

Trekfish in tracing the paths of flying fish roe in the Makassar Strait

Rini Sahni Putri^{1,2}, Indra Jaya^{3,*}, Sri Pujiyati³, Syamsul Bahri Agus³, and Mahfud Palo⁴

¹Marine Technology Study Program, Faculty of Fisheries and Marine Science, Postgraduate Bogor Agricultural University, 16680 FPIK Building, IPB Dramaga Campus Bogor West Java, Indonesia

² Fisheries Science Study Program, Faculty of Science and Technology, Universitas Muhammadiyah Sidenreng Rappang, 91651 Kampus UMS Rappang Maccorawalie Sidenreng Rappang South Sulawesi, Indonesia

³ Department of Marine Science and Technology, Faculty of Fisheries and Marine Science, Bogor Agricultural University, 16680 FPIK Building, IPB Dramaga Campus Bogor West Java, Indonesia

⁴ Utilization of Fishery Resources Study Program, Faculty of Marine Science Fisheries, Hasanuddin University, 90245 Jl. Perintis Kemerdekaan Km.10, Makassar South Sulawesi, Indonesia

Abstract. It is very important to know the route of searching for flying fish eggs as information for the next trip and to find out their whereabouts. The existence of flying fish eggs is one of the important agendas at this time, where the available information is still minimal. This article attempts to show the fishing line for flying fish eggs through the use of TrekFish in the Makassar Strait. Fishing paths for flying fish eggs were extracted and mapped using ArcGIS 10.8. Fishing line mapping shows fishing vessel trips per day in each fishing period.

1 Introduction

Information on fishing routes for flying fish eggs is one of the important things in the fisheries sector today. Flying fish eggs have become a concern in the fisheries sector, because they have quite high economic value. Flying fish eggs have a high protein content of around 59.69% [1]. The high protein content in fish can be an economic resource, as a protein or amino acid supplement or can be used as feed. Production of flying fish eggs in Indonesia currently exceeds 800-900 tons and continues to grow [2].

Flying fish egg resources are one of the things that need to be considered, where their existence can contribute to economic development in a region. Apart from that, the presence of flying fish eggs is only in certain water areas. Several studies have revealed the presence of flying fish eggs in Indonesian regions, such as the Makassar Strait [3, 4], Maluku waters [5], Flores Sea [6, 7]. Until now, these waters have become the main area producing flying fish eggs in Indonesia. Information on the whereabouts of flying fish eggs can continue to be monitored for conservation and management purposes. One technology that can be used is the use of TREKFish in monitoring the path of flying fish eggs via flying fish egg catching vessels.

* Corresponding author: indrajaya@apps.ipb.ac.id

TREKFish is a tool used to record ship positions periodically so that it can produce fishing route information in the form of points, time and speed of ship movement. The dynamics of vessel movements in fishing activities can be monitored spatially and temporally using TREKFish or Vessel Tracking System. This system can record ship locations at regular time intervals [8]. This technology is considered capable of assisting in monitoring the movement of fishing vessels for fisheries conservation and management purposes. This research provides an overview of the route for catching flying fish eggs using TREKFish technology on flying fish egg catching vessels in the Makassar Strait.

2 **Methods.**

2.1 Time and location of research

This research was carried out in February-June 2023 in the waters of the Makassar Strait with a fishing base in Pambusuang Village, Balanipa District, Polewali Mandar Regency, West Sulawesi Province, as shown in Figure 1. The fishing trip in May 2023 corresponds to the flying fish egg season. The Makassar Strait is a strait located between the islands of Kalimantan and Sulawesi in Indonesia. Data collection uses TREKFish technology to obtain data on the point and time of catching flying fish eggs in the Makassar Strait.

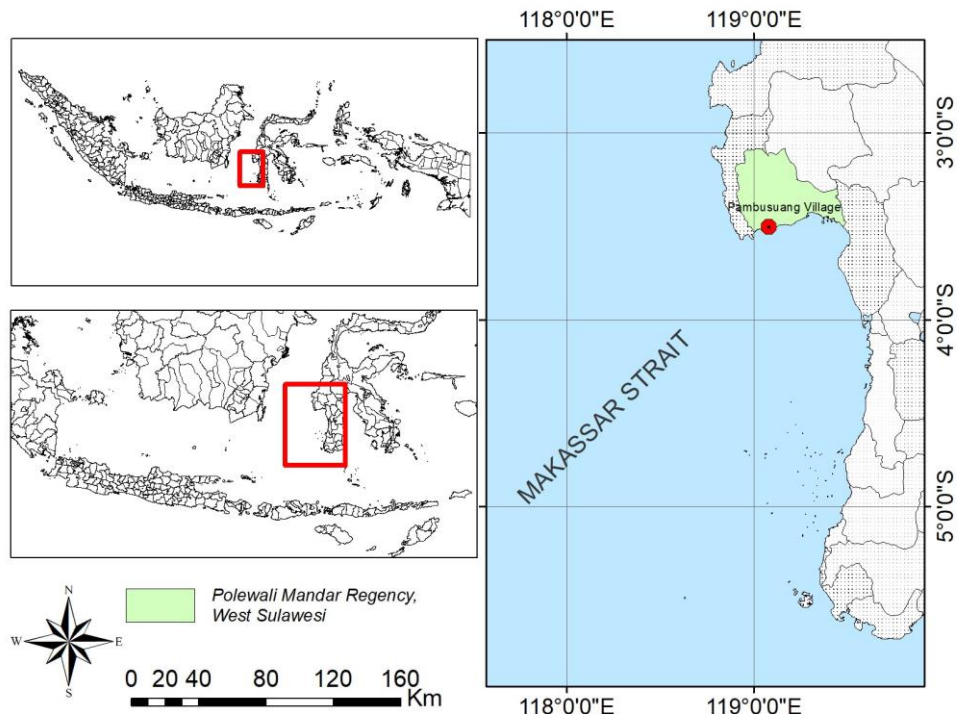


Fig. 1. Research Location.

2.2 TREKFish data

TREKFish data is data on the routes of ships catching flying fish eggs in the waters of the Makassar Strait. The fishing location is identified based on ship speed data. TREKFish

technology monitors the position of fishing vessels in almost real time [9]. TREKFish data provide invaluable information about the spatial and temporal patterns depicted by fish exploration activity at various scales [10].

This technology is widely used in increasing the effectiveness of fish resource management through controlling and monitoring fishing vessels, increasing the efficiency and effectiveness of fisheries business management, increasing fishing vessels' compliance with applicable regulatory provisions, as well as obtaining data and information on fishing vessel activities in the framework of responsible fish resource management. responsible and sustainable. This system can record ship locations at regular time intervals [8].

2.3 Cathes data

Flying fish egg catch tracks were obtained from flying fish egg catching vessels in the waters of the Makassar Strait, with the fishing base located in Pambusuang Village, Balanipa District, Polewali Mandar Regency, West Sulawesi, Indonesia (Figure 1). The length of fishing trip varies from 5-10 days based on weather considerations and the catch obtained.

2.4 Data analysis

Flying fish egg fishing routes were extracted and mapped using ArcGIS 10.8. Fishing route mapping shows the general journey of fishing vessels based on all routes taken by research vessels and also shows daily catch routes in each fishing trip. Mapping the fishing channels provides an overview of the presence of flying fish eggs in the waters of the Makassar Strait during the spawning period.

3 Results and discussion

3.1 Time and location of research

TREKFish is an instrument used to trace the capture of aquatic resources which is equipped with software that can record point, time and speed data. In Indonesia, Vessel Traffic System (VTS) technology is used as a vessel monitoring system which must be installed and activated continuously on fishing vessels measuring more than 30 GT [11]. Preparation of the instrument begins by charging it (Figure 2b) which is indicated by a red light at the corner of the instrument (Figure 2c).

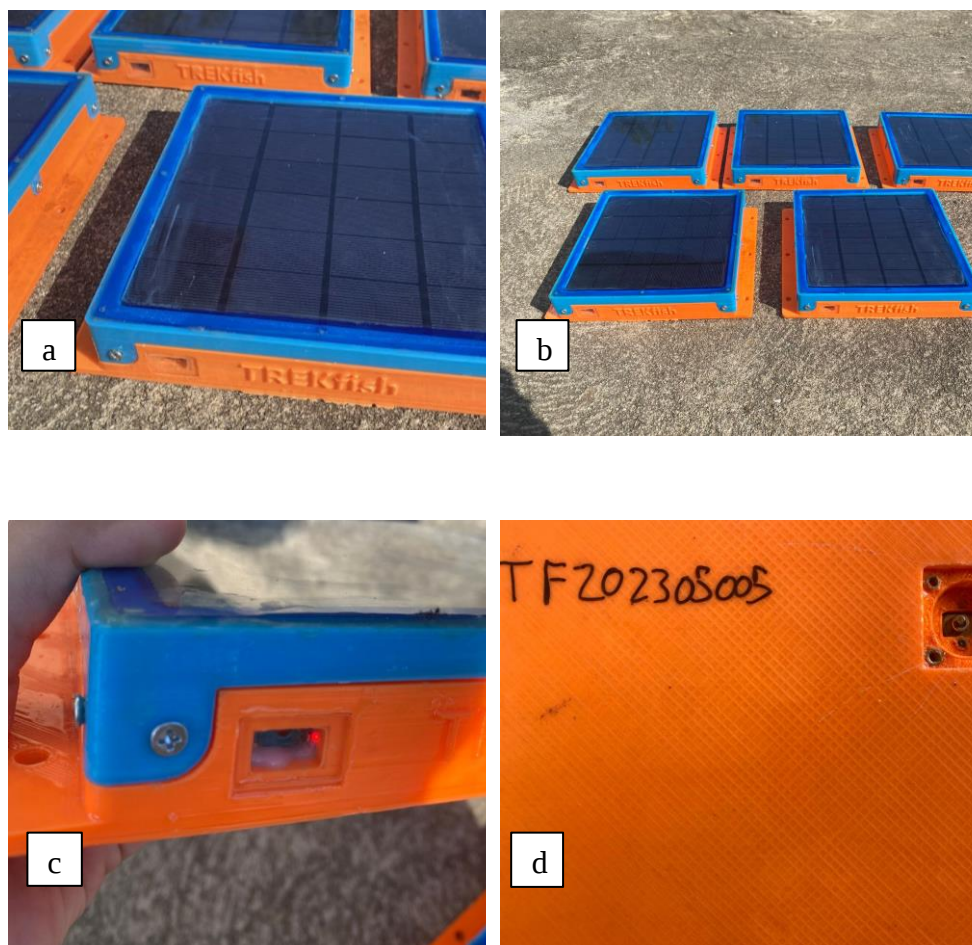


Fig. 2. TREKFish (a); Charging (b); Charging Light (c); Active & Inactive Panels (d)

The figure when installed and then activated (Figure 2d) when the vessel starts to depart for the fishing ground. When TREKFish is activated, the instrument will record data periodically from fishing base to fishing ground. This data will be saved and can be downloaded after the fishing trip is complete

Recording using TREKFish produces point, time and speed data per period. Furthermore, the resulting data can be interpreted through a mapping application for flying fish egg fishing routes. Flying fish fishing route information is used for the purposes of conservation and management of flying fish eggs. Continuous exploitation of flying fish eggs can have a negative impact on the sustainability of the resource if it is not monitored regularly. Fisheries management strives to preserve aquatic resources [12, 13].

3.2 General tracks

Fishing tracks are the routes that vessel follow in the activity of catching flying fish roe. Track recording is intended to provide fishing route information needed to realize

responsible, optimal and sustainable use of flying fish egg resources. Flying fish eggs are resources that are not available all year round. Based on information from several fishermen in the Makassar Strait, flying fish eggs are usually available in May-October each year. However, this time period may change, such as in 2023 fishermen will find that the production of flying fish eggs has decreased from the previous year.

In May, flying fish eggs began to be discovered in the waters of the Makassar Strait (around the Spermonde waters). Flying fish egg catching tracks were mapped based on 4 tracks recorded in the waters of the Makassar Strait. Track 1 is shown by a red line, track 2 is shown by an orange line, track 3 is shown by a blue line and track 4 is shown by a yellow line. Fishing activities are indicated to occur on repeated tracks in certain areas, as seen in Figure 3. The location where flying fish eggs are found is predicted to be a spawning area. The spawning area is the location where fish carry out the breeding process. Temperature intervals have an influence on the process of successful hatching of eggs and development of fish larvae [14, 15, 16, 17]. Suitable water temperatures encourage fish to spawn optimally [18]. Apart from water temperature, currents also have a major role in the level of spawning success by increasing or inhibiting larval retention in the spawning ground [17, 19, 20].

In June, it became difficult for fishermen to find flying fish eggs, in fact in the second week of June most fishermen stopped fishing for flying fish eggs because the income they earned was not able to cover the costs incurred in fishing activities.

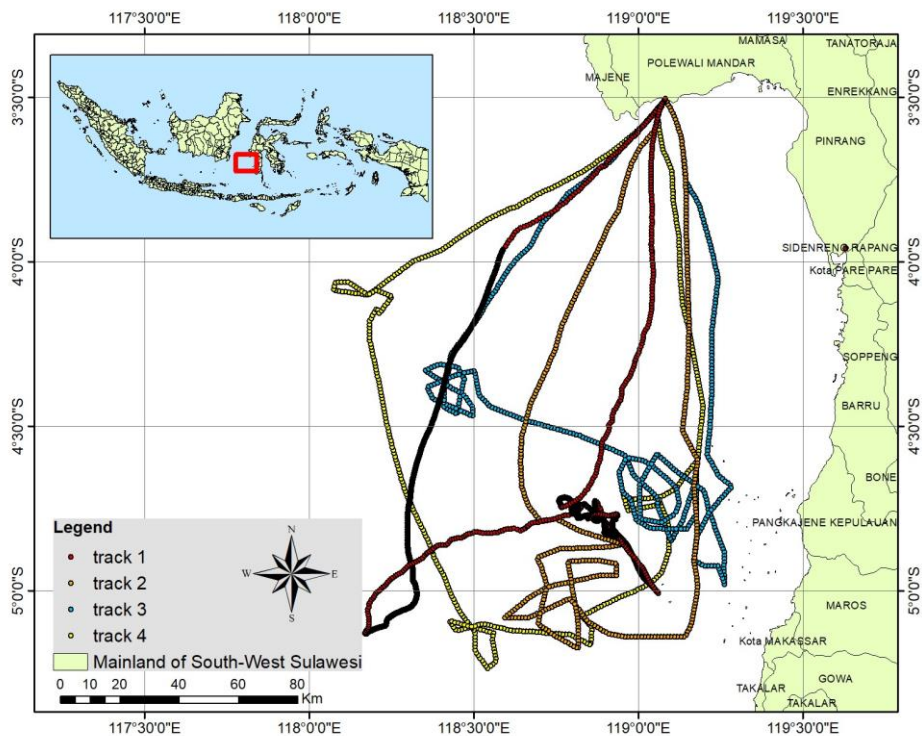


Fig. 3. General Tracks of TREKFish.

3.3 Daily tracks

3.3.1 Track 1

Track 1 lasts for 10 days starting on 16 May 2023-25 May 2023 showing the route for catching flying fish eggs starting on the red line and ending on the green line. Fishing activities that indicate the presence of flying fish eggs occur in the range of points 118°11' E - 119°04' E and 4°45' S - 5°12' S. This range of points indicates the spawning of flying fish that produce eggs. Flying fish eggs are usually attached to wooden sticks or floating objects on the surface of the water. Flying fish eggs are easy to see but they have a spawning season so they are not available all year round.

3.3.2 Track 2

Track 2 lasts for 10 days on 20 May 2023 - 29 May 2023 showing the route for catching flying fish eggs starting on the red line and ending on the green line. In contrast to track 1 which starts fishing further from land, the second track with a different ship shows a route through waters closer to land. However, fishing activity can be seen when the ship heads further away from land. Fishing activities indicating the presence of flying fish eggs occurred at a narrower point range and only one rotation, namely 118°35' E - 118°58' E and 4°52' S - 5°13' S.

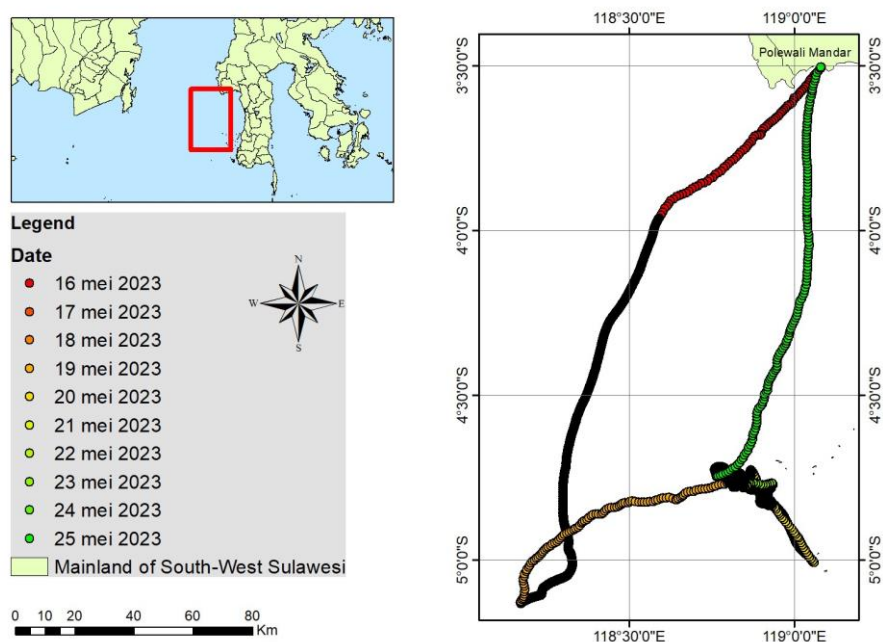


Fig. 4. Daily Track of Trip 1.

3.3.3 Track 3

Track 3 lasts for 10 days starting on 20 May 2023 - 29 May 2023 showing the route for catching flying fish eggs starting on the red line and ending on the green line. The movement pattern from leaving to returning to the fishing base is the same as track 1, starting in waters farther from land then heading closer to land.

Catching activity indicating the presence of flying fish eggs is shown in the range of points 118°18' E - 119°19' E and 4°21' S - 4°59' S. Catching activity is shown around the orange line and the yellow to green line young.

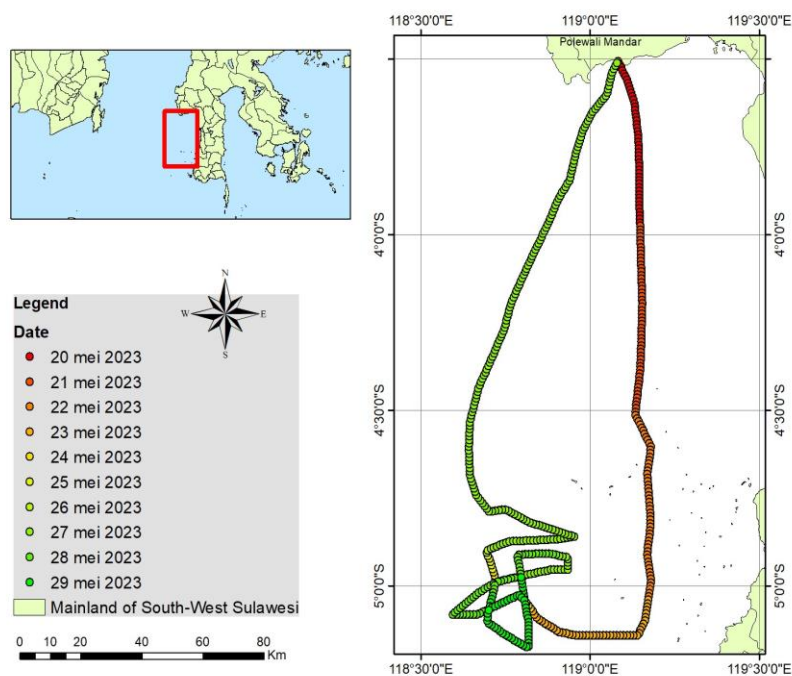


Fig. 5. Daily Track of Trip 2.

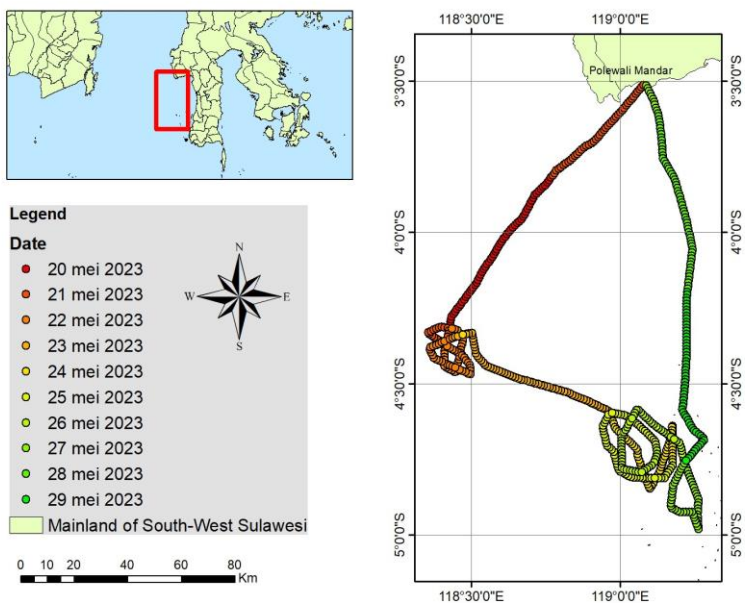


Fig. 6. Daily Track of Trip 3.

3.3.4 Track 4

Track 4 lasts for 5 days on 26 May 2023 - 30 May 2023 showing the route for catching flying fish eggs starting on the red route tracing outer waters, then heading to waters closer to the mainland of South Sulawesi and ending on the green route to Return to the fishing base in Pambusuang Village.

Fishing activities indicating the presence of flying fish eggs occurred at a wider point range, namely 118°04' E - 119°04' E and 4°03' S - 5°14' S. The presence of flying fish eggs is difficult to find so the search is carried out in a wider area, but in a shorter time. The search for flying fish eggs resulted in declining catches so that fishermen decided to stop fishing activities at the end of May 2023.

At the beginning of June 2023, there were still fishermen who tried to search for flying fish eggs but produced few catches and there were even fishermen who did not catch anything. The decline in fisheries production in several regions is caused by several factors, such as overexploitation, human population growth and climate change [21, 22, 23]. If not managed well, fishing pressure, climate change and other disturbances can threaten the sustainability of fish resources [23, 24]. Incompatibility between fisheries management and aquatic ecological processes can threaten the sustainability of fisheries resources and the lives of fishermen who are highly dependent on these resources [25, 26, 27]

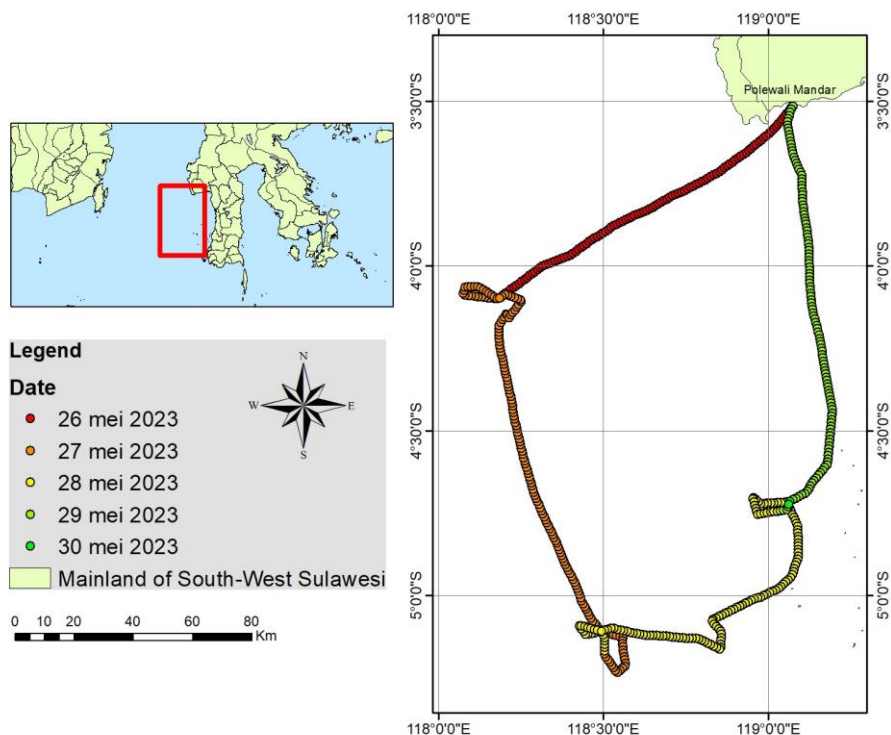


Fig. 7. Daily Track of Trip 4.

4 Conclusion

The presence of flying fish eggs was detected in the waters of the mainland area of South Sulawesi at points ranging between $118^{\circ}04' E$ - $119^{\circ}19' E$ and $4^{\circ}03' S$ - $5^{\circ}14' S$. At the end of May 2023, the presence of flying fish eggs was difficult to find, indicating a decline in flying fish egg production.

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