Original Research Article

The Retail Gap: Investigating Betta Fish Welfare in South Bay Area Pet Stores

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ABSTRACT

This study examines the relationship between current retail care practices and recommended welfare standards for betta fish (*Betta splendens*) within California's South Bay Area. Through a non-experimental, mixed-methods approach, structured and objective field observations and employee interviews were conducted across four retail pet stores. The data were systematically collected and analyzed using a deductive codebook tracking seven critical welfare variables: tank size, environmental enrichment, water quality, water temperature, water change schedules, feeding practices, and employee training. Observational data revealed a distinct variation from the recommended welfare standards regarding necessary environmental conditions. Across all evaluated locations, betta fish were housed in small, unheated, unenriched containers containing an average of approximately 10 ounces, representing 1.6% of the 5-gallon recommended welfare standard. Conversely, care variables, such as water quality (1.75/2) and employee training (1.5/2), demonstrated moderate alignment to recommended welfare standards. The descriptive evidence indicates that although commercial retail settings successfully implement practices to ensure short-term biological survival, they do not incorporate environmental complexity and adequate heating to ensure optimal well-being. These localized data provide a baseline for institutional retail guidelines, consumer education initiatives, and policy framework for ornamental fish at the point of sale.

Keywords: *Betta splendens*; Siamese fighting fish; betta fish; ornamental fish trade; retail pet stores; environmental enrichment; animal welfare

INTRODUCTION

While animal welfare standards have advanced in commercial industries in recent decades, ornamental fish, defined as species of fish that are kept for aesthetic purposes or as pets, remain vulnerable at the point of retail sale (1). Among ornamental fish species, betta fish (also known as Siamese fighting fish or *Betta splendens*) are one of the most popular freshwater tropical pets, yet they are frequently housed in environments that challenge their biological needs (2). While existing research defines the recommended welfare standards that are necessary for betta fish to thrive, there is a clear lack of data on whether these standards are met in retail pet stores.

The objective of this research is to analyze the alignment between recommended welfare standards and retail care practices for betta fish. In this study, recommended welfare standards are defined as evidence-based care and environmental criteria synthesized from

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peer-reviewed literature and veterinary guidelines to systematically and objectively assess the baseline requirements for betta fish to thrive. This study addresses a gap in the current body of research by shifting from large-scale analysis of the fish trade as a whole, to focusing on the specific conditions that betta fish face at the point of sale. The research question guiding this study is: How do care practices of betta fish in California's South Bay Area retail pet stores compare to recommended welfare standards required for the species to thrive?

Based on the clear gap of data on ornamental fish welfare in retail environments and economic incentives in commercial settings, this study hypothesizes that significant discrepancies do exist between recommended welfare standards and current retail practices, with an emphasis on environmental factors such as enrichment and tank size.

LITERATURE REVIEW

Welfare Framework and Ornamental Fish Underrepresentation

Animal welfare research generally conceptualizes welfare as extending beyond an animal's capacity to survive in captivity. According to Fraser, animal welfare should be assessed through multiple factors, including biological functioning, behavioral expression, and environmental conditions (3). This framework establishes that animal welfare cannot be fully evaluated by one metric, but rather by an animal's ability to express natural behaviors and maintain physiological health. This approach to welfare assessment creates a general foundation for evaluating care practices across different types of animal species.

Although animal welfare frameworks provide a comprehensive way to assess care practices, they have not been emphasized equally across all animal groups. Past research by Huntingford *et al*. shows that fish have historically received less attention in animal welfare studies compared to other animals, particularly mammals (2). They explain that there is difficulty for human observers to identify clear indicators of stress and well-being in fish. These limitations are particularly relevant for ornamental fish, which are widely kept in captivity yet still face underrepresentation in welfare-driven research.

This disconnect found by Huntingford *et al*. is further highlighted by the concept of "charismatic megafauna," as explained by Mazzoldi *et al*. (2, 4). "Charismatic megafauna" is an idea where regulatory and public concern is disproportionately directed toward larger, more aesthetically pleasing animals, often mammals. In the United States, the Animal Welfare Act (1966) created welfare standards for the treatment of warm-blooded animals in research and exhibition by requiring minimum cage sizes as well as regular veterinary checkups. However, the Act excludes welfare standards for cold-blooded animals, including fish, meaning that they are offered no federal protection under this Act (5).

Betta fish were selected for this research paper due to their solitary and territorial nature, which distinguishes them from schooling fish species (1). Their solitary nature reduces variability when looking at recommended welfare standards, which allows environmental welfare factors, such as tank size, enrichment, and maintenance, to be investigated with greater clarity and accuracy.

Environmental Standards

One of the most important environmental factors affecting betta fish welfare is tank size. Betta fish are often kept in small tanks or bowls, as those are more cost-effective options for both pet stores and fish owners. Experimental research shows that betta fish kept in larger tanks, ideally five gallons or more, have higher activity levels, and exhibit more natural behaviors compared to betta fish kept in smaller containers (6). Large tanks allow for exploration and stimulation, which are vital for healthy development of fish. Similarly, environmental enrichment plays a key role, as a study by Oldfield *et al*. (7) found that various forms of enrichment, such as plants, hiding spaces, and other tank structures, allow fish to express more natural behaviors.

Water quality and temperature are also important factors influencing fish well-being. Vanderzwalmen *et al*. (8) found that factors such as pH and waste levels changed across different parts of fish handling, which impacted fish behavior. They also found that a strict and consistent water change schedule is vital to manage toxins and ensure proper water quality. Species-specific care guidelines established in veterinary literature specify that betta fish must be kept in dechlorinated water with a pH range of 6.5 to 7.5, and there must be a water heater keeping the temperature of the water 76 to 81 degrees Fahrenheit (9). Temperatures below this range would suppress immune system function and slow metabolic processes (10). Fish behavior is an important indicator in evaluating stress, so this suggests that sub-optimal water conditions can negatively impact welfare.

In the retail sector, feeding practices are frequently

reduced to maintenance feeding. While Maia *et al*. (1) explain that economic incentives lead to low-cost diets for fish, Norazmi-Lokman *et al*. (11) highlight that standard fish pellets and flakes often lack key nutrients for optimal growth. Betta fish require high crude protein levels in their food for immune health and biological functioning.

Ultimately, the management of these conditions in retail pet stores relies primarily on the employees. A study conducted by Alley *et al*. (12) found that retail employees often lack specialized knowledge regarding the biological functioning and needs of betta fish, which can lead to consumers receiving advice that diverges from recommended welfare standards.

Gap in Existing Research

A significant portion of existing research on ornamental fish welfare consists of a large-scale analysis of the fish trade. While systematic reviews of the ornamental fish trade highlight challenges across stages, few studies analyze welfare conditions specifically in the retail sector. For instance, Biondi *et al.* (13) examine welfare concerns in the ornamental fish trade from a broad ethical perspective, with a focus on coral reef fish. Similarly, Maia *et al*. (1) focus on the welfare of ornamental fish in the fish trade as a whole. Although public interest regarding betta fish housing in retail environments has increased (14), academic literature evaluating multiple environmental welfare factors remains sparse.

Existing retail-focused studies tend to either focus on a specific factor or do not involve field research. For instance, Alley *et al.* (12), utilized telephone surveys to assess employee knowledge, concluding that staff often lack specialized training despite serving as primary caretakers. However, that study focuses only on staff knowledge rather than examining its direct correlation with environmental welfare conditions. Conversely, Pleeging & Moons (10) provide a comprehensive overview of the biological requirements of betta fish and potential welfare deficits in retail stores, yet the conclusions lack empirical data from active retail environments. Consequently, a significant research gap remains regarding comprehensive field research on betta fish welfare conditions in retail pet stores in comparison with recommended welfare standards.

This study addresses this gap by shifting the focus from a broad analysis to a multi-factor, localized evaluation of care practices in retail pet stores in the South Bay Area of California. As one of the most densely populated urban regions in the United States, the South Bay serves as a strong socio-economic environment for the retail pet industry. In high-density areas such as the South Bay, commercial real estate is costly (15), which may incentivize retail pet businesses to prioritize spatial economy. By investigating seven factors impacting betta fish welfare in retail stores, this study aims to fill this research gap and quantify any discrepancies between recommended welfare standards and current retail practices.

METHODS AND MATERIALS

Overview

This study utilized a non-experimental, mixed-methods approach consisting of structured field observations and employee interviews. This design was selected to facilitate a comprehensive evaluation of both qualitative and quantitative factors that define betta fish welfare in retail stores. Based on literature identifying key factors influencing fish welfare, a total of seven variables were chosen: tank size, enrichment, water quality, water temperature, water change schedule, feeding practices, and employee training. Together, these variables make up a comprehensive welfare profile that accounts for biological needs, environmental factors, and institutional practices. To ensure consistency across all data collection and analysis, a single researcher conducted all store observations, employee interviews, data coding, and scoring.

Structured observations were utilized to examine tank size, enrichment, water quality, and water temperature in a non-disruptive manner. However, observational data alone are insufficient to evaluate routine maintenance protocols. Therefore, employee interviews were integrated to collect information about care practices that could not be directly observed. These data were analyzed using a deductive codebook, which allowed for an objective and systematic approach to comparing pet store conditions with recommended welfare standards. In addition to the variables in the codebook, contextual factors, which are factors that indirectly impact betta fish welfare, such as prices, tank size availability, and duration in pet stores, were also recorded to provide further insight into care management.

Sampling

This study used purposive convenience sampling to select retail stores and participants in the South Bay Area region of California. Fieldwork was conducted

over a four-week period from January 31 to February 21, 2026. While convenience played a role in geographical accessibility, this area was strategically selected, as it is representative of a high-density, urban area (15). To ensure a broad geographic spread across the South Bay, stores were visited across multiple distinct cities, specifically in Sunnyvale, San Jose, Mountain View, and Cupertino.

A total of ten retail stores were initially visited. Complete data collection, which required both field observations and employee interviews, was successfully achieved at four corporate chain locations (designated as Stores A, B, C, and D). All observations and interviews were conducted during a single visit per store. At the remaining six stores, employees were either unavailable or declined to participate in the study. Because a complete welfare profile under this mixed-methods framework requires the direct cross-examination of environmental conditions with corresponding care protocols, no observational data were collected at these six non-participating stores as it would fail to provide a holistic picture of store practices. A total of four employees were interviewed across the study, corresponding to the single employee staffing the aquatics department during each visit.

Codebook

A deductive codebook was developed based on existing academic literature on betta fish and their welfare to establish recommended welfare standards. This codebook incorporated key measurable variables in betta fish welfare, including environmental conditions and care practices. In the absence of a pre-existing standardized codebook, these criteria were synthesized from different sources that addressed specific aspects of betta fish welfare conditions. Each variable and recommended standard was defined through academic sources or credible veterinary care guidelines. The recommended welfare standards for tank size, water temperature, and water change schedule were determined based on veterinary recommendations for proper betta fish care (16, 17). For the rest of the variables, credible peer-reviewed academic sources were utilized to define the recommended welfare standards (7, 8, 11, 12). These sources established that each aspect of the codebook was supported by credible recommendations or existing research, which provided a reliable foundation for evaluating retail care practices.

The evaluation criteria consisted of three categories, "meets," "partially meets," and "does not meet," with reference to the recommended welfare standards. The "partially meets" category was included to account for conditions that showed some alignment with the recommended welfare standard, but did not fully meet all criteria. This approach allowed for a more nuanced evaluation of betta fish environmental conditions and care practices across diverse retail settings. This codebook was the framework for evaluating observational data and interview responses in a systematic and objective manner (Table 1).

Table 1. Codebook for evaluating betta fish welfare conditions and retail care practices. *The seven variables were assessed against recommended welfare standards derived from peer-reviewed literature and veterinary guidance. Each variable was classified as "meets," "partially meets," or "does not meet" and assigned a score of 2, 1, or 0, respectively.*

Variable	Definition	Recommended Welfare Standard	Evaluation Criteria	Source
Tank Size	Volume of container or tank used for a single betta fish	≥ 5 gallons	≥ 5 gallons = meets 2 - 5 gallons = partially meets < 2 gallons = does not meet	(16)
Enrichment	Presence of hiding spaces, plants, or decorations in tank	Include both a hiding space and a plant	≥ Hiding space & plant = meets Missing one = partially meets No enrichment = does not meet	(7)
Water Quality	Cleanliness of water conditions	Clear water with no visible waste or cloudiness	Clear & clean = meets Slightly cloudy / minor waste = partially meets Dirty / cloudy = does not meet	(8)
Water Temperature	Water temperature conditions	Stable, warm, tropical conditions	Heater present = meets Unclear / inconsistent = partially meets No heater present = does not meet	(16)

Continued Table 1. Codebook for evaluating betta fish welfare conditions and retail care practices. *The seven variables were assessed against recommended welfare standards derived from peer-reviewed literature and veterinary guidance. Each variable was classified as "meets," "partially meets," or "does not meet" and assigned a score of 2, 1, or 0, respectively.*

Variable	Definition	Recommended Welfare Standard	Evaluation Criteria	Source
Water Change Schedule	Water replacement frequency	Consistent, frequent water changes	Daily = meets 2 - 4 days = partially meets > 4 days = does not meet	(17)
Feeding Practices	Type of fish food & feeding schedules	Varied, high quality diet & fed once a day	Varied, high quality food & fed once a day = meets Either non-varied or low quality food = partially meets Low quality food & inconsistent feeding = does not meet	(11)
Employee Training	Level of employee knowledge & training on betta fish care	Specific training for betta fish	Clear training = meets Basic or limited knowledge = partially meets Little to no knowledge = does not meet	(12)

Observations

The observational component of this study evaluated four of the seven factors: tank size, enrichment, water quality, and water temperature, utilizing a non-invasive approach to gather data reflective of typical conditions. The observations remained in public areas and did not involve any direct contact with the fish, which represents a trade-off in measurement precision as visual indicators were used rather than invasive, more precise methods such as water chemical testing. To ensure the data were representative of the store's betta fish section as a whole, the conditions for ten fish chosen at random were analyzed for the four factors per store, recorded through photos and written observation, and the aggregate was categorized against the codebook. Store-level classification for categorical variables was determined by a six of ten majority rule. In the event of an evenly split case (five of the ten containers meeting a criterion), the condition was categorized as "partially meets" for failing to reach majority consensus. The same ten containers selected at each store were evaluated for all four observational variables. When more than ten containers were available, random spatial sampling was used by selecting every *nth* container across the display shelves to reduce selection bias. Tank size was assessed by recording the average volume of the ten selected containers. Container volume was obtained from product labels; when a label was missing or unreadable, the volume was verified using identical labeled packaging or the retailer's official inventory listings. Enrichment was evaluated by recording the presence of plants, hiding spaces, or other tank structures. Water quality was assessed through visual inspection for debris, such as uneaten food or dust, and for water cloudiness or turbidity. Water temperature conditions were evaluated by recording whether a heater was present or absent in each selected container.

During the visits, high-resolution digital photographs of the containers were recorded. These photos were used solely for verifying the data against the codebook post-visit. All images and observational notes were stored securely in a password-protected online folder to ensure store confidentiality.

Retail prices for betta fish were recorded to evaluate economic factors that may influence consumer purchasing decisions and subsequent care investment.. Betta fish prices were recorded as listed in the store. The upper and lower limits, as well as the average, were calculated and recorded. The prices of tanks marketed for betta fish were also recorded to investigate the range of tanks that were for sale. A singular betta fish must be in a tank of at least 5 gallons (16), so prices of tanks that were around 5 gallons (4.5 - 5.5 gallons) were recorded. Additionally, the price of the smallest tank was also recorded to find the difference in price between smaller tanks and recommended larger tanks. These were recorded based on tanks that were available in store at the time of the visits.

Interviews

To evaluate unobservable care practices in retail stores (water change schedule, feeding practices, and employee knowledge), semi-structured interviews were conducted with employees in the aquatic department. These interviews took place immediately following the observational phase. Before each interview, participants

were briefed on the purpose of the study and interview; they were then provided with a consent form (Appendix A). To encourage open reporting, participants were guaranteed total anonymity; thus, employee names and store locations (designated as Stores A through D) were not recorded in this study. One employee was interviewed per participating store.

After obtaining informed consent, interviews were audio-recorded for transcription. These interviews used a set of 10 questions (Appendix B). If responses were unclear or contradictory, follow-up questions were asked. To mitigate social desirability bias, where employees may feel pressured to provide "corporate-approved" answers (18), several filler questions were added alongside the primary questions (labeled in Appendix B) to increase employee willingness to answer honestly. These filler questions were designed to establish rapport and reduce interview formality. Only the primary questions were used for data analysis, while the filler questions supported the flow of the interview. Question #10 (Appendix B) was asked as a contextual factor to better understand the scope of the retail stage. Knowing how long betta fish stay in pet stores before purchase provides necessary context for understanding welfare. The interview phase allowed for deeper insight into betta fish care and store practices, and, in addition to observational data, created a more comprehensive picture of betta fish care practices.

Data Analysis

The data collected from observations and interviews were analyzed by comparing retail conditions with recommended welfare standards. Observational data in the form of photographs were documented and converted to written descriptions, and interview audio recordings were transcribed to allow for detailed analysis of employee answers. Each variable was evaluated based on its level of alignment with the recommended standards listed in the codebook, with categories of "meets," "partially meets," or "does not meet."

To quantify the level of alignment, a numerical scoring system was used. If a variable in a pet store met or exceeded the recommended welfare standard, a score of 2 was assigned. A score of 1 indicated partial alignment with the recommended welfare standard, and a score of 0 meant that the condition did not meet the standard at all. These numerical scores allowed for a more comprehensive view of the overall alignment of store practices with recommended welfare standards.

RESULTS

Although ten pet stores were visited across the South Bay geographic range, observational data and interviews were collected from four locations. Data collection at the remaining six locations was prevented by employee unavailability or decline to participate. The four stores that participated were labeled Store A, Store B, Store C, and Store D to ensure location and employee confidentiality. All four participating stores were large-scale chain corporations, providing a level of institutional consistency across the sample. Each store was assigned a score of 0, 1, or 2 for each variable, along with a total score, which is the sum of all seven variables. In addition, mean scores were calculated per variable across the four stores.

To clarify the scoring decisions presented in Table 2,

Table 2. Welfare-alignment scores for each store across the seven evaluated variables. *Each variable was scored from 0 to 2, where 0 indicates "does not meet," 1 indicates "partially meets," and 2 indicates "meets" the recommended welfare standard. The maximum possible total score per store was 14.*

Variable	Store A	Store B	Store C	Store D	Average per Variable
Tank Size	0	0	0	0	**0**
Enrichment	0	0	0	0	**0**
Water Quality	2	2	1	2	**1.75**
Water Temperature	0	0	0	0	**0**
Water Change Schedule	1	1	0	2	**1**
Feeding Practices	1	1	1	2	**1.25**
Employee Training	2	2	1	1	**1.5**
Total per Store	**6**	**6**	**3**	**7**	

the observational and interview findings were examined for each welfare variable. Across all four stores, every betta fish observed was housed in a 10-ounce display cup; therefore, all stores received a score of 0 for tank size. Similarly, none of the ten containers examined at each store contained plants, hiding spaces, or other enrichment, resulting in a score of 0 for enrichment across all locations. Water quality showed greater variation. Stores A, B, and D had clear water with no visible waste in all observed containers and received scores of 2, whereas 50% of the containers at Store C showed slight cloudiness or visible debris, resulting in a score of 1. Water heaters were absent from all ten containers at every store, so all locations received a score of 0 for water temperature.

Interview responses indicated differences in routine care practices. Store D reported daily water changes and received a score of 2. Stores A and B reported changing the water every two to three days and received scores of 1, while Store C reported weekly water changes and received a score of 0. For feeding practices, Stores A and C reported providing standard pellets once daily, while Store B used standard flakes once daily; each received a score of 1. Store D reported providing a varied diet of high-quality pellets and bloodworms once daily and received a score of 2. Employee training also varied. Employees at Stores A and B reported completing aquatic training modules that covered the biological needs of betta fish, resulting in scores of 2. Employees at Stores C and D reported receiving only general pet-care onboarding and therefore received scores of 1.

The housing volumes observed across all four retail locations were completely uniform, consisting of standard plastic display cups with volumes of approximately 10 fluid ounces. To quantify the discrepancy in alignment, this volume was compared against the recommended five-gallon standard, which converts to 640 fluid ounces (5 gallons multiplied by 128 ounces per gallon). The calculation used to find the percentage of recommended housing space provided to each fish is as follows: (10 fluid ounces / 640 fluid ounces) × 100% = 1.56%. This mathematical relationship confirms that the retail display containers represent approximately 1.6% of the volume required for the species to thrive. Overall scores varied across the four pet stores. Store D received the highest score, 7 points. Stores A and B both scored 6 points, and Store C scored the lowest, with 3 points. The difference between Store C and the other pet stores highlights substantial variability in the total scores across different locations.

Figure 1 shows the total score for each store by adding up the scores of each variable at that store. As shown in Figure 1, Stores A, B, and D have relatively similar total scores, but Store C has the lowest observed total score. The bar labeled "Hypothetical Ideal Store" represents a store that fully meets the recommended welfare standards for all seven variables, which would score 14 points. It is a hypothetical benchmark, not an observed location. None of the evaluated stores achieved more than 50% of the full 14 points possible for meeting each recommended welfare standard.

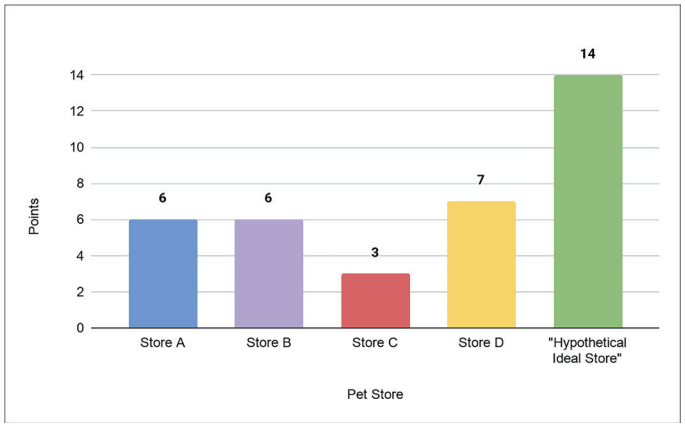

Figure 1. *Total welfare-alignment scores across the four participating retail stores. Each store received a score from 0 to 2 for each of seven welfare variables, producing a maximum possible total of 14. The "Hypothetical Recommended-Standard Store" represents full alignment with all seven recommended welfare standards and is included only as a reference benchmark, not as an observed location.*

In addition to overall scores, analysis of individual variables across pet stores revealed patterns (Figure 2). The variables tank size, enrichment, and water temperature each received scores of 0 across all four stores with no variation observed across stores. Figure 2 shows the average score for each variable across all four stores. An ideal mean score for a variable, that all four stores met the recommended standard, would be 2 points. As shown in the graph, tank size, enrichment, and water temperature had the lowest average scores, at averages of 0 points.

Other variables had higher average scores. Water quality yielded the highest mean score of 1.75 points across all stores. Employee training received the second-highest score of 1.5 points, while feeding practices had

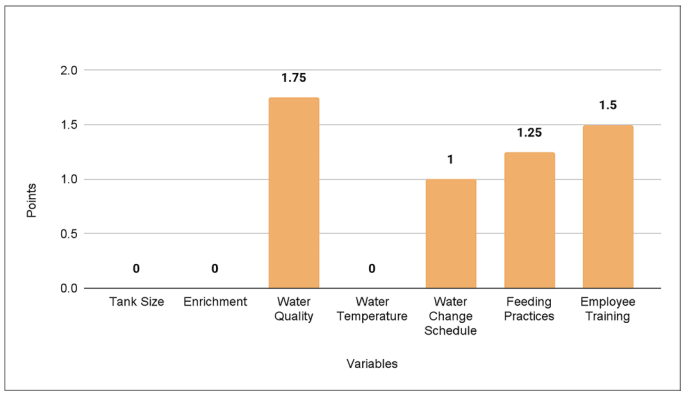

Figure 2. *Mean welfare-alignment score for each variable across the four participating retail stores. Scores ranged from 0 to 2, where 0 indicates "does not meet," 1 indicates "partially meets," and 2 indicates "meets" the recommended welfare standard. The maximum possible mean score for each variable was 2.0.*

a mean score of 1.25 points. Water change schedules yielded a mean score of 1 point. In contrast to the environmental variables, these variables demonstrated variability across stores. None of the variables received scores of 2 across all four retail locations, which illustrates the divergence between recommended welfare standards and current practices. Some variation was observed between individual stores. Store D received higher scores across some variables, such as water change schedule and feeding practices. Conversely, Store C received lower scores across multiple variables, such as water quality and water change schedule, which contributed to its overall lower average score.

DISCUSSION

The findings of this study demonstrate a substantial deviation between betta fish care practices in retail pet stores and the recommended welfare standards for their welfare. While some variables did show some alignment with these standards, such as water quality, feeding schedule, and employee training, none of the variables were able to achieve a perfect alignment of 2 across all stores. This indicates that none of the variables fully met the recommended welfare standards across all stores, illustrating a discrepancy between retail conditions and established welfare frameworks.

One of the most significant findings of this study was that there was a consistent deficit in suitable environmental enrichment and tank volume across all four stores. Betta fish in each store were housed in extremely small containers, often around 10 ounces, which represents merely 1.6% of the five-gallon recommended welfare standard as defined by Mueller *et al.* (16). The finding of this stark discrepancy between recommended and actual standards for tank sizes connects back to research by Clark-Shen *et al.* (6) and Oldfield *et al.* (7). Both groups of researchers found that restricted physical volume directly causes stress and health issues for betta fish, suggesting that long-term housing in small display containers hinders physiological well-being With small containers, water changes must be much more regular, but interview responses indicated that water changes for most stores were not as frequent. The combination of inadequate container sizes and water change schedules limits movement and accelerates the accumulation of waste. This aligns with Vanderzwalmen *et al.* (8), who noted that waste fluctuations and pH in small-scale handlings are key causes of stress for ornamental fish.

In addition to tank size and water change schedules, water temperature was also another vital environmental factor that exhibited zero alignment with recommended welfare standards across the sample. None of the stores provided any form of water heating, despite betta fish being tropical fish and depending on consistently warm water to maintain proper health and biological functions. Research by Pleeging *et al.* (10) found that without stable warm water conditions (76 - 81 degrees Fahrenheit), betta fish experience suppressed metabolic rate and compromised immune functioning.

Similarly, enrichment in the form of hiding spaces or plants was absent in each pet store. Both Clark-Shen *et al.* (6) and Oldfield *et al.* (7) explain the importance of enrichment for betta fish. As betta fish are solitary creatures, they rely on enrichment for stimulation and exhibition of natural behaviors. Hiding spaces increase betta fish vitality, while plants help naturally regulate water quality. Without enrichment, betta fish can face elevated stress levels and lower lifespans. This study found that in every pet store, betta fish were kept in small containers with a lack of heating and enrichment. The findings of these studies highlight that betta fish needs are often unmet in retail settings, which connects to the study by Maia *et al.* (1), which found that ornamental fish are at risk in every stage of the fish trade.

These findings underscore that environmental factors required for proper biological functioning are rarely prioritized in retail housing. Although some conditions such as feeding practices and water quality demonstrate some alignment with recommended welfare standards,

full alignment is necessary to maintain proper welfare for betta fish. Animal welfare extends far beyond survival and includes the ability to display natural behaviors and biological functions (3). The results of this study show how retail pet stores may prioritize short-term maintenance and survival over the well-being of their fish.

Apart from direct environmental and care conditions, contextual factors such as betta fish pricing and availability of tank sizes can indirectly influence the welfare of betta fish. Across all stores, betta fish ranged from around $5 to $26, with most prices falling around $14. Because betta fish are relatively inexpensive, customers may choose to purchase a basic tank to remain in line with the price point of the fish. The four pet stores sold a variety of fish tank but all offered tanks marketed specifically toward betta fish that were much smaller than the recommended size of 5 gallons. Store B sold 1-gallon tanks at a significantly lower price point than 5-gallon tanks, which may cause customers to select smaller enclosures that fit the low financial investment of the fish.

Though environmental conditions were consistently inadequate, there were some variations in other aspects of care across the four pet stores. Stores A, B, and D had overall higher scores compared to Store C. However, these differences did not translate to environmental conditions, as they remained well below recommended welfare standards across all locations. None of the stores had adequate tank sizes, enrichment, or water heating for their betta fish. These findings align with existing research on fish welfare and how ornamental fish face care deficits in every stage in the fish trade (1). They emphasize the importance of alignment with recommended welfare standards to ensure the maintenance of betta fish health and well-being. Through employee interviews, it was found that although certain betta fish with more "desirable" colors are purchased quickly, others can stay in pet stores for over six months, highlighting that the inadequate care they receive can take a significant toll on their health. Overall, these results reinforce the need for much greater alignment between established welfare standards and retail pet store conditions to ensure that betta fish are supported in their well-being and health.

CONCLUSION

This study aimed to answer the question: How do care practices of betta fish in California's South Bay Area retail pet stores compare to recommended welfare standards required for the species to thrive? The findings revealed a clear discrepancy between current retail conditions and recommended welfare standards for betta fish, particularly in environmental factors such as tank size, enrichment, and water temperature. Specifically, the four participating corporate-chain stores displayed no alignment to recommended welfare standards for tank size, enrichment, and water temperature, while the remaining care variables showed only partial alignment. None of the variables fully met the recommended welfare standards across all stores. Overall, the results highlight that betta fish in retail environments may not consistently be provided with the conditions that are necessary to thrive. These findings are consistent with the original hypothesis that there would be a considerable discrepancy between pet store conditions and recommended welfare standards for betta fish, with the largest discrepancy found in environmental factors.

Because these findings are based on a small convenience sample of a single store type in one geographic area, the implications are exploratory rather than generalizable. Commercial pet retailers may utilize these empirical baselines to reassess their standards. Increased public awareness regarding proper care practices can influence purchasing decisions and create demand for more suitable environments. Additionally, these localized field data provide metrics for policy analyses examining regulatory protections for ornamental fish.

Despite these potential contributions, the findings also have some limitations. The sample size was limited to only four pet stores within the South Bay Area due to the lack of employee availability or consent in the other six stores, which limits the generalizability of the findings. This high number of missing stores highlights potential participation bias in the data. Stores with inadequate care practices or understaffing could have chosen not to participate when asked, while the stores with better resources may have been more open to doing the interviews. Because of this, these four stores are not fully representative of the entire South Bay pet store industry. Instead, these results provide a closer look at the specific problems happening inside these particular retail spaces.

Additionally, this study exclusively sampled large-scale corporate chains; thus, the findings may not be generalizable to independent retailers. Furthermore, this study focused primarily on information that can be gathered in a public space, such as visual observations

and interviews, over a brief amount of time, so the direct impact of these conditions on betta fish health could not be measured. Notably, each participating store was visited only once, which may not fully reflect routine or long-term care practices. Additionally, although social desirability bias of employees was mitigated through filler questions, the study relies on the accuracy of self-reported interview data.

Future research should build upon these baseline data by examining the impact of environmental conditions in retail pet stores on betta fish health outcomes. Additionally, further studies could explore consumer purchasing behavior and how the different prices of fish tanks and accessories can influence post-purchase care choices. Investigating how retail pet store conditions and prices impact conditions betta fish experience after purchase could also provide additional insight beyond retail settings. Ultimately, these future directions would lead to a more comprehensive understanding of ornamental fish welfare, and will provide a more comprehensive framework for advancing ornamental fish welfare.

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CONFLICT OF INTEREST

The author declares no conflicts of interest related to this work.

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APPENDIX A: EMPLOYEE CONSENT FORM

Researcher: Anya Dhall
Homestead High School

Purpose of the Study:
The purpose of this study is to learn and identify trends about betta fish in the South Bay Area.

What You Will Be Asked to Do:
If you agree to participate, you will be asked to answer a short set of general questions about betta fish. The interview will take approximately 5–10 minutes.

Voluntary Participation:
Your participation is completely voluntary. You may choose not to answer any question or stop the interview at any time.

Confidentiality:
- Your name and information will **not** be recorded.
- The store name and location will not be included.
- Audio recording will be for efficiency of the interview, and will **not** be shared with anyone.

Risks and Benefits:
There are no anticipated risks associated with participation. While there may be no direct benefit to you, your participation will help improve the understanding of betta fish.

Consent Statement:
By signing below, you confirm that:
- You understand the purpose of the study.
- You voluntarily agree to participate.
- You understand that everything will be anonymous and an audio recording will be kept for efficiency purposes. It will not be shared with anyone.

Employee Signature: _____
Date: _____

APPENDIX B: EMPLOYEE INTERVIEW QUESTIONS

1. What is your favorite type of betta fish?
2. **Primary:** How often is the water changed for betta fish, and is there a set schedule employees follow?
3. Are male or female betta fish more popular for customers?
4. **Primary:** What brand or type of fish food do you give the betta fish?
5. **Primary:** What is their feeding schedule like?
6. What is the most popular betta fish type among customers?
7. What is the most popular tank that customers buy for their betta fish?
8. **Primary:** Do employees receive specific training on betta fish care, and what does that training include?
9. If someone is buying their first betta, what is the #1 tip you would give?
10. **Primary:** How long does it typically take for a betta fish to be bought?