specific reef habitat as opposed to randomly selected sites, and thus by definition, the sites are not representative of a given area or management designation. Further, a recent analysis shows that Hawaiʻi Island has a highly variable distribution of fish biomass (Donovan et al., 2020; **Figure 2**). This analysis, which combined all available fish surveys from multiple organizations throughout Hawaiʻi, highlights the enormous spatial variability in herbivorous fish populations across hardbottom habitats in West Hawaii and island-wide (**Figure 2**).

3. "On January 5, 2018 the DLNR issued a press release clarifying that no aquatic life may be taken for commercial aquarium purposes in West Hawai'i until an environmental review is complete." (page 25 of RFEIS PDF). Therefore, population data after January 2018 should be **excluded** from trend estimates in open areas because no legal aquarium collecting occurred after January 5th 2018. The RFEIS purported upward trend may therefore be the result of the aquarium fishing moratorium, allowing fish populations to recover.

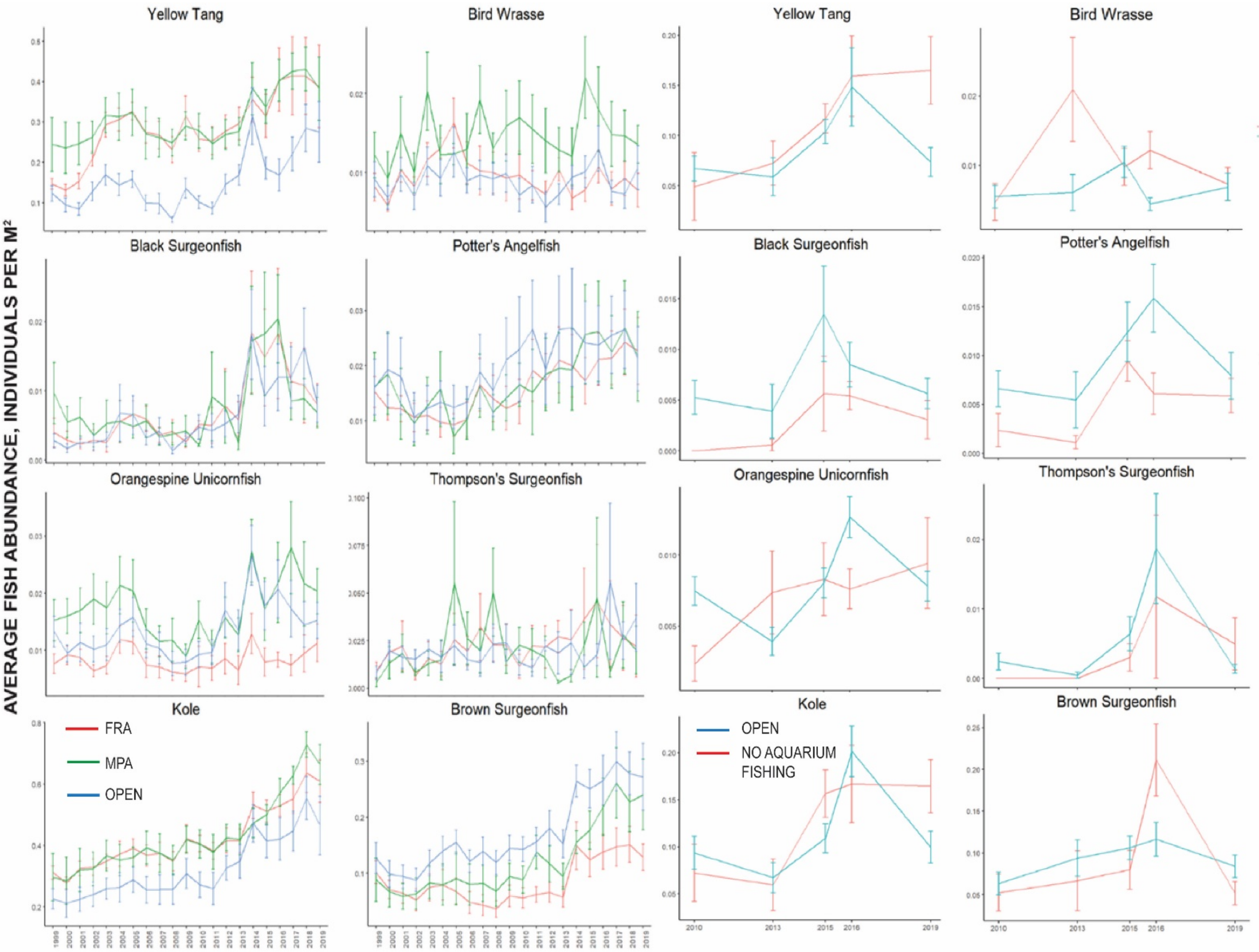

Figure 1. Annual site means from WHAP (left two columns) and PIFSC-ESD (right two columns) data for the proposed reduced white-list species. For WHAP: Averages for abundance data across all sites per management type are displayed ± standard error. Survey details - from 1999-2004: FRA (n=9), MPA (n=5), OPEN (n=9), 2005-2006: FRA (n=9), MPA (n=5), OPEN (n=10), 2007-2019: FRA (n=9), MPA (n=6), OPEN (n=10). Note that our error bars are larger than those presented in the RFEIS because we consider the average of the four transects per site (rather than each as a separate count) as they are pseudoreplicates. These four counts per site are averaged first to provide an overall site number, and then averaged for the number of rounds repeated that year. For PIFSC-ESD data: averages for abundance data across all sites per management type are displayed ± standard error. Survey details - 2010: No aquarium (n=3), Open (n=18), 2013: No aquarium (n=5), Open (n=13), 2015: No aquarium (n=15), Open (n=50), 2016: No aquarium (n=13), Open (n=23), 2019: No aquarium (n=12), Open (n=25).

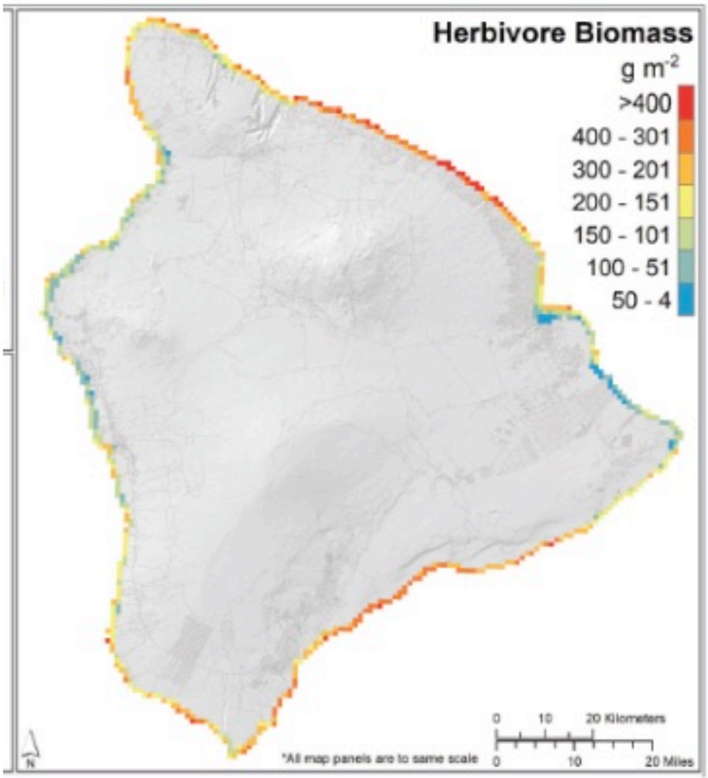

Figure 2. Variability in herbivore biomass across Hawaiʻi Island (figure from Donovan et al., 2020).

II. High proposed individual catch quotas despite reduced fishers, without Hawaiʻi stock assessment

The proposed total potential catch (taken from column 3, **Table 3-2 from the RFEIS, page 52**) for the reduced white-list was not calculated using best available science on sustainable levels of catch.

Table 1. Proposed catch quotas for the revised white-list compared to average annual reported aquarium catch from 2000-2017. Proposed catch quotas are from Table 3-2, RFEIS, page 52.

Species	Total Potential Catch (all 7 fishers)	Average Annual Aquarium Catch (2000-2017)
Yellow Tang	200,000	281,974
Black Surgeonfish	3,152	3,613
Orangespine Unicornfish	5,872	5,759
Kole	30,000	31,513
Bird Wrasse	344	346
Potter's Angelfish	4,376	1,101
Thompson's Surgeonfish	2,016	145
Brown Surgeonfish	800	702
TOTAL	**246,560**	**325,153**

We present the total reported catch for the past 20 years for all of Hawaiʻi Island nearshore (0-2 nm) waters for the reduced white-list species, with the total proposed catch indicated with a dotted line on each graph (**Figure 3**). For Potter's Angelfish (*C. potteri*) and Thompson's Surgeonfish (*A. thompsoni*), the total proposed catch is much higher than all previously reported catch numbers. In particular, the total potential catch is 14 times higher than the historical mean reported annual catch for *A. thompsoni* (**Table 1**). Therefore, even if only seven aquarium fishers are permitted, they will still be impacting the system similarly, and in some cases, more than previous years for some species.

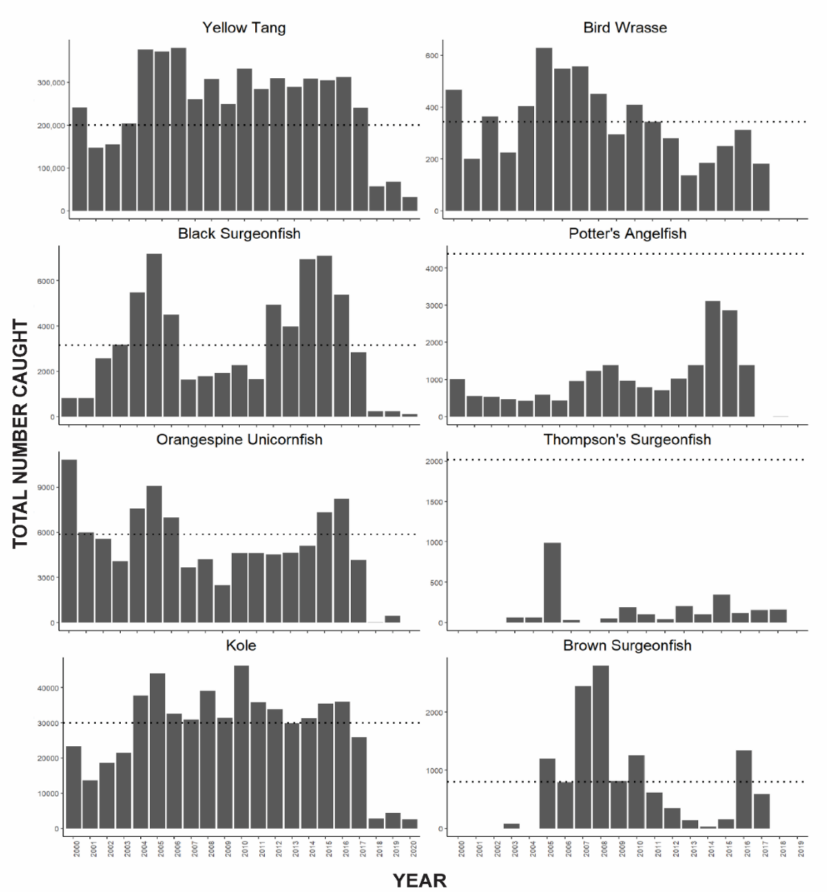

Figure 3. Annual reported aquarium catch data for all of Hawaiʻi Island nearshore (0 – 2nmi) waters for the reduced white-list species for the past 20 years, compared to total proposed catch limit for 7 fishers from the RDEIS (dotted line). Note that some data was withheld from annual reported aquarium catch to protect fisher confidentiality resulting in years that appear to have zero catch.

The RFEIS heavily bases its "sustainable" levels of catch on one manual focused on species from the Philippines (Ochavillo and Hodgson 2006). The manual gives a list of total allowable catch (TAC) values for common species in the Philippines, which the RFEIS uses directly for Hawaiian species that never appear in the guide. Borrowing values for species in the Philippines is not an adequate method to determine whether aquarium collection catch rate is sustainable for Hawaiian species, especially as TAC will be specific for each species. **To be scientifically defensible, the RFEIS should conduct stock assessment modelling for target species**. Resources exist for this, such as Nadon et al. (2017), which provides stock assessment and methods for coral reef fishes of Hawaiʻi.

III. The impact of aquarium collection on fish populations has not been adequately communicated

The RFEIS does not adequately cover relevant scientific literature to support its claims. Issues include:

1. The RFEIS acknowledges the importance of herbivorous fish for coral reef health, yet the proposed species list primarily targets herbivorous fish (6 of 8 species are herbivores). The herbivorous species on this reduced list represent 99% of the total proposed annual catch (244,200 fish out of 246,560 fish).

2. The RFEIS reports incorrect information about fish in relation to herbivory, stating: "…herbivores collected by the aquarium fishery typically consist of the smaller size classes which are the least effective sizes for cropping algae." (Page 16 of RFEIS PDF). Previous research shows that for a given level of biomass, communities dominated by smaller fishes have higher grazing potential than larger fishes (Silliman et al. 2013; Robinson et al. 2017; Ng and Micheli, 2020). Further, the RFEIS selected one result: *"Kelly et al. (2017) examined the role of herbivores in an herbivore management area off Maui, where take of herbivores is prohibited. The study found that larger size classes of "scraper/excavator" herbivorous fish contributed more to consumption as time progressed from when the area was established."* (Page 157 of RFEIS PDF). The actual study, however, also stated: *"Grazers of the two smallest size classes played important roles in turf and macroalgal removal, likely a result of their high bite rates, which exceeded those of both browsers and scrapers."* These findings indicate that targeting smaller fish for the aquarium industry will have a substantial impact on algal control.

3. The RFEIS only presents part of the results from prior, peer-reviewed literature on the aquarium industry. One example is its use of Tissot and Hallacher (2003). Despite the RFEIS citing this reference at least eight times, the RFEIS fails to acknowledge the primary finding of Tissot and Hallacher (2003): Seven of the ten aquarium fish species were significantly reduced by collecting, and aquarium fish abundances were up to 75% lower in control sites in comparison to sites where aquarium fishing was permitted.

4. The WHAP surveys were designed to determine the impacts of activities such as aquarium collection, which involves analyses that compare the differences between MPAs, FRAs and Open areas. This was reported by the National Oceanic and Atmospheric Administration (Gove et al. 2019), which found: *"In 2017, MPAs and FRAs had 66.2% and 90.2% more juvenile yellow tang than in open areas"* and *"total abundance and biomass, adult fish length, species richness, herbivore biomass, juvenile yellow tang were 1.1–2 times higher in MPAs than open areas in 2017"* (Gove et al. 2019). These two findings utilized the WHAP data to assess how open areas are impacted by activities prohibited in MPAs and FRAs, but were not reported in the RFEIS, despite Gove et al. (2019) being cited many times within the RFEIS.

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