



Gorontalo Fishermen Knowledge Studies Related to Astronomy and the Movement of Fish in Tomini Bay

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Tomini Gulf coast inhabited by various ethnic groups in Indonesia, one of Gorontalo. The coastal area Gorontalo Tomini Bay stretches from the border Bone Bolango - Mongondow Bolaang South (North Sulawesi) to Pouhuwato - Parigi Moutong (Central Sulawesi). The purpose of this research for the inventory of local knowledge Gorontalo related to astronomy and movement of pelagic fish in the Gulf of Tomini. Based on this research, there is local wisdom that still retained fishermen off the coast of Gorontalo, Tomini, like the seasons, currents and astronomy (astrology). Fishermen off the coast of Gorontalo, Tomini, referring to the constellation as a direction and a benchmark in the utilization of fishery resources.

Collecting data in this study done by observation and interviews with several respondents fishermen. Respondents were determined by purposive sampling (intentionally). Data collection for this study from September 2017 until February 2019. Similarly Discussion Forum Focus (Focus Group Discussion, FGD) in several places on local wisdom for the season, currents and astronomy.

Keywords: Tomini; gorontalo; astronomy; movement fish.

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1. INTRODUCTION

Tomini bay waters located on the equator, covering three provinces, namely North Sulawesi, Gorontalo and Central Sulawesi. Tomini have high marine biodiversity, evidenced by the variety of fish species, coral reefs, seagrass beds and mangroves. Tomini Bay is the second-largest bay in Indonesia, after the Cenderawasih Bay. Tomini geologically formed about six million years ago, which has an area of 70 020 km² [1], directly adjacent to the Maluku Sea.

Tomini depth varies from 0 to 3,854 meters, in the middle of the bay there is a submarine hydrothermal activity [1]. Type of rugged coastline with steep elevation coastal slope > 45 degrees, is occupied by a variety of types of coral reefs, providing shelter, as well as the proliferation of a variety of fish [2]. Tomini Bay waters in Gorontalo has the potential of the large pelagic fishery as well as medium and small pelagic.

Tomini including one of the largest marine waters in Sulawesi included in Arlindo (Flow / Flow Trails Indonesia). Arlindo is one of support in the bay of Tomini. In dynamics, Arlindo, formed by empohan warm water (warm water pool) in East Mindanao and northeastern direction Halmahera is the result of the mass transport of water [3]. Flow Katulistiwa North (AKU) and the flow of the Equator South (AKS) were gathered there for the discrepancies Tarah (flat surface) of the sea (sea level) 40 cm higher than that in the south coast of Java and Sumbawa [3]. Tomini included in Regional Fisheries Management (WPP) 715 along the Maluku Sea, Halmahera Sea, the Seram Sea and the Bay of Berau in West Papua.

Tomini is regionally and globally significant as a gathering place for these kinds of endangered or restricted-range species (migration corridors, nesting beaches, locations of spawning or feeding and care area). Geological history-rich Tomini has given a very high level of endemism for that small region, including various species of fish and stomatopods are associated with coral reefs and eel Anguillidae [4].

Conservation International Indonesia, In collaboration with the Research Center for Oceanography LIPI and Hasanuddin University, has done a Marine Rapid Assessment Program and marine fauna in the islands Togeian 596 coral reef fish species that are included in 62

families in the islands Togeian ([5] Ministry of Maritime Affairs and Fisheries, 2015: 6), including the type of *Paracheilinus oogenesis* and *Escenius sp* allegedly endemic that can only be found in the islands Togeian.

Also recorded 555 species of molluscs from 103 familia, 336 gastropods, bivalves 211, 2 cephalopods, 2 Scaphopoda and 4 species of chiton ([5]; Ministry of Maritime Affairs and Fisheries, 2015: 6). Togeian waters are rich with a variety of marine species. There are 262 types of coral, including *Acropoda togeanensis*, which is endemic Togeian. Molluscs rare wildlife among others: giant clam (*Tridacna gigas*) shell clams (*Tridacna squamosa*) and Lola (*Trochus niloticus*). In these waters, there is also a green turtle (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), dugong (*Dugong dugong*) and pilot whales.

Through the integrated local ecological knowledge with modern science can provide basic information about the movement of pelagic fish in the Bay of Tomini. As for the study of ecological knowledge of coastal communities in the province of Gorontalo has been done in some locations, such as in Dulupi district was the familiar four fishing season [6], start of the season tahulo (small fish such as Nike and anchovies), ewela (medium-sized fish), munggiyango (sharks and the like) and pahi (stingray). Local wisdom in tradition and behaviour of these communities, and the ecological value of coastal biodiversity conservation principles [6].

When traced, the appearance of these fish species scientifically implies the food chain in aquatic ecosystems [6]. Traditional ecological knowledge of local culture-based Nike fish has also been conducted in Gorontalo [7].

Local ecological research, such as the species Dugong dugon been done by Zulhan Harahap [8]. The existence of these marine mammals has long been known to the local community. Its presence in waters known to start by eating seagrass (seagrass) and marriage. In Arakan-Wawontulap, dugong mating when the seawater is not too high tide and low tide is not too or so called water-sala sala.

National Park Wakatobi, Southeast Sulawesi has also researched dugongs through assessment of potential local ecological knowledge of local communities [9]. Interviews were conducted to determine the appearance of dugongs, seagrass

and perception of knowledge about the dugong population changes over time.

Local ecological knowledge plays an important role when it is integrated with modern science. Butler, et al. [10] suggested that local ecological knowledge as fishermen in Melanesia has been integrated with the management of Western science and produce innovative fisheries management and effective.

2. METHODS

2.1 Place and Time of Research

Gorontalo coastal waters in the Bay of Tomini has unique characteristics. Calcareous rocks are present almost the entire coast from Taludaa, Bolango Bone reGENCY, until Bilato, Gorontalo reGENCY. Coastal topography is dominated by rocks, and only in some locations, there are sandy beaches. Plant seagrass (seagrass) and the coral reefs are present in almost all locations.

Location settlement concentrated near the Trans Sulawesi, with hilly topography and the high karst mountains. When you look closely, this region does not have the extensive mangrove. There is only one location that is overgrown with several species of mangrove in coastal Bone.

Generally, coastal topography sloping 50 to 100 meters and straight steep (drop off) this is one of the factors that hinder mangrove plants grow well. On the beach, there is no place for mostly former muddy limestone and coral death. This also distinguishes the topography in Bolango Bone, Gorontalo and Gorontalo reGENCY, with the west in the district was and Pohuwato. In these two districts, mangroves grow on the coast, and the topography is gentle and there are small islands.

Data collection for this study from September 2017 until February 2019. This study is an integral part of the local community ecological knowledge study on the emergence of *Orcinus orca* in Gorontalo, Tomini. In the administration of the study site in the waters Bolango Bone reGENCY, Gorontalo, Gorontalo district, and the district were Pohuwato, in the waters of the Bay of Tomini, Gorontalo province.

This research by making observations in several water points in Gorontalo and interviewed 38 respondents, fishermen, in 14 coastal villages Bolango Bone reGENCY, Gorontalo, Gorontalo district, and the district was Pohuwato. This study

site selection, focusing on the location of appearance, fishing activities, especially fishing of pelagic and guard FADs. The intensity of fishing activity is an option to get data and information from several fishermen in Gorontalo.

Collecting data in this study done by observation and interviews with some respondents fishermen. Respondents were determined by purposive sampling (intentionally) and collected with a snowball sampling technique [11], Ferguson, et al. 2012.

Based on the data in the Department of Marine and Fisheries Gorontalo [12], the number of fishermen in the research sites in five counties and cities as much as 15 645. Each in Bone reGENCY Bolango many as 2,497, 3,486 Gorontalo City, Gorontalo ReGENCY of 3156, the district was 2,515 and 3,991 Pohuwato. This amount consists of a fisherman fishing full, the main sideline fishermen and fishermen additional sideline. Full fishermen in the study site as much as 8102. In Bone reGENCY Bolango full as much as 1,162 fishermen, 1,865 Gorontalo City, Gorontalo ReGENCY of 1833, the district was 1,081 and 2,161 Pohuwato. The number of households fishery in 2015, 6213 and 2016 as many as 5,164.

Location respondents spread across the village Bilolantunga District of Bone, Olele, Oluhuta, Molotabu Huangobotu (Inengo) and Botubarani in District Kabila Bone Bone Bolango District.

Furthermore, in the Southern District of Dumbo Leato and Tanjung Kramat Raya in District Hulonthalangi Gorontalo. Then in the village in the district Lopo and Kayubulan Batudaa Gorontalo reGENCY beach. Other respondents in the village in the district Dulupi Dulupi and East Pentadu village in the district was in the District and Village Bumbulan Pohuwato Paguat and Village East in District Marisa Pohuwato. Discussions also conducted Focus Focus (Focus Group Discussion, FGD) in Botubarani, Huangobotu and Tanjung Keramat on local wisdom for the season, currents and astronomy (astrology).

3. RESULTS AND DISCUSSION

In general, on the coast of Gorontalo, Tomini, ranging from Bone County Bolango Taludaa to East Pohuwato (Marisa) in Pohuwato fishermen in the study site does not rely on catching fish that live in coral reefs and mangroves.

Fishermen at research sites in 14 towns/villages are small pelagic fishing and big. If there are fishermen who catch fish in the coral reef, just to eat. The catch is sold mostly pelagic fish. In the study site, the fishermen have the wisdom and local knowledge related to the utilization of fishery resources.

3.1 There Yilulo

Local wisdom that ever existed on the coast of Gorontalo is colourful rice (pale yilulo). This form of local wisdom had been a tradition in the customs and daily life of fishermen Gorontalo. Colourful rice attribute is commonly done as in traditional practices mopoliho lo limu (kaffir lime herb water bath) and mongubingo (circumcision for girls).

There Yilulo consists of five kinds of rice, respectively: red, white, black, yellow and green. Red rice (mela) symbol existing red blood on the body, white (moputi'o) symbolizes the white blood present in the body, black (moyitomo) symbolizes the flesh on the body, yellow (lalahu) symbolizes the marrow of a body and a green (moyidu) symbolizes the existing veins in the body.

Activities in the coastal and marine, pale yilulo been used as a form of local wisdom of the elderly. Generally, the use of this yilulo pale to obtain sustenance and safety at sea. When FADs were first brought to the marine waters, attributes and symbols colorful rice became part of the ritual.

Likewise, when fishing and there will be a storm, fishermen will sow yilulo pale. The use of other colorful rice, when marine mammals crossed the coast near the settlement of fishermen and in FADs (heita), such as in Inengo (Huangobotu). In the past, older people sow pale yilulo when the killer whale or large-sized cetaceans across the waters near the coast. It is as a marker there will be an abundance of pelagic fish.

Of the 14 rural / urban neighborhoods do interviews, local knowledge is still there in the pale yilulo Kayubulan Village, District Batudaa Beach district, Gorontalo and in Huangobotu / Inengo District of Kabila Bone. Respondents who still practice in Kayubulan Ismail Harmain (66 years) and in Huangobotu Husain Rahman (58 years) for the use of pale yilulo on FADs (heita). Other villages no longer practice the pale yilulo on the coast and the sea.

3.2 Hot

FADs or Gorontalo language called heita was first created in 1969. The fishermen Fishermen Gorontalo Gorontalo make FADs, as a gathering place for pelagic fish is not copied from another area or taken other fishermen. Heita history made after removing the soma dampar Rahman Ibrahim (trawlers) at a huge log drifting in the sea. This dampar Soma encircling the stem wood, a lot of catches obtained by Ibrahim.

After some time removing soma dampar on a log with catches many Ibrahim with the fishermen in Huangobotu (Inengo) makes heita very simple. Construction heita flowers made of wood, as a binder using a rattan rope and bulahu with ballast stones. The length of rope for this heita 150 fathoms (1 fathom = 1.8 meters) with a weight of 100 kilograms. Heita of this wood can be used for three months.

In the 1970s construction of heita replaced with bamboo sticks, binders and ropes to the seabed using a cane. There are three circular rattan tied to a rope FADs. The durability of FADs with bamboo and rattan material for three to six months. Since the 1970s and 1980s the use of FADs has spread in the waters of Gorontalo, Tomini. Rattan is used as mooring lines to be replaced with plastic straps.

Heita manufacture of construction materials, they use bamboo with white straps. The length of the rope is released into the seabed until 1500 fathoms long, using 750 kilograms of ballast stones.

For the soma (fishing nets), fishing Gorontalo create your own from cotton material. The makers of soma is in Pohe (Gorontalo). For reinforcement nets, will soaked with preservative of tangalo (mangrove).

3.3 The Currents and Upwelling Phenomenon

In connection with the ocean currents, fishing in Gorontalo know wawalunga designation (surface and underwater currents). Wawalunga or current two branches moves horizontally on the surface of the west, while the bottom flows moving from the east. Flows one direction on the surface and subsea horizontal termed tolohu lolohu, and the current limited moves like a river called tolohu lohihedu. When seen tolohu lohihedu, this current usually brings a lot of fish.

There are currents in the Bay of Tomini below sea level to the top like a boil is called tolohu lilimbueya. Flow moving from bottom to top, then scatter on the surface is called tolohu lolohu. Other vertical flow is tolohe lobutu or flow from bottom to top. There is also a current three branches, on the surface leads to the east, at a depth of 7-20 meters to the north and at depth of 40 meters to the west.

Tomini Bay, Gorontalo fishing oceanographic knowledge related to the vertical flow with the term tolohu lilimbueya, tolohu lolohu and tolohu lobutu. Three kinds of these currents move from under the sea and has several variants while on the surface, such as seawater appear to boil, split up and go with the flow surface. This fishing oceanographic knowledge gained as often removing fishing nets and fishing hook large and small pelagic fish or are on FADs in the Gulf of Tomini. In addition to the vertical flow, fishermen know the current two branches with the term wawalunga and for density, also known as the three branches of the current flow that shows the difference in the direction of flow on the surface and the depths of the ocean.

Research Natsir, et al. [13], regarding the indication of upwelling in the Bay of Tomini occurs in about June, July, and August, characterized by increasing levels of fertility waters such as chlorophyll and the drop in the surface temperature at the same time (an indication that the mass of cold water coming from deeper waters). Upwelling that occurs because of Ekman drift generated by wind in Tomini occurs in the West has been studied Sulaiman & Sadli [14] and Surinati [15]. Modeling flow pattern related to the fishing areas have also been conducted by Center for Marine Research, Ministry of Marine Fisheries. In the Gulf of Tomini, based on the modeling of the upwelling have appeared in January (the Goddess, CTF.

Upwelling is the process of water movement of the thermocline toward petala petala face, tersebut petala water deficit paras [3]. An important process called raising water (upwelling) occurs where the wind is still moving away from the water surface slope steep shore, and bring to the surface of cold water rich in nutrients, which have accumulated in place in [16]. These nutrients will invite phytoplankton and various species of fish, marine mammals and birds. Surinati [15] upwelling is a phenomenon or events related to the movement of the masses

rising sea water. Upwelling in a body of water is one of the pivotal study oceanographers.

The phenomenon of upwelling occurs when the wind is blowing from the east and the effect serentetannya turned south as in the north there are obstructions (land / beach), then led to a spate of water masses surface layer of the sea dragged to the south away from the shore, so that the mass of water from deeper layers will fill vacancy in the surface layer [17]. As for the down welling is the process that occurs when the wind is blowing in the opposite direction. Upweeling and down welling patterns is possible greatly affect fertility patterns in the waters of the region [17].

Upwelling which occurs only covers one percent of the ocean surface, but these events accounted for 50 percent of world fisheries [15]. Ocean current that moves up bringing nutrients from the bottom waters. These nutrients will invite phytoplankton, zooplankton, small fish, big fish up to cetaceans and other marine species.

One indication of upwelling in the waters with the presence of phytoplankton *Chaetoceros* sp. Wiadnyana [18] suggested that most phytoplankton found in Tomini Bay research station, which *Chaetoceros* sp (average = 30.8% of the total number of phytoplankton cells) and *Rhizosolenia* (average 18.8%). Setyadji research results and Priatna [19] in the Gulf of Tomini shows the abundance of phytoplankton and zooplankton showed a high value on West season, declined in the first shift and the lowest in East season. In West season sebarannya concentrated around the mouth of the bay, while in the transition season I spreading evenly, the type of *Chaetoceros*, *Coscinodiscus*, and *Rhizosolenia* is a type of phytoplankton of the class Bacillariophyceae that have a high frequency of attendance, while the dominant group crustacean zooplankton [19]. In some locations waters, abundant presence of *Chaetoceros* sp is one indication of upwelling (boosts mass of water) in the waters around the [20].

3.4 Season and Astrology

Gorontalo fishermen know some of the constellations associated with the season, signpost and fishing. In the east, the constellation of the kite will be visible in the southern sky, or as a hint towards the south. After that, you will see two stars called tahulo near the constellation

kite (ewela). In astrology and winds, the four major East respectively (matolodulahu), west (otolopa), north (tilayo) and south (huliyaliyo).

Fishermen Gorontalo in Huangobotu / Inengo, Dulupi, Tanjung Keramat and Botubarani know ewela and tahulo as a marker of the season will go east or in the eastern Bay of Tomini season, is in the range from June to August. Based ewela and tahulo in the east, there are a series of astrology (poliyama) relating to the local ecological system called: Tadata, Otoluwa, maluo, munggiyango and pahi, as Table 1.

3.5 The Constellation Constellations and Movement of Fish

Based on this research, there is a local wisdom that still retained fishermen off the coast of Gorontalo, Tomini, as in astrology. Fishermen off the coast of Gorontalo, Tomini, making reference to the constellation as a direction and a benchmark in the utilization of fishery resources.

The main Centaurus constellation is a kite consisting of Crux star, Alpha Crux (Acrux), Mimosa and Gactrux. This constellation Gorontalo language called Ewela, Westerners know as Crux or cross. Rasi this kite accompanied by bright stars Alpha Centauri (Rigil Kentaurus) and Hadar called Tahulo Gorontalo language. Ewela existence and Tahulo at night, as a pointer towards the south.

The movement of large pelagic fish and small, yellowfin (Yellow Fin Tuna, *Thunnus atbaces*), Skipjack (*Katsuwonus pelamis*), Fish Mackerel (*Rastrelliger brachysoma*), Fish Bloating men (*Rastrelliger kanagurta*), Fish Kite Fair (*Decapterus russelli*), Fish Kite blue / Malalugis / Momar (*Decapterus macarellus*), fish Layang Deles (*Decapterus macrosoma*), Deho (*Auxis rochei*), Tude (*Selaroides leptolepis*), as well as other types of fish can be seen in the star position (poliyama) called Taadata, Otoluwa,

Maluo, munggiyango and pahi. Position azimuth (direction) taadata star, otoluwa and maluo from the east will be seen with tahulo and ewela lies in the south. The position of these stars will indicate the number of fish species currently taadata and Tamboo Tamboo lo lo otoluwa.

Poliyama lo taadata referring to the seven-star constellation Ursa Major. Based on the Sky Map application, the names of, among others Dubhe, Merak, Phad, Alioth and Alkaid. Poliyama lo otoluwa refer to star in the constellation Orion. There are three main stars, then four other star on the side. In the Sky Map application one of three stars with a name sequentially Alnilam, then the star next to each Rigel, and Betelgeuse Saiph. Poliyama lo maluo refers to the constellation Canis Major. The main star in this maluo lo poliyama with the name Sirius. Sirius is known as the brightest star in the sky. In addition to the star Sirius, and Procyon are the star Canopus.

Taadata star positions along Tahulo and east Ewela season of June, July, August and September as a marker of pelagic fish spawning in the Bay of Tomini. In astrology constellation fishermen Gorontalo, there is no activity when fishing with catches in large amounts, changes in the shape of fish, spawning and fishing is restricted before sunrise. Gorontalo fisherman called this by various terms such as tadata, otoluwa, maluo, butu, Tamboo, hulita, bitoo, pahi, and munggiyango as in Table 2.

In the constellation astrology, there hulita to see the position of east and west, and east and west, which is based on tahulo and ewela. Hulita matolodulahu, tahulo star position and ewela have not seen, while hulita lo otolopa, tahulo position and ewela appeared at 21.00 in the Bay of Tomini. In astrology position like this will appear butu lo taadata, small and large pelagic fish in large quantities, including bukurasi (tuna).

Table 1. Astrology

Folium	Complexion	Position
Falls on	Kite constellations	South
Tahulo	Two stars alongside ewela	South
Taadata	Number seven stars	East
Otoluwa	Three stars sequential, somewhat oblique	East
Board	Number three stars (one main star)	East
Totoiya	One major star	East
Munggiyango	Star-like fins	East
Droppings	Star like stingray	East

Table 2. The movement of pelagic fish by astrology

Astronomy	Information
Taadata	Pelagic fish spawning season, the fish in large quantities
Otoluwa board	Pelagic fishes ready to be arrested How early hours of fishing before the cock down foraging
Tamboo	The fish in large quantities, abundant
Tamboo lo tadata	Pelagic fish in large quantities, rain
Tamboo otoluwa	Pelagic fish in large numbers in the constellation otoluwa
Tamboo cattle Pack	Nike fish popping up in large quantities in the waters of Gorontalo, every end of the month in the Hijri calendar year.
It would be	The fish in large quantities, are easily caught
Butu the tadata	Large and small pelagic fish in large numbers in the constellation tadata
Hulita the otolopa	Position in the western and eastern astrology
Hulita is to the dulahu	The position of astrology in the east and west
Bitoo	Plankton, juvenile
droppings	Stingrays in large quantities, small and large
Munggiyango	Shark

It would lo taadata occurred in September until the peak fishing season bukurasi (yellowfin) in December. *Tamboo lo otoluwa* occur when stars tahulo own entrance (not shown) on the west season otoluwa emerging star (stars lined three) in the east. Fish in large quantity at 04:00 to 05:00. In taadata star position, pelagic fish spawn (spawn). Fish single sand with a pattern tail is gray, laying in Napo (coral) are mixed with white sand, single usual with shades of yellow tail spawn in Napo that only the reef, and single red with a pattern tail red spawn in estuaries or near beach. Local knowledge of fishermen, there are three kinds of mackerel, to name two finger-sized difference, Lopa-lopango size of three fingers and dehoma or Ruma-Ruma with a pattern of lines on the body. The puffer fish spawn in locations with coral. In the rainy season, the fish will be quick single and bloating great.

Local ecological knowledge of fishermen Gorontalo Tomini Bay is in line with research Widiyastuti and Zamroni [21], which states that the sex ratio of fish malalugis (*Decapterus macarellus*) in Tomini Bay waters are found to conditions ripe gonads in August. Large pelagic fish, such as bukurasi (yellowfin or yellowfin tuna) also appeared in the east. Bukurasi fish in large quantities to occur in the eastern time *Tamboo Tamboo lo lo otoluwa tadata* and transition season and seasons to the west. Nugraha and Suwarco [22], suggests that the tuna season adult size in Tomini for August to December. According Mardlijah and Patria [23] season of spawning yellowfin Tomini Bay waters is expected to start taking place in December.

Likewise with munggiyango (shark), the star shape that appears similar to the fin on the shark. Further, when the star position pahi (similar to stingrays) seen in the east, the species will be more visible in the sea, with various sizes.

Other local wisdom in astrology like not lowering the new boat when seen totoiya star. This prohibition relating to the sustainability boats used or safety at sea. Gorontalo fishermen also use the Morning Star (ti dunu) as a marker or a hint of the time at sea.

3.6 Fish Nike and Whale Sharks Emersion

Nike fish in the discussion Gorontalo called duwo, appearance end of each month in the Hijri calendar year in the waters of Gorontalo. Occurrences like fish in large quantities termed Gorontalo *Tamboo lo duwo*, which uses the calculation month. In the 12 months (one year), not every month there is a lot of nike fish catches by fishermen.

According to BMKG [24] moon are celestial bodies that orbit the Earth. Because the light source the Moon as seen from Earth is the reflection of the sunlight, the shape of the Moon as seen from Earth will change. Changes in the shape of Earth's moon appears is called with the phases of the Moon. From several phases of the Moon, there are four main phases, namely the phase of the new moon, half-full initial phase (first quarter), the full moon phase, and phase half-full end or quarter-end [24].

Quarter-final phase is always accompanied by the emergence of Nike fish. Nike fish existence has associated with the aggregation of whale sharks (*Rhincodon typus*, Whale Shark). Since ancient times when giant fish whale sharks across the waters of Gorontalo, Tomini.

Aggregation of whale sharks in the waters of Gorontalo as prey, such as small fish in these locations. This is supported also by the presence of phytoplankton and zooplankton in the waters. In Gorontalo, the whale shark is called by local names Munggiyango Hulalo.

Typically, in each month will emerge Nike fish in the waters of Tanjung Keramat Leato. Location furthest emergence Nike fish in the waters Botubarani border Gorontalo city and Bone Bolango. Aggregation of whale sharks in the waters of Gorontalo as prey, such as small fish in these locations. This is supported also by the presence of phytoplankton and zooplankton in the waters.

4. CONCLUSION

Fishermen Gorontalo in the study site had the wisdom and local knowledge regarding the current season as well as the utilization of fishery resources associated with astrology and movement of pelagic fish. Gorontalo fishing knowledge about ocean currents under the surface and called Wawalunga, tolohu lolohe, tolohu lohihedu and tolohu lohihedu, tolohu lilimbueya, tolohu lolohu and tolohe lobutu.

Gorontalo fishermen know some of the constellations associated with the season, signpost and fishing. In the east, the constellation of the kite will be visible in the southern sky, or as a hint towards the south. After that, you will see two stars called tahulo near the constellation kite (ewela). In astrology and winds, the four major East respectively (matolodulahu), west (otolopa), north (tilayo) and south (huliyaliyo).

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CONSENT

As per international standard written participant consent has been collected and preserved by the authors.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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