Int. j. adv. multidisc. res. stud. 2024; 4(4):713-716

Received: 17-06-2024
Accepted: 27-07-2024

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Analysis of the Status of Sustainable Utilization and Management of Flyfish (Decapterus russelli) Resources in Pasongsongan Waters, Sumenep Regency using the Walter-Hilborn Model

[1] **Kamaruddin Hidayat,** [2] **Akhmad Farid,** [3] **Teti Sugiarti**
[1, 2, 3] Magister Pengelolaan Sumber Daya Alam, Universitas Trunojoyo, Madura, Indonesia

DOI: https://doi.org/10.62225/2583049X.2024.4.4.3097
Corresponding Author: **Akhmad Farid**

Abstract
Flyfish (Decapterus russelli) is a small pelagic fish with a fairly high economic value. Flying fish are the fish with the highest production landed at the Pasongsongan Beach Fisheries Port, Sumenep Regency. In recent years, the production of flying fish in Pasongsongan has continued to decline, excessive fishing activities and an increase in the number of fleets are feared to interfere with the sustainability of flying fish resources. Therefore, sustainable management of flyfish resources needs to be carried out, the purpose of this study is to find out the sustainable potential of flyfish resources, to know the number of catches allowed, and to know the status of the utilization of flyfish resources in Pasongsongan waters. The methods used in this study are quantitative and qualitative methods. The analysis used is a surplus production approach using 3 models, namely the Schaefer model, the Fox model and the Walter-Hilborn model. The results of the analysis using the Walter Hilborn model are a surplus production model that is suitable for use with a maximum catch value (Ymsy) of 2,255 tons and a permissible catch (JTB) of 1,804 tons, the utilization rate of flying fish landed in PPP Pasongsongan is 87% with the utilization status in the Fully Exploited category, where in this condition illustrates that the stock of resources has been exploited by 75-100%. An increase in the number of fishing efforts is not recommended even though the number of catches can still increase because it will interfere with the sustainability of fish resources.

Keywords: Flycatch, Utilization Status, Sustainable Management, *Walter-Hilborn*

1. Introduction

The optimal utilization of marine fishery resources is a demand for people's lives, especially to improve the welfare of fishermen, meet the nutritional needs of the community, and expand jobs, as well as to increase the country's foreign exchange through exports (Ketjulan *et al*, 2022) [4]. The open access nature of ocean resources causes many irresponsible fishing activities and ignores environmental sustainability. For most of the people of Pasongsongan, the fishing profession is the main choice because they think that fishing is a job inherited by their ancestors, besides that because of the limited job opportunities on the mainland. The open access nature of ocean resources leads to many irresponsible fishing activities and neglect of environmental sustainability. For most of the people of Pasongsongan, the fishing profession is the main choice because they think that fishing is a job inherited by their ancestors, besides that because of the limited job opportunities on the mainland. The decline in fly fish production in the Pasongsongan PPP consecutively occurred from 2018 to 2021 indicates high fishing activity, this will have an impact on the stock of flying fish over time will run out. For this reason, in the context of the sustainability of flyfish management, it is necessary to conduct an assessment of sustainable potential, the number of catches allowed, and the level and status of their utilization so that it can be used to determine policy strategies for the management of flyfish in Pasongsongan waters in the future. Fisheries resource management is a very important issue to pay attention to, the form of fisheries resource management is not only in the form of written rules, but also in the form of rules that are sourced from habits or customs that have been running for generations, or local wisdom, therefore the analysis of these forms of local wisdom is important to know, so that it can continue to run and indirectly also have a positive impact on management fish resources in the future.

2. Learning Area

This research was conducted in the waters of Pasongsongan, Sumenep Regency, East Java. According to the annual report of PPP Pasongsongan (2022), Pasongsongan District is located on the North coast of Madura, UPT. PPP Pasongsongan is located at coordinates 6,886,304 and 113,654,814, with a geographical location of 135 Km from the city of Surabaya, and approximately 38 Km from the city of Sumenep Regency. UPT. PPP Pasongsongan is very strategic as a fishing port, because it is located close to the main section of Pantura. So that it can become the main choice of transportation and trade facilities.

3. Data Collection

The data collection techniques or methods in this study include primary data and secondary data. Primary data is data obtained directly from the first source at the place of research activities. The data was obtained from the results of further management through interviews with related parties as resource persons. Meanwhile, secondary data is data obtained indirectly that has been processed previously and presented well by the primary data collector.

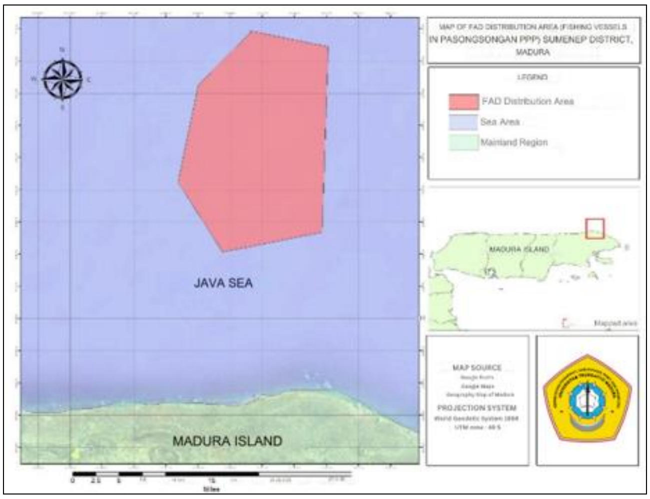

Fig 1: Pasongsongan Waters

4. Index

This research was conducted using the Walter Hilborn model. The non-equilibrium state approach in this model estimates population parameters (r, k and q) so that the estimation is more dynamic and closer to reality in the field. Walter-Hilborn stated that the biomass in the year (t+1) (Pt+1) can be expected from Pt plus the growth of biomass during the year minus the amount of biomass released. Based on the reference from Andriyanto (2015) [1], metamatically it can be written in the following equation.

$$P_{(t+1)} = P_t + \left[r \times P_t - \left(\frac{1}{d}\right) \times Pt^2\right] - q \times Et \times Pt$$

Where :

P(t+1): The amount of biomass stock at time
t+1 Pt: The amount of biomass stock at time t
r: Intrinsic growth rate of biomass stock (constant)
q: Arrest coefficient
Et: The amount of effort to exploit biomass in t.

The number of catches of the effort and the catch per unit of the catch effort (CpUE) under equilibrium conditions has the following equation:

$$E_0 = \frac{r}{2 \times q}$$

$$P_e = \frac{k}{2}$$

$$U_e = \frac{q \times k}{2}$$

Where:

r: Intrinsic growth rate of biomass stock (constant)
K: Environmental carrying capacity.

The value obtained based on the calculation using the Walter Hilborn model is then carried out by calculating the Number of Catches Allowed. According to Nugraha *et al*., (2012) [5], the allowable catch (JTB) is 80% of the maximum sustainable potential (MSY). The underlying thing is the principle of prudence in estimating fish resource stocks. so that fish resources remain sustainable. The formula for the value of the Number of Catches Allowed is as follows:

$$JTB = 80\% * MSY$$

Where:

MSY: Maximum sustainable catch (tons)
JTB: Allowable catch (tons)

According to Setyohadi (2009) [6], the value of the allowed catch is 80% of the sustainable potential of fish resources. With the percentage of the number of catches allowed between 70%-90% MSY, but to make it easier to choose a middle value of 80% MSY. Based on the results of the calculation of the JTB value, it is then continued by calculating the status of the utilization of fishery resources.
According to Cahyani *et al*., (2013) [3], the level of utilization of a fish resource can be known by the formula of the utilization rate as follows:

$$TP = \frac{ft}{JTB} \times 100$$

Where:

TP: Utilization rate (tons/year)
Ft: Average catch attempts (units)
JTB: Allowable catch (tons).

After knowing the percentage of the utilization rate, it is possible to determine the status of the waters based on FAO (1995) in Bintoro (2005) [2], which divides the status of fish resources into six groups:

a. Unexploited (0)
b. Lightly exploited (<25%)
c. Moderately exploited (25-75%)
d. Fully exploited (75-100%)
e. Over exploited (100-150%)
f. Depleted (>150).

5. Result

5.1 Flyfish Production (Decapterus russelli)

The production of flying fish landed at PPP Pasongsongan over the last 9 years, namely 2014-2022, has changed in number from year to year (Fig 2). The highest production of flying fish occurred in 2022 of 2,415.75 tons, while the lowest production of flying fish occurred in 2014 at 355.25 tons. The low catch in 2009 according to some fishermen and local port authorities is due to the small number of fishing fleets that carried out fishing operations that year.

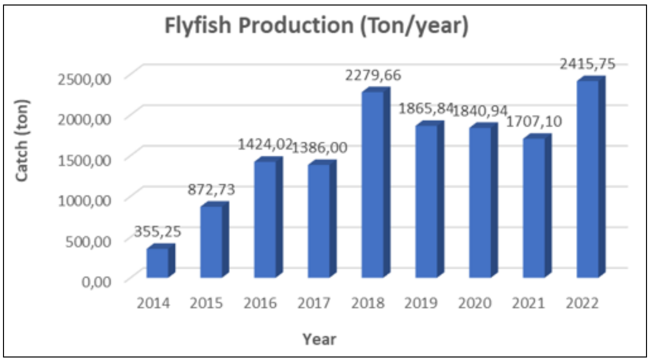

Fig 2: Flyfish Production in PPP Pasongsongan in 2014-2022

Effort data was obtained from the number of trips per fishing gear for 10 years from 2014 to 2022. The fishing gear used to catch kgliders at PPP Pasongsongan is purse seine fishing gear. Arrest efforts can be influenced by several factors, one of which is the number of arrest fleets. The following is a graph of the progress of efforts to catch purse seine fishing gear at PPP Pasongsongan.

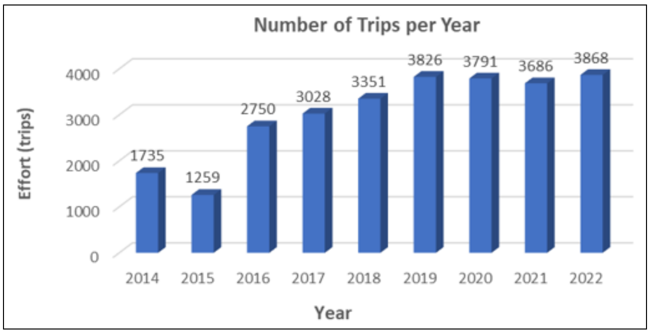

Fig 3: Development of Purse Seine Fishing Gear Catching Efforts in PPP Pasongsongan in 2014-2022

Based on the graph above, the number of arrest attempts has changed from year to year. Based on this, the CpUE value. The highest Purse Seine fishing attempt occurred in 2022 with a total of 3868 trips to catch it. According to several fishermen and local port authorities, the high fishing efforts that year were due to the increase in the number of fleets, and the entry of fishermen from neighboring sub-districts such as Pasean and Slopeng. Meanwhile, the lowest arrest attempt occurred in 2015 with a total of 1259 trips. This is because there is still a small number of fishing fleets that carry out arrest operations.

5.2 Catch per Catch Attempt Unit (CpUE)

Catch per unit effort or Catch per Unit Effort (CpUE) is a number that describes the comparison between the catch and the unit of catch effort. The CpUE value can be used to see the ability of a resource if it is exploited continuously. CpUE data was obtained from the production of flying fish and the number of trips of purse seine fishing gear for 9 years, namely from 2014 to 2022 (Fig 3).

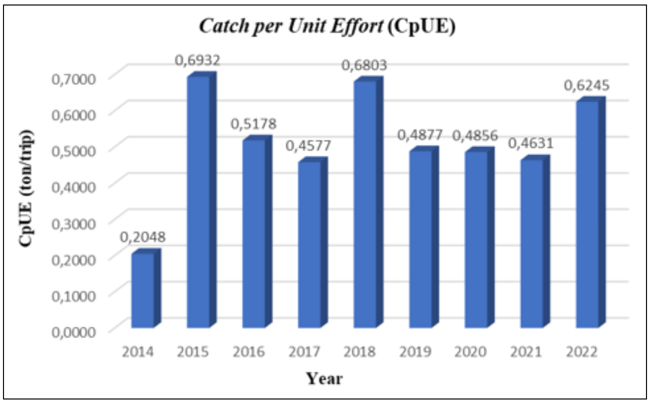

Fig 4: Results of CpUE of flyfish in PPP Pasongsongan in 2014-2022

The CpUE values above indicate volatile data. The highest CpUE value occurred in 2015 at 0.6932 tons/trip. The lowest CpUE value occurred in 2014, which was 0.2048 tons/trip. The value of CpUE depends on the number of catches and capture attempts. In 2015 there was an increase in fishing efforts but the catch decreased, causing the value of CpUE to decrease. The decline in CpUE is an indicator that the utilization of fish resources is high.

5.3 Analysis of the Walter-Hilborn Model

In this method, there is an estimation of each parameter, namely the potential of sustainable reserves (Be), is the intrinsic growth rate (r), the maximum carrying capacity of the water (k), and the ability of fish to be caught (q). To calculate the potential value of sustainable reserves (Be) from flyfish resources using the Walter-Hilborn model, production data (tons), fishing efforts (trip), and CpUE are needed. Data on The table is used on the Walter-Hilborn model 1, where in this method statistical analysis is carried out on two variables, namely variable 1 is CpUE (Ut), and variable 2 is effort (Ft).

Year	Flyfish production (ton)	Effort (Ft)	CpUE	Y (Ut+1/Ut)-1	X1 Ut	X2 Ft
2014	355.25	1735	0.20476	2.385486	0.20476	1735
2015	872.73	1259	0.6932	-0.25299	0.6932	1259
2016	1424.02	2750	0.51782	-0.11605	0.51782	2750
2017	1386	3028	0.45773	0.486236	0.45773	3028
2018	2279.66	3351	0.68029	-0.28314	0.68029	3351
2019	1865.84	3826	0.48767	-0.00424	0.48767	3826
2020	1840.94	3791	0.48561	-0.04628	0.48561	3791
2021	1707.1	3686	0.46313	0.348532	0.46313	3686
2022	2415.75	3868	0.62455			

The Walter-Hilborn model is method 1 with data as in the Table, then analyzed statistically through regression analysis. The results of this analysis are presented in the following table.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.957170875
R Square	0.916176084
Adjusted R Square	0.882646518
Standard Error	0.301326909
Observations	8

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	4.962000969	2.4810005	27.324424	0.002034
Residual	5	0.453989531	0.0907979		
Total	7	5.4159905			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
	3.761677019	0.509147908	7.3881812	0.0007144	2.452871	5.070483	2.452871	5.070483383
1	-5.10787538	0.752212206	-6.7904713	0.001054	-7.0415	-3.17425	-7.0415	-3.174252351
2	-0.00030711	0.000117816	-2.6066903	0.0478608	-0.00061	-4.3E-06	-0.00061	-4.25417E-06

Based on the results of the analysis above, it can be known that the value of R square, intrinsic growth rate (r), maximum carrying capacity (k), ability of fish caught (q), and potential sustainable reserves (Be) can be known. The results of the analysis using the Walter-Hilborn model method 1 produced an R Square (R2) value of 0.9161, meaning that 91.61% of the changes could be explained by changes X1 and X2, and 8.39% of the changes could be explained by other variables. The growth rate value (r) is 3.7616 % per year, the maximum environmental support value (k) is 3.7616 % per year, the b1 value is -51078 and b2 (q) is -0.0003 tons, and the value (k) is 2,397 tons/year. Then determine the potential value of sustainable reserves (Be) obtained from the calculation of the maximum carrying capacity value (k) divided by half and obtained a result of 1,198 tons/year.

5.4 Estimation of Utilization Status

Status of the utilization of flying fish landed at UPT. PPP Pasongsongan Sumenep using the Walter Hilborn model shows the condition of Fully exploited status. To determine the most suitable and good model, it can be seen from the highest R Square value. The R Square value on the Walter Hilborn model is 0.9161. So it can be concluded that the Waltern Hilborn model is an appropriate model, which is based on the number of permissible catches of 1,804,086 tons while the utilization rate is 87%, which means that the utilization status of flying fish landed at the Pasongsongan PPP is at the status of Fully Exploited or the stock of resources has been exploited 75-100%.

6. Conclusion

According to the results of the analysis using the waltern - hilborn method, the maximum catch value is 2727.6 tons/year. The amount of catch allowed according to Walter Hilborn's analysis is 2182.1 tons/year. The status of the utilization of flyfish resources according to the results of Walter Hilborn's analysis is Fully exploited. Arrest efforts should be reduced, because the utilization status estimation model has shown the Fully exploited category. There needs to be a policy formulation related to the implementation of the number of catches allowed.

7. References

1. Andriyanto. Pengelolaan Sumberdaya Ikan Tongkol (Euthynus Sp) di Selat Madura yang di daratkan di Kabupaten Situbondo Jawa Timur. Skripsi. Fakultas Perikanan dan Ilmu Kelautan. Universitas Brawijaya. Malang, 2015.
2. Bintoro Gatut. Pemanfaatan Berkelanjutan Sumberdaya Ikan Tembang (Sardinella fimbriata Valenciennes, 1847) di Selat Madura Jawa Timur. (Disertasi). Institut Pertanian Bogor. Bogor, 2005.
3. Cahyani RT, Sutrisno A dan, Bambang Y. Potensi Lestari Sumberdaya Ikan Demersal (Analisis Hasil Tangkapan Cantrang yang Didaratkan di TPI Wedung Demak). Universitas Diponegoro. Semarang. Prosiding Seminar Nasional Sumberdaya Alam dan Lingkungan 2013, 2013.
4. Ketjulan R, Pratikino AG, Erawan MTF. Demplot Budidaya Ikan Kakap Putih di Masa Pandemik Covid-19 Menggunakan Karamba Jaring Tancap (KJT) di Desa Samajaya, Kabupaten Konawe, Provinsi Sulawesi Tenggara. Jurnal Pengabdian Meambo. 2022; 1(1):8-15.
5. Nugraha Ershad B, Koswara Yunianti. Potensi Lestari dan Tingkat Pemanfaatan Ikan Kurisi (Nemipterus Japonicus) di Perairan Banten. Universitas Padjajaran. Bandung, 2012.
6. Setyohadi D. Studi Potensi dan Dinamika Stok Ikan Lemuru (Sardinella lemuru) di Selat Bali Serta Alternatif Penangkapannya. Jurnal Perikanan. 2009; 11(1):78-86.