

ANALYSIS OF THE INTERACTION BETWEEN TIME AND BAIT TYPE ON THE EFFECTIVENESS OF CATCHING BIJINANGKA FISH (*Upeneus moluccensis*)

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ABSTRACT

Fishing for bijinangka (*Upeneus moluccensis*) in the waters of Tual City generally involves using a handline in the morning and evening with worms (*Dendronereis pinnaticirris*) and anchovies (*Engraulis* sp.) as bait. This study aims to analyze the effects of bait type, fishing time, and the interaction between the two on the catch yield of bijinangka. The method used in this study was experimental fishing with a factorial design. Data were analyzed using two-way ANOVA via the SPSS application. The results showed that bait type had a significant effect on catch yield ($F(1,92) = 309.897$, $p < 0.001$), accounting for 77.1% of the variation. The fishing time factor also showed a significant effect ($F(1,92) = 791.890$, $p < 0.001$), accounting for 89.6% of the variation. There was a significant interaction between bait type and fishing time ($F(1,92) = 65.533$, $p < 0.001$) with a partial eta-squared value of 0.416. The most effective combination for catching bijinangka fish is using worms as bait in the morning.

Keywords: *Upeneus moluccensis*; *Dendronereis pinnaticirris*; *Engraulis* sp.; Handline

INTRODUCTION

The Bijinangka fish (*Upeneus moluccensis*) is a demersal fishery commodity with tender flesh and is a good source of animal protein, making it easily consumed by people of all ages (Nirmala *et al.*, 2025). This fish is easily recognized by the public due to its elongated, oval body shape and distinctive features, including a pair of barbels under its chin and a forked tail fin (Alwi *et al.*, 2024). Bijinangka fish stocks are found throughout nearly all of the waters of Maluku, including the waters off the city of Tual. This fish is a demersal species, meaning it lives on the seafloor and is one of the primary target species for local fishermen (Rahaningmas, 2025).

The types of fishing gear commonly used by fishermen to catch bijinangka fish are nets, traps, and longlines. Of these three types of gear, fishermen predominantly use longlines because the materials are inexpensive, the design is simple, and the quality of the catch is guaranteed (Rahaningmas, 2020; 2025). Furthermore, Nabutaek *et al.* (2020) and Wahyuni *et al.* (2025) explain that longline fishing is a simple, environmentally friendly method with a high level of selectivity. However, the use of longline fishing gear has not yet been fully optimized in Tual.

The success of catching bijinangka fish using a handline is largely determined by the bait. The types of bait used by fishermen to catch bijinangka fish are anchovies and worms. This aligns with the findings of a study (Alwi *et al.*, 2025), which explains that the primary diet of bijinangka fish consists of small fish or anchovies (*Engraulis* sp.) and other macrofauna, particularly from the class Polychaeta, namely worms (*Dendronereis pinnaticirris*). Furthermore, the results of the analysis by Ünlüoğlu *et al.* (2002) show that the stomach contents of bijinangka fish are often found to be empty at night;

this proves that this fish is not nocturnal, and thus *Upeneus moluccensis*, or bijinangka, is specifically classified as a diurnal feeder.

Scientific information regarding the interaction between bait and fishing time on bijinangka catch has never been systematically studied. Therefore, this study aims to analyze the independent effects as well as the interactions between bait type and fishing time to determine the most effective fishing strategy for bijinangka.

RESEARCH METHODS

Time and Location of the Study

This study is a field study conducted in the waters off Faer Island, Tual City ($5^{\circ}38'19''\text{S}$ dan $132^{\circ}43'25''\text{E}$). Based on the established methodology, the research activities were scheduled to take place from March 4 to 28, 2025. A map of the bijinangka (*Upeneus moluccensis*) fishing area is shown in Figure 1.

Equipment and Materials

This study used a handline, the components of which consisted of a fishing line (polyamide monofilament, Ø 1.43 mm), a size 16 hook, and a sinker. The types of bait used were worms (fresh) and anchovies (whole). Both types of bait were 4 cm in length. The construction of the longline and the two types of bait are shown in Figure 2.

The method used in this study was experimental fishing, in which the researchers conducted direct fishing in controlled and systematic waters to test scientific hypotheses (Harianto *et al.*, 2025).

Fishing Operations

Bijinangka fishing activities are divided into a first period from 7:00 a.m. to 10:00 a.m. WIT and a second period from 2:00 p.m. to 5:00 p.m. WIT. These two periods were chosen to align with the circadian rhythm (daily behavior) of bijinangka fish, which are active in foraging on the seafloor when sunlight is not too intense (morning and evening), thereby ensuring an effective catch (Sabrah & El-Ganainy, 2009).

The fishing area is located approximately 2 miles from the coast, with a water depth of about 50 m. Fishing operations were conducted by two anglers in a single boat, each holding a longline equipped with two hooks of the same size. The first angler used earthworms as bait, while the second angler used anchovies. The types of bait used by the fishermen were rotated (exchanged) for each subsequent fishing session. The first fishing session took place from 7:00 a.m. to 10:00 a.m. WIT, and the second session began at 2:00 p.m. and ended at 5:00 p.m. WIT. These fishing activities were conducted over a period of 24 days.

Data Analysis

The SPSS software was used to analyze the data in this study. A two-way ANOVA was used to analyze the effect of two independent factors (bait type and fishing time) on one dependent variable (catch).

The catch of bijinangka fish was estimated based on combinations of bait type and fishing time using the following formula (Uspar, *et al.*, 2024 and Giovani *et al.*, 2025):

Morning–Worm Bait

Morning, Day x

$$= \text{Morning Catch Totals} \times \frac{\text{Morning Worm Bait}}{\text{Daily Catch Totals}} \dots\dots\dots(1)$$

Afternoon–Worm Bait

Afternoon, Day x

$$= \text{Afternoon Catch Totals} \times \frac{\text{Afternoon Worm Bait}}{\text{Daily Catch Totals}} \dots\dots\dots(2)$$

Morning–Anchovy Bait

Morning, Day x

$$= \text{Morning Catch Totals} \times \frac{\text{Morning Anchovy Bait}}{\text{Daily Catch Totals}} \dots\dots\dots(3)$$

Afternoon–Anchovy Bait

Afternoon, Day x

$$= \text{Afternoon Catch Totals} \times \frac{\text{Afternoon Anchovy Bait}}{\text{Daily Catch Totals}} \dots\dots\dots(4)$$

Next, the estimated data were analyzed using SPSS to produce univariate analysis of variance (ANOVA) results. This was followed by Levene's test for equality of error variances a and b using SPSS. The analysis continued with a test for between-subjects effects. Additionally, tests were conducted for bait type and fishing time.

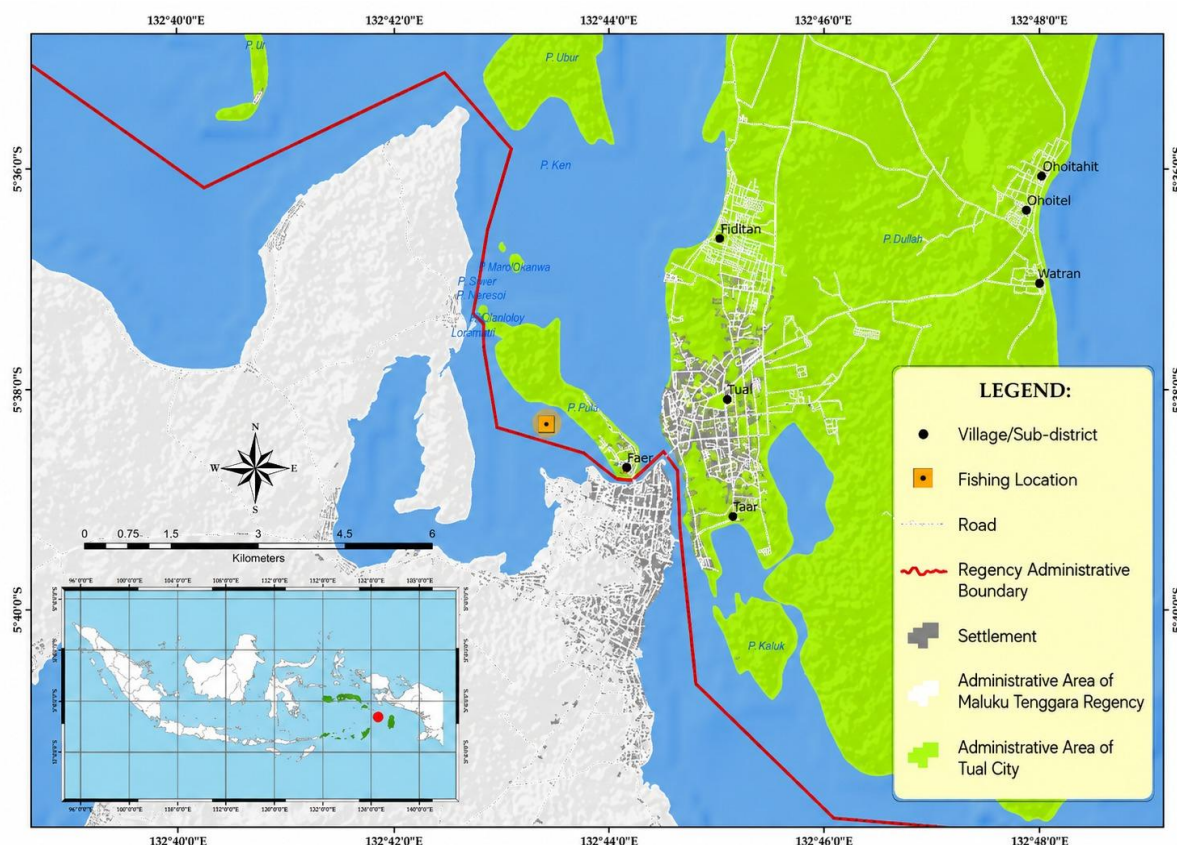


Figure 1. Fishing Location for Bijinangka (*Upeneus moluccensis*)

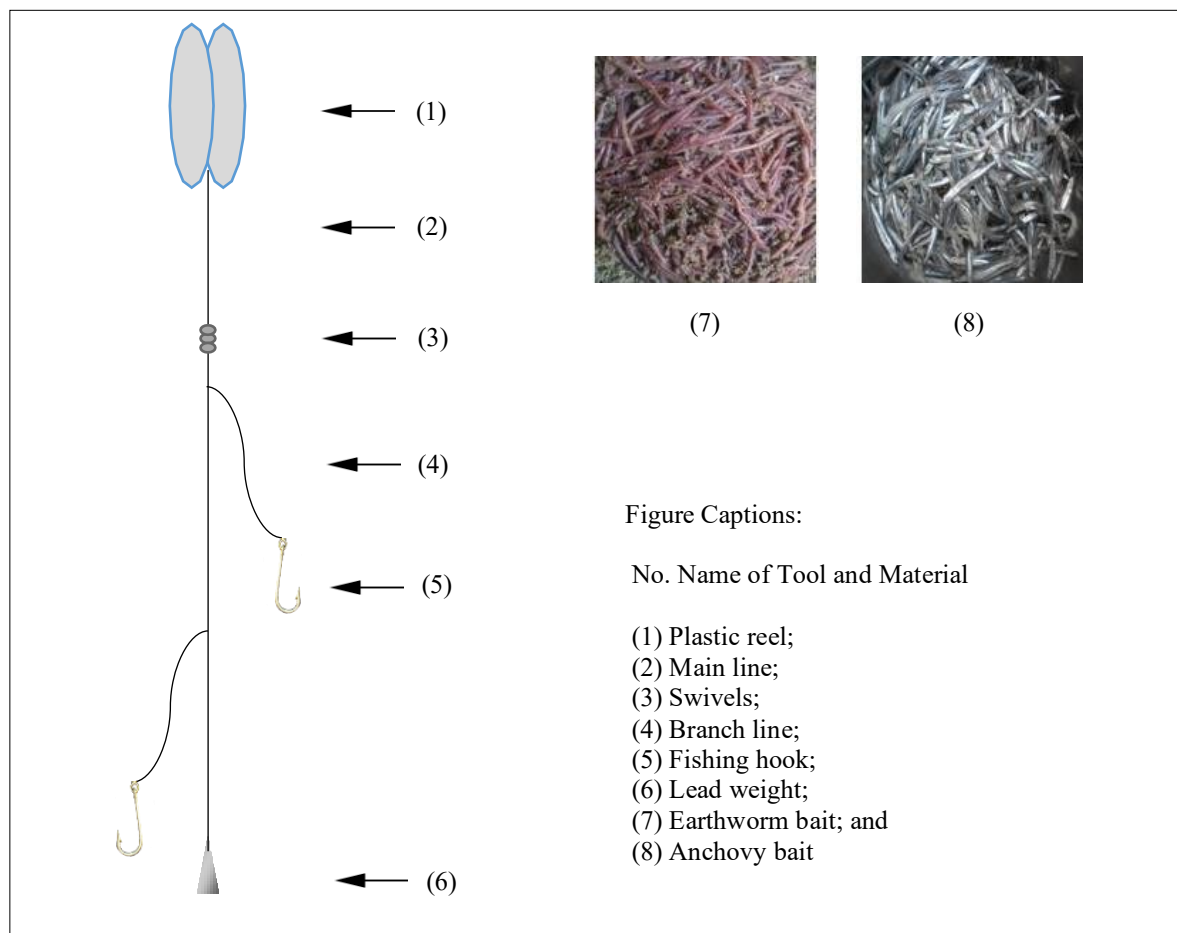


Figure 2. Construction of the Longline and Bait

RESULTS AND DISCUSSION

The total catch of bijinangka fish using worms and anchovies as bait during the study was 410 fish. Figure 3 shows the catch results for bijinangka fish (*Upeneus moluccensis*) that the number of bijinangka fish caught using worms as bait was

209 fish between 07:00 a.m. and 10:00 a.m. WIT and 64 fish between 02:00 p.m. and 05:00 p.m. WIT. Meanwhile, using anchovy bait, 105 fish were caught between 07:00 a.m. and 10:00 a.m. WIT, while only 32 were caught between 02:00 p.m. and 05:00 p.m. WIT.

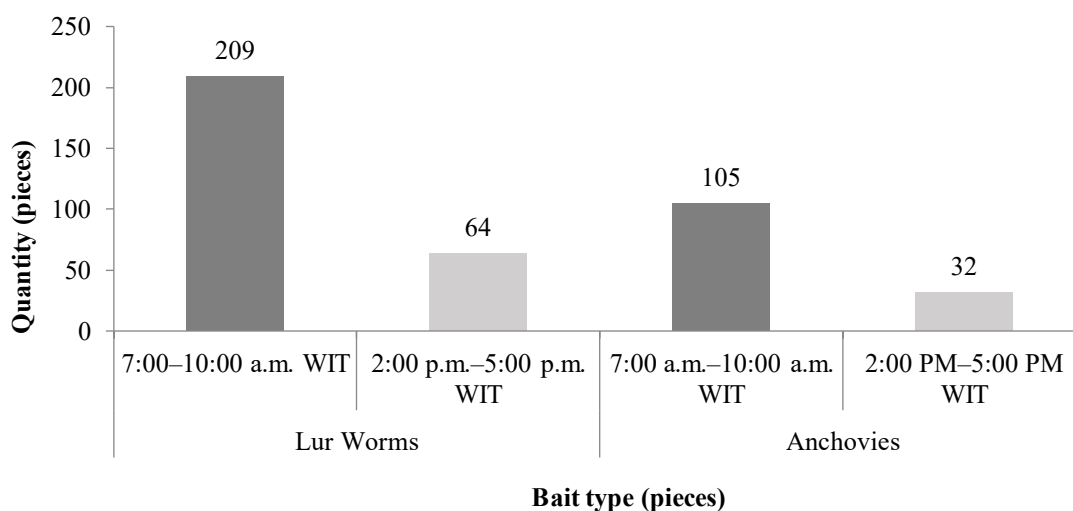


Figure 3. Graph of Catch Results Based on Bait Type and Fishing Time

These data demonstrate that bijinangka fish are highly attracted to both types of bait and tend to feed in schools, resulting in relatively high catch yields (Asriyana, 2011).

Furthermore, Aydin & Akyol (2016) noted that worms and anchovies yield high catch rates. However, worms are often considered superior because they combine a soft texture with a scent that bijinangka fish on the seafloor find highly appealing. Moreover, both bijinangka fish and worms inhabit the seafloor, so bijinangka fish respond more quickly to worms because they are a familiar natural food source. Rahaningmas (2025) further clarifies that differences in bait types such as worms and anchovies have a significant impact on the catch of demersal fish, specifically bijinangka.

The graph shown in Figure 3 regarding fishing times indicates that the highest catch of bijinangka fish occurred in the morning from 7:00 a.m. to 10:00 a.m. WIT totaling 314 fish (the sum of 209 caught using worms and 105 caught using anchovies). Meanwhile, between 2:00 PM and 5:00 PM WIT, the catch totaled only 96 fish (64 from worms and 32 from anchovies).

This indicates that bijinangka fish are actively foraging in the morning because the water temperature is still cool and the sunlight is not yet too bright, encouraging the fish to emerge from their hiding places to engage in more aggressive feeding behavior (Notanubun *et al.*, 2024). Furthermore, research by Rahaningmas (2025) demonstrates that the best time to fish for bijinangka (*Upeneus moluccensis*) is in the morning (around 7:00–10:00 WIT).

The Most Effective Combination of Fishing Time and Bait Type for Catching Bijinangka Fish (*Upeneus moluccensis*)

Data on bijinangka catch results based on different bait types and fishing times can be seen in Figure 4, which shows

that earthworms yield a higher catch of bijinangka compared to anchovies. Additionally, fishing in the morning is more effective for obtaining a larger catch than fishing in the afternoon. This aligns with the findings of Iriansyah *et al.* (2023), who reported that the most effective time for fishing is at 8:00 a.m. Furthermore, the Bijinangka catch data were estimated, and the results of these estimates based on a combination of bait types and fishing times over a 24-day period are shown in Figure 5.

The estimation results show that worms were the most effective bait for catching the highest number of bijinangka fish in the morning between 7 and 10 fish per day while in the afternoon, the catch ranged from 1 to 4 fish per day. Meanwhile, anchovy bait yielded a morning catch of bijinangka fish ranging from 3 to 6 fish per day. In the afternoon, the catch was only 1 to 2 fish per day.

Analysis of the Combination of Fishing Times and Bait Types in the Catch of Bijinangka Fish (*Upeneus moluccensis*)

The results of the between-subjects factor analysis show the distribution of the number of observations based on two independent factors: bait type and fishing time. The first factor is bait type, consisting of two categories: worms and anchovies, each with 48 observations. The second factor is fishing time, which is also divided into two categories morning and afternoon with an equal number of observations: 48 for each category.

Thus, the research design used a between-subjects approach, ensuring that each combination of categories had a balanced number of observations. Ilovs for the analysis of the main effects of bait type and fishing time, as well as the interaction between the two, on the measured response variable. Levene's test for equality of error variances a,b was conducted using SPSS, and the results are shown in Table 1.

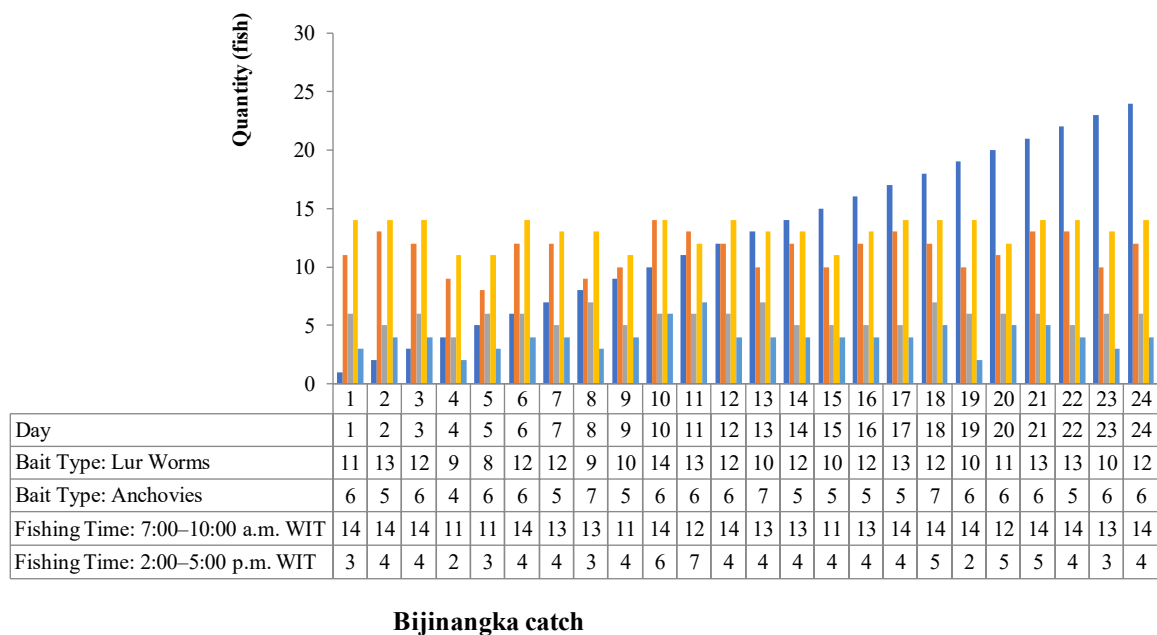


Figure 4. Catch Data for Bijinangka Fish (*Upeneus moluccensis*)

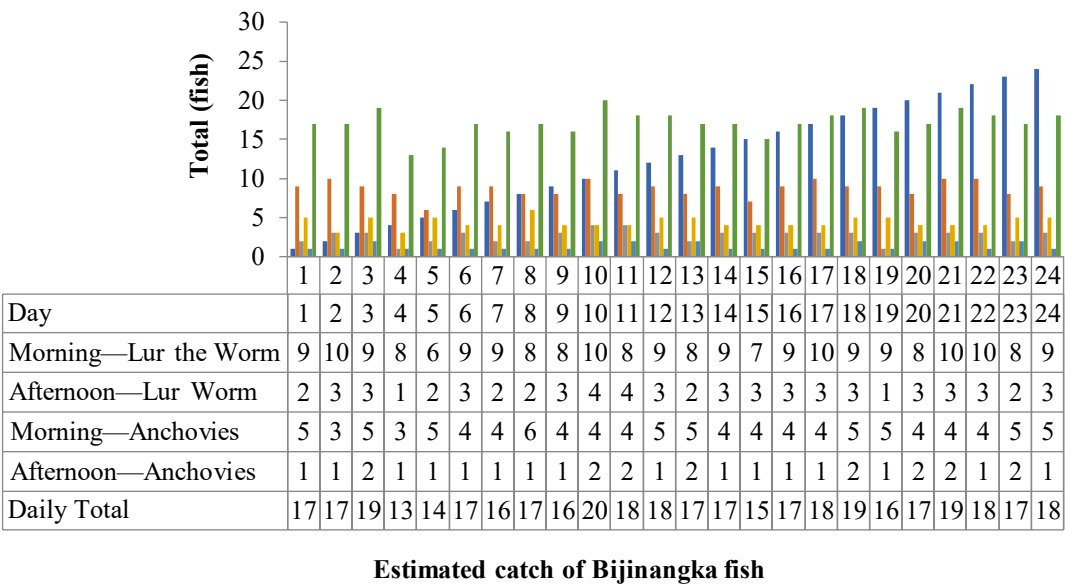


Figure 5. Estimated Catch Quantities of Bijinangka Fish (*Upeneus moluccensis*)

Table 1. Levene’s Test for Equality of Error Variances a, b

Levene’s Test of Equality of Error Variances ^{a, b}					
		Levene Statistic	df1	df2	Sig.
Total Fish Catch	Based on Mean	5,761	3	92	0.001
	Based on the Median	3,164	3	92	0.028
	Based on the median and with adjusted degrees of freedom	3,164	3	76,560	0.029
	Based on the trimmed mean	5,606	3	92	0.001
Tests the null hypothesis that the error variance of the dependent variable is the same across groups.					
a. Dependent variable: Total Fish Catch					
b. Design: Intercept + Bait + Time + Bait * Time					

The results of Levene’s test indicate that the variance in total fish catch differs significantly among the groups combining bait type and fishing time. Although the homogeneity assumption was not met in this study, data analysis could still proceed because the sample sizes across groups were equal (48 per group), making ANOVA relatively robust (safe to use even when certain assumptions are violated) against violations of homogeneity (Usmadi, 2020).

Subsequently, testing continued with the Between-Subjects Effects Test. The results of the Two-Way ANOVA on the number of fish caught showed a significant effect of both independent factors (Bait Type and Fishing Time) as well as their interaction on the dependent variable (Number of Fish Caught).

The Bait factor had a significant effect ($F(1,92) = 309.897, p < 0.001$), with a partial eta-squared value of 0.771, indicating that bait type explains approximately 77.1% of the variation in the number of fish caught. The Fishing Time factor was also significant ($F(1,92) = 791.890, p < 0.001$), with a partial eta-squared of 0.896, meaning that fishing time explains approximately 89.6% of the variation in the number of fish caught. The interaction between Bait and Fishing Time was significant ($F(1,92) = 65.533, p < 0.001$) with a partial eta-

squared of 0.416, indicating a combined effect of bait type and fishing time on catch volume . However its contribution was smaller than the main effects of each factor. The R-squared value of 0.927 (adjusted R-squared = 0.925) indicates that the ANOVA model explains approximately 92–93% of the total variation in fish catch, demonstrating that this model effectively captures the effects of the factors under study.

Further analysis of the Bait Type and Fishing Time factors revealed clear differences in catch quantities among combinations of bait types and fishing times, confirming the results of the previous Two-Way ANOVA interaction test, namely: Fishing with a handline using earthworms in the morning yielded an average catch of 8.63 fish (95% CI: 8.30–8.95).

In contrast, fishing in the afternoon yielded only 2.75 fish (95% CI: 2.43–3.07). These results indicate that the effectiveness of earthworms is significantly higher in the morning than in the afternoon. Fishing with anchovy bait in the morning yielded an average catch of 4.46 fish (95% CI: 4.14–4.78). In contrast, afternoon fishing yielded only 1.21 fish (95% CI: 0.89–1.53). In conclusion, the effectiveness of anchovies is also higher in the morning, although the catch is lower than that of earthworms. An analysis of interactions reveals that the

difference in catch between morning and afternoon is greater for earthworms than for anchovies.

This indicates that the effect of bait type on catch volume depends on fishing time, meaning that the interaction between bait and fishing time is significant and practically important. Overall, these data confirm that, to achieve maximum catch, earthworms in the morning are the most effective combination, while anchovies in the afternoon yield the lowest results.

The results of the study show that bait type and fishing time have a significant effect on the number of fish caught, and there is a significant interaction between these two factors. This is evident from the results of the Two-Way ANOVA, which show significant F-values for the Bait factor ($F(1,92) = 309.897$, $p < 0.001$) and the Time factor ($F(1,92) = 791.890$, $p < 0.001$), as well as the interaction between bait and time ($F(1,92) = 65.533$, $p < 0.001$).

The partial eta-squared values for each factor indicate a substantial contribution to the variation in catch numbers, with Time (0.896) and Bait (0.771) having a more dominant influence than the interaction (0.416). This confirms that although an interaction occurs, the main effects of fishing time and bait type remain key factors in determining catch results.

The results of the two-way ANOVA indicate that time has a stronger influence than bait type in determining catch volume. This aligns with the findings of Salote *et al.* (2023), who stated that the most effective time for fish to forage is between 6:00 and 7:00 a.m.

Furthermore, the partial eta-squared values indicate that time contributes significantly more than bait to the variation in catch numbers. These two values confirm that although an interaction occurs, the key factors in determining catch results are fishing time and bait type.

CONCLUSION

Based on the research results, it can be concluded that bait has a significant effect on catch yield. Furthermore, fishing time also has a significant effect on catch yield, and there is variation in the number of fish caught. Additionally, the combination of bait and time has a highly significant effect, indicating that both bait type and fishing time influence catch yield. Furthermore, the most effective combination of bait and time for catching bijinangka fish is fishing in the morning using worms as bait.

ACKNOWLEDGMENTS

Acknowledgments are extended to the line fishermen who assisted the author in conducting the Bijinangka fish catch operations

REFERENCES

- Alwi, D., Wahab, I., Safar, F., & Rahman, I. (2024). Analysis of the Relationship Between Length and Weight of Biji Nangka Fish (*Upeneus vittatus*) Caught in the Waters of Imam Lastori Port, Morotai Island Regency. *Jurnal Segara*, 19(1), 65–70.
<http://dx.doi.org/10.15578/segara.v19i1.14187>
- Alwi, D., Wahab, I., Safar, F., & Asy'ari. (2025). Feeding Habits and Sex Ratio of Jackfruit Fish (*Upeneus vittatus*) Caught in the Waters of Imam Lastori Port, Morotai Island Regency. *Hikamatzu Journal of Multidiscipline*, 2(2), 175–183.
<https://yasyahikamatzu.com/index.php/hjm/about>
- Aydin, I., & Akyol, O. (2016). Northernmost Record of *Upeneus moluccensis* (Bleeker, 1855) (Osteichthyes: Mullidae) along the Turkish Coast of the Aegean Sea. *Turkish Journal of Fisheries and Aquatic Sciences*, 16(3), 749–752
- Asriyana. (2011). Trophic Interactions of Fish Communities as a Basis for Fish Resource Management in the Waters of Kendari Bay, Southeast Sulawesi. [Doctoral dissertation]. Graduate School, Bogor Agricultural University. Bogor. 106p.
- Salote, F.H., Luasunaung, A., Labaro, I.L., Patty, W., Mandagi, I.F., & Modaso, V.O.J. (2023). A Study on Bait Types and Catching Times for Kuwe Fish Fry Using Bamboo Fishing Rods. *Journal of Capture Fisheries Science and Technology*, 8(2), 73–77
- Giovani, N. A., Putra, I.D.N.N., Puspitha, N.L.P.R. (2025). Estimation of CPUE (Catch Per Unit Effort) and the Maximum Sustainable Yield of Tongkol Fish (*Auxis* sp.) Landed in Seraya Timur Village. *Journal of Marine Research and Technology*, 8(2), 229–237
- Hariato, W., Mairizal., & Arfian, B.M. (2025). The Effect of Fishing Time on Catch Yields Using Tempirai Fishing Gear in Kedotan Village, Sekernan Subdistrict, Muaro Jambi Regency. *Mantis Journal of Fisheries*, 2(3), 170–179
- Iriansyah, Wati, E.F., & Hafizah. (2023). The Effect of Operational Time and Different Bait Types on Catch Yields Using Wire Stage Traps in the Swamp Waters of Marampiau Village, Tapin Regency. *Proceedings of the National Seminar on Wetland Environment*, 8(3), 49–58
- Nabutaek, M.A.L., Risamasu, F.J.L., & Eoh, C.B., (2020). Analysis of Trolling Catch Results from Different Fishing Fleets Operating in the Timor Sea. *Jurnal Bahari Papadak*, 1(1), 26–34
- Nirmala, D., Latinsani, A., & Kusdarwati, R. (2025). The Effect of the Distribution Channel for Jackfruit Fish (*Upeneus moluccensis* Blkr.) on Microbial Contamination at the Nusantara Brondong Fishing Port. *Department of Aquaculture, Bangka Belitung University*, 10(2), 148–152
- Notanubun, J., Thenu, I. M., Ngamel, Y. A., & Rahantan, A. (2024). Analysis of Species Diversity in Bottom Gillnets According to Catch Time in the Waters of Labetawi Village, Tual City. *Journal of Fisheries*, 14(1), 203–214
- Rahaningmas, J., M. (2020). The Effect of Different Hook Designs on Catcherfish Catch Yields. *IPTEKS PSP Journal*, 7(14), 116–126.
<https://doi.org/10.20956/jipsp.v7i14.10855>
- Rahaningmas, J., M. (2025). Response of Bijinangka Fish (*Upeneus moluccensis*) to Different Baits and Hook Designs. *Jurnal SaintekPerikanan: Indonesian Journal of Fisheries Science and Technology*, 21(4), 284–289
DOI: [10.14710/ijfst.21.4.284-289](https://doi.org/10.14710/ijfst.21.4.284-289)
- Sabrah, M.M. & El-Ganainy, A.A. (2009). Observations on the Biological Traits of the Striped Goatfish (*Upeneus vittatus*) and the Freckled Goatfish (*Upeneus tragula*) from the Gulf of Suez, Egypt. *World Journal of Fish and Marine Sciences* 1(2), 121–128
- Ünlüoğlu, A., Cihangir, B., Kaya, M., & . (2002). Variations in the feeding intensity and diet composition of red mullet

- (*Mullus barbatus*) during a 24-hour period in the summertime in Hisarönü Bay: *Journal of the Marine Biological Association of the United Kingdom*, 82(3), 527–528
- Usmadi. (2020). Testing Analytical Assumptions (Homogeneity and Normality Tests). *Educational Innovation*, 7(1), 50–62
- Uspar., Djamil, C., Firmansyah, M., & Jaswan. (2024). Analysis of Hand Line Catch Landed at the Pangkalan PPI Lappa Port. *Tarjih: Fisheries and Aquatic Studies*, 4(2), 102–109
- Wahyuni, M.G., Noor, M.T., & Saraswati, E. (2025). Analysis of the Environmental Friendliness of Hand Line Fishing Gear in Octopus (*Octopus* sp.) Fishing in the Southern Waters of Bali. *Zebra: Journal of Animal Science and Animal Husbandry*, 3(2), 31-48.
<https://doi.org/10.62951/zebra.v3i2.260>