The use of simulation light & moving images in determining data for artificial coloration lure design (top water) for Sebarau fish species

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Abstract. The pursuit of game fish is as much an art as it is a science. Amongst the varied species targeted by anglers, the Sebarau fish species or Hampala Barb, renowned for its fighting spirit and elusiveness, presents a unique challenge. The crafting of lures color to attract this esteemed quarry is an intricate task, necessitating an understanding of their sensory perception and behavioral patterns. The use of simulated light and moving images has emerged as a revolutionary tool, transforming the way design and employ artificial coloration in top-water lures. These concept simulations, can provide unique insights into the way Sebarau fish react to different visual stimuli. By exploring the intricate interplay of light, color, movement, and the aquatic environment, it can predict how these particular fish species respond to varying lure colors. Thus, the data-driven approach is the culmination of blending modern technology with current angling knowledge. Its purpose lies not only in augmenting the success rates of anglers but also contributes significantly to the color of trust in the field of behavioral studies. Despite its popularity, there is a noticeable lack of local research on how artificial lure color impacts the Sebarau species in their natural habitat. Important factors such as light transmittance, feeding patterns, water conditions, and seasonal changes have not been thoroughly studied in relation to the fish's response to specific lure colors. While the evolution of artificial lure design, particularly in terms of type, size, action ability, weight, and exaggerated features, continues to drive market demand, the selection of lure color remains predominantly guided by the established trust in classic choices.

Keywords: Lures color, light transmittance, color of trust

F. Mustaffa (ed.), *Proceedings of the 3rd International Conference on Creative Multimedia 2023 (ICCM 2023)*,
Advances in Social Science, Education and Humanities Research 786,
https://doi.org/10.2991/978-2-38476-138-8_35

1 INTRODUCTION

1.1 Background - The Evolving Popularity and Understanding of Lure Fishing in Malaysia

In recent times, lure fishing has experienced a surge in popularity throughout Malaysia, offering a wealth of opportunities for fishing enthusiasts across various age groups and backgrounds. This angling technique has emerged as a common entry point for beginners who may initially have reservations about the effectiveness and proper usage of lures. Initially, skepticism surrounded the idea of fish being enticed by pieces of steel and wood, but the advent of new inventions and innovations in the domestic and global markets has gradually changed perceptions. Moreover, the dissemination of knowledge through diverse channels, including magazines, seminars, television, radio, and the internet, has significantly increased exposure within fishing communities, fostering a stronger foundation of knowledge and expertise among anglers engaged in lure fishing.

Frederick Goh (2010)[1], the lure fishing industry in Malaysia and Southeast Asia exhibits promising prospects, transitioning from a means of procuring food to a popular sport. Malaysia's diverse fish species contribute to the allure of lure fishing, making it highly appealing. Furthermore, developed countries boast a substantial number of recreational anglers, with at least 220 million individuals, surpassing the count of commercial anglers by fivefold (Arlinghaus et al., 2018)[2]. Estimates suggest that recreational anglers may catch up to 47 billion fish annually, with approximately two-thirds of them being released back into the water (Pita et al., 2018)[3].

Despite the growing enthusiasm for lure fishing in Malaysia and the region, there remains an ongoing debate about the selection of lure colors for specific fish species during fishing trips. This uncertainty, coupled with the increasing demand for lure fishing, has sparked fascination among local anglers with new and modern tackle products, as each item has become a personalized choice and essential tool for catching fish. Recreational fishing using artificial lures, in particular, has played a significant role in promoting the demand for tackle products in Malaysia.

Considering this context, this research aims to investigate potential experimental approaches to evaluate primary management measures for determining how Sebarau fish species respond to different top water lure color presentations. By shedding light on this aspect of lure fishing, we can further enhance our understanding of the intricacies involved in attracting and enticing specific fish species, ultimately contributing to the advancement of this popular angling technique in Malaysia.

Fig. 1: Recreational fishing on artificial lures

2. THE COLOR OF TRUST

Genuine consideration is given to the existing lure color products, which are developed based on the originality and characteristics of native baitfish studied by researchers or designers from their respective countries. The effectiveness of these lure colors for local predatory fish species compared to species from other regions is a subject of discussion and debate. The understanding of how fish perceive colors has garnered attention worldwide and has led to diverse findings.

The phenomenon of the "color of trust" among anglers, particularly in the selection of top-water lure colors for Sebarau fishing, is a classic observation. The warm color scheme (red, orange, and yellow families) and its influence on visual attention have been dominantly established among local anglers, although the specific study supporting this observation remains unknown. However, local research studies have not found a clear metric correlation to sufficiently validate the attractiveness of the trusted colors on the feeding patterns of Sebarau fish species.

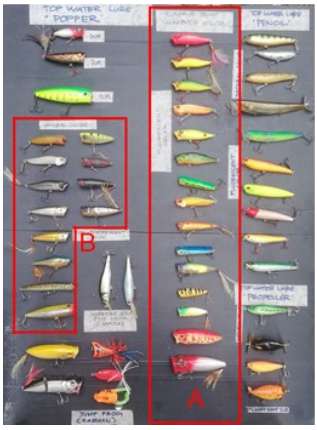

Fig. 2. The set of two-color categories (A: Warm Color/Color of trust; B: Neutral Color/Native Bait Fish Color)

On **Fig.2** photo above, two colors have been classified: warm and neutral. The warm color has been identified as the 'color of trust' in Sebarau lure fishing and is highly sought after. On the other hand, the neutral color is associated with the feeding pattern of bait fish for Sebarau fish species. The recommended size for topwater lures is between 5cm to 7cm in length. This size range is commonly favored by Sebarau anglers as it is convenient to carry in a simple tackle box

Fig. 3. The color of trust (warm color) phenomenon among the Sebarau lure fishing form each of anglers from their tackle box

The visual capability of fish, particularly in relation to their feeding patterns, plays a crucial role in their natural habitat. While the impact of lure coloration on light transmittance processes and records remains a formally untested hypothesis (Andrew. D. Moraga, Alexander D.M. Wilson, Steven J. Cooke,2015)[4], size-selectivity has been evaluated in recreational fisheries, primarily focusing on lure size rather than lure color). The correlation between lure coloration and the water splashes can be examined by the associate. qualities include the physical attributes of the lure, such as its size, color, movement, and sound it produces. Therefore, studying how the coloration of the lure body interacts with the water splashes can provide valuable insights into its potential effectiveness in attracting fish.

3. SEBARAU FISH SPECIES, ARTIFICIAL LURE AND LIGHT TRANSMITTANCE

Fig. 4. Sebarau Hampala macrolepidota, National Park, Kuala Koh Kelantan

Hampala macrolepidota, commonly known as Sebarau (Kamaruddin et al., 2011)[5] or jungle perch, is a carnivorous fish. It belongs to the Hampala genus of the Cyprinidae family and is widely distributed across Southeast Asia, including Thailand, Malaysia, Vietnam, the Philippines, and Indonesia. Within the Hampala genus, there are five species: H. macrolepidota (including the sub-species H. m. Sabana), H. ampalong, H. bimaculata, H. lopezi, and H. dispar. These species differ in external morphological characteristics, particularly in their color patterns (Safran Makmur, Diana Arfiati, Gatut Bintoro, Arning Wilujeng Ekawati, 2014)[6].

As one of the highly sought-after game fish for lure fishing in Malaysia, Sebarau shares common traits with other fish species. Their eyesight is well-developed, allowing them to detect and stimulate the feeding patterns of their prey. They are particularly active during the early morning and late evening, with the rainy season being the optimal time for their hunting activities. Sebarau often take cover in underwater structures such as fallen trees or rocks, and their hunting strategy is finely tuned to ambush passing prey within their strike zone. (Eddie Chua, Lure of the Sebarau 2012)[7] Sebarau can be easily caught using artificial baits such as lures, spoons, flies, or mini jigs. Among these options, using topwater lures like poppers or pencil baits is particularly enjoyable. The thrill of feeling the fish aggressively take the lure adds to the excitement of the angling experience. The contemporary tacklebox for recreational fishing is packed with lures that cover the full spectrum of colors with the assumption that color influences fishing success, but this, to a large extent, remains a formally untested hypothesis (Andrew. D. Moraga, Alexander D.M. Wilson, Steven J. Cooke,2015)[8].

A method for selecting a fishing lure of a color or colors most visible and attractive to fish includes observing the water's condition to be fished to determine the relative clarity of the water, then measuring the light transmittance at the depth in the water to be fished. (Loren G. Hill, 1987)[9]

The fishing experiences provoke attractiveness in a combination such in motion, shape and color, as well as the scents in and depth of the water, while the majority of fish have developed eyes that will detect the type of colors typical of their environment (Davis Ross, Fish EyeSight,.2018)[10.] Very less of scientific measure on data collection to understand how lure coloration on light transmittance processes and recorded except the theoretically remains a formally untested hypothesis. (Andrew. D. Moraga, Alexander D.M. Wilson, Steven J. Cooke,2015)[11]

4. UNDERWATER LIGHT TRANSMITTANCE ON COLOR OBJECT

Color and light have a close relationship and play crucial roles in creating beautiful visual experiences. There are three elements that contribute to this relationship: natural light sources such as the sun, the presence of objects such as fishing lures, and the receiver, which in this context refers to the fish. While almost all fish can see color under ideal conditions, whether or not a particular color is visible depends on factors like depth, time of day, weather, and the color itself (Brian Silvestre, 2012)[12].

In the research on "Underwater Image Enhancement: Using Wavelength Compensation and Image Dehazing," it is mentioned that underwater environments often lead to the scattering of colors and the presence of color cast in underwater photography. This color scattering occurs due to the haze effect, which arises when light reflected from objects undergoes multiple absorptions or scatterings by particles in the water.

Haze in underwater environments is caused by suspended particles such as sand, minerals, and plankton, which are present in lakes, oceans, and rivers. As light reflected from objects travels towards the camera, a portion of the light encounters these suspended particles, resulting in the absorption and scattering of light (J. Y. Chiang and Y. -C. Chen, 2011)[13].

The image **Fig.5** model below shows how the object's color towards the light by various wavelengths through the water.

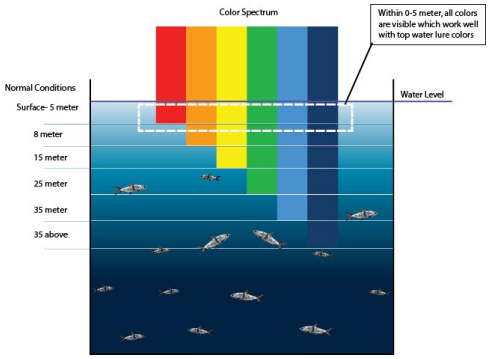

Fig. 5. Object color on light wavelength through water column

It's clearly showing that the light has significantly perceived the color wavelength of the object in a certain depth. In the context of fishing lures, it is important to consider the impact of water depth and conditions on the visibility of lure colors. It appears that the significance of the "red" color wavelength within certain depth ranges, such as 0-5 meters (17ft) in the first depth. The second color of orange being visible up to 0-8(24ft), followed by yellow at 15 meters (50ft), green at 25 meters (85ft), while the blue and dark blue remain visible towards 35meters (116ft)

This color images have shown that the colors within this range work well for attracting Sebarau, considering that the top water lure (floating ability) may not go having issue on color visibility through water column. Understanding the optimal depth range for lure presentation and the corresponding effective color spectrums can be valuable knowledge for anglers targeting Sebarau using top water lures. It allows them to make informed choices when selecting lure colors to maximize their chances of attracting and catching the desired fish species.

5. THE EYESIGHT FOR SEBARAU FISH SPECIES

It is often reported by angler communities that the eyesight of Sebarau fish species is remarkable and that they possess impressive visual capabilities when it comes to locating and targeting their prey. The ability of Sebarau to see their prey is often described as exceptional.

The precise reasons why Sebarau fish dash out to attack their prey can be multifaceted and may involve various factors. While lure color can be a contributing factor in attracting the attention of Sebarau and triggering their predatory behavior, it is not the sole determinant. The feeding patterns of Sebarau are influenced by a combination of factors such as the movement, size, shape, and behavior of the prey, as well as the environmental conditions and the fish's innate hunting instincts. These fish have evolved as predators and have developed specialized adaptations to efficiently locate, pursue, and capture their prey.

Fig. 6. The Sebarau fish on lure fishing

6. APPARATUS ITEMS FOR TESTING APPROACHES

This paper primarily focuses on examining how color influences the response of the Sebarau fish species to artificial topwater lures. The study specifically emphasizes a particular category of lures, namely the topwater lures, in the size range of 7-9cm. The research does not delve extensively into other lure designs, such as shallow or deep dive lures.

Top Water Lure Type and Sizes

The experiment study solely focuses on the use of a specific type of lure, namely the topwater lure known as a Popper. The study focuses on limiting the sizes of the topwater lures used to either 7cm or 9cm. This selection is influenced by several factors, including the popularity and availability of these specific sizes in the market. The chosen sizes are commonly used and easily accessible to anglers, particularly those engaging in jungle adventure, fishing in jungle rivers. and these sizes are practical for carrying in small tackle boxes.

Fig. 7. An example of 7cm & 9cm top water lure

In addition to the selection of lure type and sizes, the study includes a set of lure colors that are categorized into two groups: natural colors (which mimic the appearance of baitfish in their natural environment) and warm colors, known as the "color of trust" syndrome observed in many Sebarau hunters. These two-color categories will be evaluated and recorded based on the response of the Sebarau fish species during the experiment, which will be conducted using a tank simulation as the experimental test apparatus.

Below is a basic example of two sets of colors: natural and warm. The warm colors, represented on the right side, will include shades of yellow, orange, red, or a combination thereof. These colors are intended to evoke a sense of heat, warmth, sunlight, or fiery tones. On the other hand, the natural colors, represented on the left side, will consist of hues that closely resemble the colors commonly observed in the daily environment. These colors can be described as cool, earthy, or

closer to the authentic colors of baitfish found in the water systems, particularly those inhabited by the renowned Seluang fish species

Fig. 8. Two basic colors for natural color (left) and warm color(right) from Rapala brand

In this paper, the specific experiments conducted using the selected apparatus are not depicted in any of the pictures, including the colors and dedicated branding. The final selection of colors and brands will be determined and specified in subsequent applications and agreements. A recommendation is made to prioritize a dedicated local brand that offers a consistent model type with a set of natural and warm colors.

Methods

By using the qualitative research on variation in a situation and exploring the variable experiences and experiment, the testing experiment will be divided into several applications. A dedicated area for the tank simulation has been identified and endorsed by UPM (University Putra Malaysia) Hatchery-Aquaculture Research Station, located in Bukit Puchong, Selangor. The simulation tank will be filled with approximately 40 tons of water per gallon and has specific dimensions of 15ft Length x 15ft Width x 12ft Depth. This controlled environment will provide the necessary space and conditions to conduct the experiment effectively

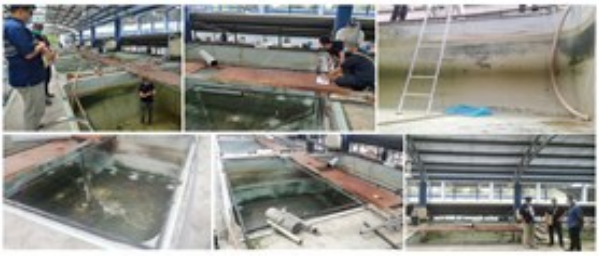

Fig. 9. The simulation tank for simulation light and moving images on top water lure (15ft L x 15ft W x 12ft D)

Hatchery simulation, light and moving images testing profile

The potential testing profile for simulating light and moving images has been identified, and it involves several applications and processes. Each application within the process will include

underwater video filming and photo capture, focusing on capturing the necessary footage and images for further analysis and evaluation. This approach allows for a comprehensive examination of the response of the Sebarau fish species to different visual stimuli, ensuring the significance of the collected data and observations.

The diagram below shows the proposal underwater camera and light installation

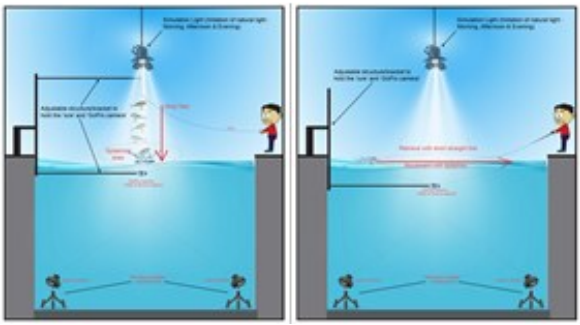

Fig. 10. The proposal of tank simulation with underwater camera and lighting installation

Based on the diagram, four apparatus profiles have been identified for the testing application.

1) Water Mode Replication
Two types of water replication are considered significant and closest to the natural habitat of the Sebarau fish species: clarity and cloudy water. The choice between these two modes will depend on the overall condition of the hatchery system. Factors such as water source, filtration, and environmental conditions will determine whether the water in the simulation tank replicates the clarity of pristine water or the cloudiness typically found in certain natural environments. The aim is to create a realistic setting that resembles the Sebarau fish species' natural surroundings for accurate experimentation and observation

2) Lure Coloration (Top Water lure)
The topwater lure coloration will be categorized into two groups: natural color and color of trust. These categories will help classify the different color variations used in the study. Additionally, the topwater lure colors will be paired with two specific lure sizes, namely 7cm and 9cm. These chosen sizes will be used consistently throughout the experiment to ensure a standardized approach and facilitate comparisons between the different lure colors

3) Replication of Light Simulation
For each light simulation, the 'LUX' perimeter setting will be used, and the timing of the simulations will be aligned with the feeding patterns of the Sebarau fish species. Three specific time settings have been identified:

3.1) **Simulation Light 1:** Morning - From 7.00 am to 10.00 am.

3.2) **Simulation Light 2:** Afternoon - From 11.00 am to 2.00 pm.
3.3) **Simulation Light 3:** Evening - From 4.00 pm to 7.00 pm.

4) Action perimeter's for (moving video filming and image capture)

Regarding the action perimeter, there are two applications for testing:

4.1) **Splashes Test:**

This test aims to determine the volume of attraction based on the size and lure drop pattern. Splashes created by the lure hitting the water surface will be captured, allowing for the analysis of the color spectrum and spread in the water column.

4.2) **Retrieve Test:**

This test involves capturing the color patterns created by the movement of the topwater lure along a straight line on the water surface during retrieval. The focus will be on observing the color spectrum spread during the lure's movement.

7. CONCLUSION

Lure fishing is indeed a fascinating experience that offers anglers the opportunity to attract and target specific fish species using artificial lures. The availability of imported lures in the local market has played a significant role in enhancing the excitement and success rates of fishing trips. These imported lures are designed to mimic the appearance and behavior of natural bait, effectively attracting fish and increasing the chances of a successful catch. The specific color preferences and attraction mechanisms of Sebarau fish (Hampala macrolepidota) towards lures may indeed be influenced by their behavior and environmental factors. While there may be limited research available on this topic in the local context, it is important to consider the experiences and observations of local anglers who have found success with specific lure colors. Fish, including Sebarau, have the ability to perceive colors to varying degrees. Certain colors, such as red, orange, and yellow, are known to be more visible in underwater environments due to the way light is absorbed and scattered in water. These colors may stand out and attract the attention of fish, including Sebarau.

Behavioral studies can provide valuable insights into how fish respond to different colors and lure presentations. Observations of fish behavior, such as their tendency to strike or show interest in certain colored lures, can provide evidence of color preferences. Additionally, experimenting with different lure colors and tracking the success rates can help identify patterns and determine the effectiveness of specific colorations. By potentially conducting on dedicated testing and evaluation of existing lure colors on the market, particularly tailored to the specific fish species like Sebarau, is important for further understanding their attraction mechanisms. This can help in developing more effective lure designs that consider color observation, testing, and evaluation as primary concerns.

Integrating color into the target application of lure design is crucial because fish, including Sebarau, rely on their eyesight to detect and respond to visual stimuli. By understanding the

connectivity between the fish's eyesight and the colors presented by lures, designers can create color patterns that are more likely to attract the attention of the fish and trigger a strike response. Testing and evaluating different lure colors can involve various methods, such as controlled experiments, field observations, and data analysis. This can help identify the specific color combinations, patterns, or shades that are most appealing to the target fish species. Additionally, considering the natural prey and habitat of the fish can provide insights into the coloration that would be most effective in mimicking their preferred food sources. Encouraging local R&D efforts in lure design, including the involvement of individuals skilled in DIY lure making, can contribute to the development of innovative and effective lure colorations. Collaboration between researchers, anglers, and lure designers can foster a better understanding of the relationship between lure color and fish attraction, leading to the creation of more successful and targeted lure designs.

Potentially this research paper can serve as a starting point to explore the design process and experimental activities involved in studying color in fishing lures. By simulating light and moving images in digital applications, underwater filming, image capture, and incorporating biological contributions, the research aims to provide insights and answers regarding the specific constraints and considerations of color in lure design. The popular belief among anglers that color plays a crucial role in attracting fish raises important questions and uncertainties. This research paper intends to address these concerns by conducting experiments and collecting data to shed light on the relationship between lure color and fish attraction. Through a systematic approach and the utilization of advanced digital technologies, the study aims to provide evidence-based findings and contribute to the understanding of how color influences fish behavior and response. Overall, this research paper intends to bridge the gap between anecdotal beliefs and scientific evidence regarding the importance of lure color. By employing rigorous experimental methods and digital data analysis, it seeks to contribute to the existing knowledge on the subject and offer practical insights for anglers and lure designers.

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