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RESEARCH ARTICLE

The fishery and utilization of flying fish (Exocoetidae) in Guiuan, Eastern Samar, Philippines

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ABSTRACT

The flying fish fishery in Guiuan, Eastern Samar, Philippines, serves as a valuable source of livelihood for the local community. This study used both survey methods through face-to-face interviews with the respondents (N=37) and actual catch sampling to assess the socio-demographic profile of the fishers, the fishery, and the utilization of the commonly landed flying fish species in the locality. The survey results showed that the flying fish fishers in Guiuan were male-dominated, showing no participation of women in the capture segment of the fishery. The average number of members of a flying fish fishing household was 5. The majority (68%) of the fishers earned <PHP 5,000.00. All fishers (100%) used surface gillnet made from monofilament netting with an 8.5 cm mesh size in targeting flying fish. The catch rates generally showed a monthly variation as affected by the fishing season of the species. The surface gillnet catch was composed of 8 valuable flying fish species, including: 1) intermediate flying fish *Cheilopogon intermedius* (60%), 2) manyspotted flying fish *Cheilopogon spilopterus* (10%), 3) stained flying fish *Cheilopogon spilonotopterus* (8.7%), 4) Sutton's flying fish *Cheilopogon suttoni* (0.4%), 5) margined flying fish *Cheilopogon cyanopterus* (0.3%), 6) Abe's flying fish *Cheilopogon abei* (0.1%), 7) yellowing flying fish *Cypselurus poecilopterus* (15.6%), and 8) tropical two-wing flying fish *Exocoetus volitans* (4.9%). In terms of usage, 80% of the flying fish catch in Guiuan was utilized for household consumption, with 10% as fresh and 70% as dried, while the remaining 20% served as bait by tuna fishers.

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Introduction

The Philippines, with its 2.2 million km^2 of highly productive seas endowed with diverse fishery resources, is recognized as among the top fish-producing countries in the world (Green et al., 2003; Licuanan et al., 2019; BFAR, 2022). In 2019, the Philippines landed 8th in the world fisheries ranking with a total production of 4.41 MT tons which represented a total of 2.07% of the total world production. The fisheries sector provides for the nutritional needs of the people, helps boost the country's economy, and provides livelihood to millions of fisherfolk. In 2021, the total fisheries production reached 4.25 million MT valued at PHP 302.44 billion. This contributed 12.70% to the country's gross value added (derived as the sum of the value added from agriculture, industry and services sector) in the same year. The 47.12% of the fisheries production which is equivalent to 2 million MT valued at PHP 173.90 billion came from the capture fisheries sector. From this, 26.64% equivalent to 1.13 million MT valued at PHP 112.1 billion came from municipal capture fisheries or small-scale fisheries (Perez et al., 2012; BFAR, 2022). The small-scale fisheries support over 1.1 million municipal or small-scale fishers representing 50.03% of the total number of fisherfolk nationwide (BFAR, 2022). One of the fish resources targeted by the small-scale fishers is flying fish.

Flying fish are small pelagic schooling species belonging to family Exocoetidae. This group of fish is comprised of 71 species belonging to 6 genera, namely: *Parexocoetus*, *Exocoetus*, *Hirundichthys*, *Prognichthys*, *Cypselurus*, and *Cheilopogon* (Indrayani et al., 2020; Tuapetel & Tupan, 2021). Flying fish are found in the tropical and sub-tropical waters (Chang et al., 2012; Lewallen et al., 2018; Gomez et al., 2019). In the Philippines, 11 species belonging to three genera including *Cheilopogon*, *Cypselurus*, and *Hirundichthys* were recorded in the west coast of Surigao del Norte (Gomez et al., 2019). On the other hand, five genera were recorded in Maitum, Sarangani Province namely: *Cheilopogon*, *Cypselurus*, *Hirundichthys*, *Parexocoetus*, and *Exocoetus* (Emperua et al., 2017). Flying fish are well-known for their aquatic gliding ability through their large and elongated pectoral and unsymmetrical caudal fins, in which, they use as mechanism to escape from their predators (Lewallen, 2012; Gomez et al., 2019).

Flying fish contribute significantly to the pelagic catch in coastal zones in tropical and subtropical countries (Emperua et al., 2017). These species are typically targeted for human consumption and as bait for the tuna fisheries (Jayawardane & Dayaratne, 1998; De Croos, 2009). In the Philippines, the fishery of flying fish is an important source of income particularly for the small-scale fishing households (Gomez et al., 2019). Flying fish are among the most common small pelagic species dominating the catch landed by the small-scale fishers in certain coastal areas in the country including the western portion of the Verde Island Passages in the West Philippine Sea, around the Camotes Sea in the Visayan Sea, and in the west coast of Surigao del Norte (Emperua et al., 2017; Gomez et al., 2019). Fishers commonly use surface gillnet, drift gillnet, and drive-in net to catch flying fish (Morales et al., 2016; Emperua et al., 2017; Molina et al., 2018). In Sta. Ana, Cagayan Valley, fishers begin the fishing operations at 5:00 or 6:00 in the morning and last for 3-12 hours (Molina et al., 2018). During the peak months from February to May, the catch is either sold at a very low price or processed into dried product, and sometimes given for free. On the other hand, flying fish catch in Maitum province is sold as fresh or processed through marinating which was said to be a potential business in the area (Emperua et al., 2017).

In Guiuan, Eastern Samar, Philippines, the fishery of the flying fish locally known as "iliw" is a valuable source of livelihood and one of the major species constituting the total fisheries production of the province. Flying fish landings in Eastern Samar in the last five years (2018-2022) reached 665.04 MT (PSA OpenStat, 2023). However, despite the importance of flying fish to the local fisheries of Guiuan, there has been limited scientific information about the fishery. To the best of the authors' knowledge, no studies have yet addressed the detailed information about the fishery. Thus, this study on the fishery and utilization of flying fish in Guiuan, Eastern Samar, Philippines was conducted to provide valuable information on the current profile and status of the fishery. Specifically, this study aimed to: (1) determine the general socio-demographic profile of the flying fish fishers, (2) determine and describe the fishing gear used, (3) describe the fishing practices employed by the fishers, (4) examine the catch composition and catch rate, and (5) assess the utilization of flying fish as a local commodity in Guiuan, Eastern Samar. The results may serve as a critical baseline that can be used by the concerned institutions in developing effective management strategies for the sustainability of the fishery in the area.

Materials and Method

Study Site and Duration

This study was conducted in the municipality of Guiuan, Eastern Samar, Philippines (Figure 1) from March to June 2023.

This research was primarily conducted at the two landing sites at Taytay, Guiuan namely: 1) Pangpang, and 2) Sabang. These are the only landing sites at Taytay which is one of the coastal communities in Guiuan with the highest population of flying fish fishers. According to the records of Taytay Fisherfolk Association, the community has 40 flying fish fishers representing 57% of the total flying fish fishers in the municipality.

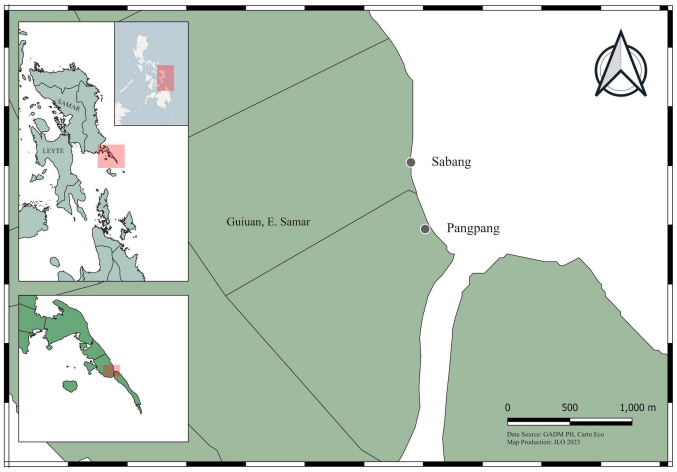

Figure 1. A map showing the study sites (Sabang and Pangpang) in Guiuan, Eastern Samar, Philippines

Study Design

This study involved both survey and actual catch sampling. The survey was conducted in-person with the 37 target respondents (flying fish fishers) using a semi-structured questionnaire. An actual catch sampling and on-site observation of the fishery were also carried out to validate the data collected during the interview (i.e., fishing gear and methods employed, catch rate and composition).

Survey Instrument and Respondents

The survey instrument consisted of several questions focusing on the general demographic and fishery profile of the respondents. The demographic profile included the respondent's gender, age, civil status, education and household information. On the other hand, the fishery profile concentrated on the fisher's experience in the fishery, income, type of fishing gear used, fishing practices, catch composition, catch rate, and catch utilization. The instrument was deployed through Kobo Collect, an open-source offline mobile application for collecting survey data. A total of 37 (92.5%) flying fish fishers of Taytay, Guiuan were successfully interviewed in this study. Prior to the interview, the fisher respondents were given a consent form to ensure their voluntary participation. Few (3) of the fishers were not able to participate in the survey due to the conflict of schedule.

Catch Sampling Procedure

Catch sampling was carried out on a weekly basis in the two landing sites (Pangpang and Sabang) from March to June 2023, to verify and expand the information acquired from the study. A total of 1,000 random flying fish samples were taken for the entire sampling duration. The sampling was done by the shore at around 3:00 PM, after the fishers had returned from their fishing operations. The samples were measured for their total length (cm) using a standard 150-cm tape measure, and weighed for their body weight (g) using a digital weighing scale with 1 g sensitivity. The catch rate was also verified during the actual catch sampling and onsite observation by directly obtaining the count and weight of the catch from the fishers when they are about to sell their catch. On the other hand, identification of the flying fish and other species were done using Carpenter & Niem (1999), White et al. (2013), and Froese & Pauly (2023).

Data Processing and Analysis

All data collected during the survey with the respondents were sent to the Kobo Toolbox server. From there, the data were downloaded in an excel file type. These were then processed accordingly and analyzed using descriptive statistics. The catch rate which was expressed as catch per unit effort (CPUE) was calculated as the number of individuals or pc/panel and pc/hour. The length-weight relationships (LWRs) were estimated using the log form of the growth equation (Ricker, 1973):

$$W = aL^b$$

wherein, W is the expected body weight (g), L is total length (cm); a (constant) is the intercept or initial growth coefficient, and b (constant) is the slope of the regression line. The analyses were performed in Microsoft Excel 2019. A product flow map was used to show how flying fish are utilized in the area.

Results and Discussion

The demographic and fishery data of the flying fish fishers of Guiuan, Eastern Samar, Philippines are presented in Table 1. The data show that the flying fish fishers in the locality were all males, showing no participation of women in the capture segment of the fishery. Typically, fishing is classified as predominantly male-oriented work, with women having a

limited role in the fisheries industry. In the Philippine fishing communities, women are usually not involved in the fishing operations. They generally stay at home to do the traditional household chores such as meal preparation, and providing care for the children and the elderly members of the family (Mutia et al., 2020). This holds true in Guiuan, wherein, women have no knowledge and experience in the fishing operations at sea. They stay at home to do the household chores.

Table 1. Socio-economic and fishery profile of the flying fish fishers in Guiuan, Eastern Samar, Philippines

Respondent's Characteristics	Frequency of Response	Frequency Percentage (%)
Gender		
Male	37	100.00
Female	0	0.00
Total	**37**	**100**
Age structure		
21-25	3	8.11
26-30	4	10.81
31-35	8	21.62
36-40	4	10.81
41-45	1	2.70
46-50	1	2.70
51-55	5	13.51
56-60	9	24.32
61-65	1	2.70
66-70	1	2.70
Total	**37**	**100**
Civil status		
Married	18	48.65
Single	7	18.92
Separated	5	13.51
Live-in	5	13.51
Widowed	2	5.41
Total	**37**	**100**
Educational attainment		
No Formal Education	1	2.70
Elementary Level	11	29.73
Elementary Graduate	9	24.32
High School Level	4	10.81
High School Graduate	7	18.92
College Level	4	10.81
College Graduate	1	2.70
Total	**37**	**100**
Household size		
1-3	13	35.14
4-6	13	35.14
7-9	7	18.92
10-12	4	10.81
Total	**37**	**100**
Number of children		
0	8	21.62
1-3	17	45.95
4-6	7	18.92
7-9	5	13.51
Total	**37**	**100**

Table 1 (continued)

Respondent's Characteristics	Frequency of Response	Frequency Percentage (%)
Number of children still studying		
0	15	40.54
1-3	10	27.03
4-6	10	27.03
7-9	2	5.41
Total	**37**	**100**
Fishing experience (years)		
<5	6	16.22
6-10	7	18.92
11-15	8	21.62
16-20	3	8.11
21-25	2	5.41
26-30	4	10.81
31-35	4	10.81
36-40	1	2.70
>40	2	5.41
Total	**37**	**100**
Average monthly income derived from flying fish fishery		
<PHP 5,000	25	67.57
PHP 6,000-PHP 10,000	11	29.73
PHP 11,000-PHP 15,000	0	0.00
PHP 16,000-PHP 20,000	1	2.70
Total	**37**	**100**
Average number of fishing trip per month (days)		
10-15	4	10.81
16-20	11	29.73
21-25	20	54.05
26-30	2	5.41
Total	**37**	**100**
Membership in fisherfolk organization		
Member	19	51.35
Non-member	18	48.65
Total	**37**	**100**
Other source of income		
Tuna Fishing	13	35.14
Gillnet Fishing	3	8.11
Tuna Fishing and Gillnet Fishing	4	10.81
Tuna Fishing and Spear Fishing	3	8.11
Squid Fishing	4	10.81
Construction	5	13.51
Dried Fishing	1	2.70
Others	4	10.81
Total	**37**	**100**

The average age of the fishers in Guiuan was 57 years old, being dominated by older fishers in the same bracket at 51-60 years old (38%), followed by a younger generation with ages from 31-40 (32%). In terms of civil status, about half (49%) of the respondents were married, while others were single (19%), separated (14%), living together (14%), and widowed (5%) at the time of the study. It was observed that more than half of the respondents were either elementary level (30%) or graduate (24%). On the other hand, only four (11%) were able to attend college and only one (3%) earned a degree. In the study of

Molina et. al. (2018) in Sta. Ana Cagayan, it was also reported that 100% (n=21) of the flying fish fishers were males. The average age of the fishers in the study area was 41 years old. Many of the respondents were also married, but most finished high school.

This study found that the average number of household members among flying fish fishers was five, including three children. Meanwhile, an average of two children were still attending school. In terms of the respondents' length of involvement in the flying fish fishery, more than half (57%) had ≤15 years of fishing experience, while the others were already 16 to 50 years in the fishery. The average monthly income of the respondents ranged from <PHP 5,000.00 to PHP 20,000.00, with majority (68%) of them earning <PHP 5,000.00. The income of the fishers reaches PHP 20,000.00 during peak season but significantly drops when the catch become scarce. The results showed that the average monthly income (<PHP 5,000.00) of the flying fish fishers was basically less than the poverty threshold in Eastern Samar at PHP 12,052.00 for a family of five as reported by the Philippine Statistics Authority Eastern Visayas (2022). This simply implies that the flying fish fishers are generally living a poor life. The income of the fishers is generally low, and the opportunities available for them to have additional earnings are limited and are also mainly low-income generating activities as indicated in the other source of income (Table 1). In the study of Molina et al. (2018), the income derived from flying fish fishing ranged from PHP 20,000.00 to PHP 61,000.00 within 7 months which was equivalent to PHP 2,857.14 to PHP 8,714.29 monthly.

Most of the respondents in Guiuan were fulltime flying fish fishers (70%), while 30% were part-time in the fishery. Fishing of flying fish is being conducted in a daily basis. More than half of the fishers (54%) reported that they conduct fishing operations for 21-25 days in a month. These fishers with higher number of fishing trips were the fulltime fishers who highly depend on the fishery during its fishing season from March to December. And, due to the seasonal characteristics of the fishery, flying fish fishers diversify when flying fish become scarce to continuously sustain their daily needs. Majority of them shifted to other fishery and continue their fishing activities including tuna fishing or "pagbudlis" (35%), gillnet fishing or "pamukot" (8%), both tuna and gillnet fishing (11%), spearfishing or "pamana" and tuna fishing (8%), and squid fishing or "pagnoos" (11%). One fisher preferred fish drying as another source of income, while five (14%) were involved in the construction field. More than half (51%) of the respondents were members of the barangay's existing fisherfolk organization, the Taytay Fisherfolk Association which is registered at the Local Government of Guiuan. On the other hand, the remainder were non-members because they were not around during the creation of the organization and/or they were not interested to join due to personal reasons.

Fishing Gear Used in the Flying Fish Fishery

The bulk (97%) of the flying fish landings in the Philippines come from gillnet and little portion from drive-in nets (Dalzell, 1993). Consistently, all flying fish fishers in Guiuan use a surface gillnet in catching the species. Surface gillnet locally known as "pukot" is a type of gillnet that hangs vertically in the water and is not anchored to the seabed. Other regions in the Philippines including Maitum, Sarangani province also use the same gear for catching flying fish (Emperua et al, 2017). However, flying fish fishers in Danajon Bank in the Camotes Sea use floating drive-in-nets that are deployed from small motorized canoes (Dalzell, 1993). In Makassar Strait, Indonesia, drift gillnet is used in catching bony flying fish *Hirundichthys oxycephalus* (Palo et al., 2019; Najamuddin et al., 2020). The same gear is used in catching flying fish in the waters of Ambon Island, Indonesia (Tupamahu et al., 2023). On the other hand, three types of fishing gears are mainly used in catching flying fish which are associated with the Kuroshio current off Taiwan namely: drive-in net, set net, and gillnet (Chang et al., 2012).

The specifications of the gillnet used by the flying fish fishers in Guiuan is shown in Table 2. The gear is constructed with a monofilament knotted nylon netting with a twine diameter of 0.25 mm and a mesh size of 8.5 cm. The netting's depth is 100 meshes down. An ethylene-vinyl acetate (EVA) foam is used in the head rope while a lead sinker is fixed in the footrope, both at one piece per meter, to keep the net open right below the water surface.

The size of the floaters being used range from 5 to 8 cm weighing 10 to 15 g, while the sinkers' size varies from 4 to 5 cm weighing 20 to 21 g. A weighted buoy is fixed at each end of the finished fishing gear. The buoys which are similarly made from EVA foam are tied to a bamboo using a monofilament transparent nylon. A 3-m long multifilament nylon rope line then connects the buoys to the main gear. The buoys serve as markers and help maintain the desired position of the gear in the upper section of the water where flying fish occur. Each flying fish fisher owns 8 to 15 panels of nets configured into 1 unit with finished length of 800 to 1,500 m. Flying fish are primarily caught in the gear through gilling. The fish is caught through its gills as it tries to escape from the net. The mesh size

Table 2. Specifications of the surface gillnet commonly used in Guiuan, Eastern Samar, Philippines

Material/ Attribute	Specification
Netting	monofilament transparent nylon 0.25 mm diameter twine size
Mesh	diamond-shaped knotted mesh with size of 8.5 cm
Floater	ethylene-vinyl acetate (EVA) foam and rubber
Sinker	lead (20-21 g)
Buoy	EVA foam or Styrofoam

of the gear is intended to catch the fish of desired size (marketable), making it generally size-selective. According to the survey, about 97-100% of the flying fish are caught through its gills, and that most of the catch are found near the headrope of the gear suggesting that flying fish are found at 0-5 meters from the water surface.

Aside from the surface gillnet used by fishers as the main gear, they also employ scoop net as accessory gear to aid in the fishing operation. The instrument is commonly made from a monofilament net fixed in a round-shaped metal frame and is attached to a handle. The frame's diameter ranges from 51 to 76 cm. The handle is typically made up of a 2-m long bamboo. Scoop nets are generally used to retrieve flying fish that fall onto the water during catch retrieval.

Fishing Practices

According to the survey, flying fish species landed in Guiuan are particularly caught in the areas of the West Pacific Ocean, about 2-4 km away from the shoreline. As early as 5:00 in the morning, flying fish fishers start to prepare for their fishing trip. They prepare their food and other things needed for the fishing operation, head to the docking site, unanchor their boats, and check the boat's engine. Their departure from the shore depends on the high tide hour which is usually between 05:00 AM to 07:00 AM. They reach the fishing ground at around 8:00 AM. In the fishing site, fishers start the actual fishing operation by setting the surface gillnet. This is done by deploying first the buoy followed by the main gear and the other buoy of the other end of the gear. On average, it takes about an hour to fully set the gear in the water. Once the gear is set, fishers stay in the boat just beside the buoy. The net is then left soaked in the water and the fishers utilize this time to talk with one another and nap. After 3 hours of soaking, fishers begin to check the net by pulling it towards the boat to check if there are already flying fish caught or gilled in the meshes. Whenever there are already gilled fishes, they will immediately get these and place on the deck of the boat and later place inside the bow. They will then have to wait for another 3 hours before the net is totally hauled. Thus, the net is soaked in the water for an average of 6 hours. At around 2:00 PM, fishers begin loading the net back to the boat, while concurrently taking the catch from the net. Finally, fishers are ready to land their catch and return home after a one-day fishing trip. Fishers usually have 1 haul per fishing operation. On the other hand, they add another haul for two reasons: (1) when the gear moved to an undesirable location due to the sudden change in the wind direction, thus change in the water current or, (2) when only few fish are caught during the first haul. In the second haul, the soaking time is reduced so that they can still return home on time. When catch is sold, income is usually divided to five, particularly for the three crew members who went to fishing, for the boat owner and the gear owner.

Emperua et al. (2017) reported that the flying fish in Maitum, Sarangani province were caught year-round. Though there were monthly variations of the catch, the seasonality of the fishery was not clearly observed during their 3-year study from 2013-2015. On the contrary, a peak season during the months of March to May was observed in Sta. Ana, Cagayan, and from February to May in the northeastern part of the country (Molina et al., 2018). In these periods, the water temperature is warmer which is expected to result to a higher primary productivity. In Guiuan, Eastern Samar, the flying fish fishers reported that the fishing for the species usually starts from late of March to early of December. In December, the northeast monsoon starts to precede, so the Pacific Ocean becomes rougher. The vulnerability of small-scale flying fish fishers to storms and greater water currents given that they use small pump boats and each of them fears the possibility of losing their gear result to the decrease in the number of fishing operations in the area. During this period, fishers shift to other fishing ground, particularly within Leyte Gulf. On the other hand, those who have commercial fishing vessels, such as those that are used for tuna fishing still continue to operate in the West Pacific waters since their fishing vessels are large enough to withstand stronger waves. Meanwhile, other fishers change fishing gear such as gillnets, spears, and hooks and lines locally

known as "pukot", "pana", and "kawil", respectively, to sustain their daily needs.

Catch Rates

The survey results indicate that flying fish fishers typically spend 9 to 11 hours with an average of 10 hours on their daily fishing trips. On the other hand, the average soaking time of surface gillnet per fishing trip was 6 hours. This soaking time is similar to the report of De Croos (2009) in the flying fish fishery in Sri Lanka.

The estimated CPUE (pc/panel, pc/hour) of flying fish landed in Guiuan from March to June is presented in Table 3. The CPUE was calculated according to the number of individuals or piece (pc) because this is the unit used in the conventional trading of flying fish catch in Guiuan. The CPUE calculated as pc/panel was based on the average number of panels used during each fishing operation which was 15. Conversely, the pc/hour was based on the average soaking time of the fishing gear (6 hours). The CPUE was generally higher in the month of March with 29 pc/panel or 74 pc/hour, suggesting a peak month for the fishery. The CPUE then declined in the succeeding months. In Surigao del Norte, Philippines, Gomez et al. (2019) reported that CPUE of flying fish in the area was highest in November with 15.11 kg/boat/day and lowest in the month of August with 6.82 kg/boat/day. In Makassar Strait, Palo et al. (2019) showed that the CPUE of *H. oxycephalus* fishery during the months of April to June ranged from 0.23 to 2.90 kg/haul with an average of 1.38 kg/haul and 0.47 to 8.93 kg/haul with an average of 3.28 kg/haul per piece of drift gillnet with mesh size of 2.54 cm and 3.18 cm, respectively. In the northwestern coast of Sri Lanka, the mean CPUE using set gillnet varied from 102±37.8 kg/boat/day to 224±82.7 kg/boat/day, wherein the highest catch was recorded in November 2002 and lowest in March 2003 (De Croos, 2009). The seasonal differences are attributed to oceanographic processes.

Table 3. Estimated catch per unit effort of the flying fish fishery in Guiuan, Eastern Samar, Philippines at an average of 15 panels of surface gillnets and average of 6 hours soaking time per fishing trip

Month	Catch per Unit Effort	
	pc/panel	pc/hour
March	29	74
April	28	70
May	16	40
June	6	16

Catch Composition

The flying fish fishery in Guiuan, Eastern Samar is dominated by flying fish species belonging to three genera including: 1) *Cheilopogon*, 2) *Cypselurus*, and 3) *Exocoetus*. On the other hand, other non-targeted species are also incidentally caught in the gear. Nevertheless, the majority of the bycatch species of the fishery are of economic and/or commercial value.

Flying fish are one of the most common fish landed in certain regions of the Philippines including Sarangani, Cagayan, Surigao and Camotes Island (Emperua et al., 2017; Molina et al., 2018; Gomez et al., 2019). It is critical to have knowledge on the variety and composition of the flying fish catch in order to properly manage the fishery. In Guiuan, Eastern Samar, the catch of the flying fish fishery using surface gillnet is mainly comprised of the target species composing more than 95% of the total catch. Similarly, Harsha et al. (2017) reported that the gillnet used in catching flying fish in Tharuvaikulam coast, India, is highly species selective. In the present study, it was found that small-scale fishers in Guiuan catch eight valuable species of flying fish as presented in Table 4. Majority of the samples obtained were comprised of *Cheilopogon* species including intermediate flying fish *Cheilopogon intermedius* (60%), many spotted flying fish *Cheilopogon spilopterus* (10%), stained flying fish *Cheilopogon spilonotopterus* (8.7%), Sutton's flying fish *Cheilopogon suttoni* (0.4%), margined flying fish *Cheilopogon cyanopterus* (0.3%) and Abe's flying fish *Cheilopogon abei* (0.1%). The two other species recorded were the yellowing flying fish *Cypselurus poecilopterus* (15.6%) and the tropical two-wing flying fish *Exocoetus volitans* (4.9%). The results of the catch composition suggest that the flying fish fishery in Guiuan, Eastern Samar is dominated by *C. intermedius*. This further suggests that the aforementioned species is the most abundant species of flying fish in the area at present. On the contrary, *C. suttoni* and *C. abei* recorded to have the least quantities in the fishing ground. In Surigao del Norte, *C. poecilopterus* was observed as the most dominant and abundant flying fish species in the area constituting 37.80% of the total sample (Gomez et al., 2019). On the other hand, *C. abei* was observed to dominate the catch in Maitum, Sarangani comprising 21.45% of the total catch (Emperua et al., 2017). In Danajon Bank, two species of flying fish namely: *Cheilopogon nigricans* and *Cypselurus opisthopus*, and a halfbeak *Oxyporhamphus convexus* constituted about 90% of the landings using drive-in nets (Dalzell, 1993).

Table 4. Species and size composition of flying fish landed in Guiuan Eastern Samar, Philippines

Flying Fish Species	N	%	Total Length (cm)			Body Weight (g)		
			Range	*Mean*	*SEM*	*Range*	*Mean*	*SEM*
Cheilopogon intermedius	600	60	22.00-30.50	26.51	±0.06	87.00-202.00	130.57	±0.96
Cheilopogon spilopterus	100	10	25.70-33.50	28.60	±0.15	97.00-234.00	163.06	±2.51
Cheilopogon spilonotopterus	87	8.7	23.30-29.50	25.87	±0.12	92.00-165.00	114.21	±1.47
Cheilopogon suttoni	4	0.4	30.20-33.40	31.83	±0.64	170.00-207.00	185.50	±7.85
Cheilopogon cyanopterus	3	0.3	28.80-33.30	30.63	±1.11	150.00-219.00	174.67	±18.14
Cheilopogon abei	1	0.1	24.20	24.20	-	91.00	91.00	-
Cypselurus poecilopterus	156	15.6	20.80-28.50	23.80	±0.11	67.00-194.00	103.20	±1.43
Exocoetus volitans	49	4.9	25.20-30.00	27.09	±0.21	90.00-196.00	134.57	±4.63
Total	**1000**							

In the waters of Ambon Island, Indonesia, the flying fish drift gillnet catch was dominated by three species including *C. suttoni*, *C. abei* and *H. oxycephalus* (Tupamahu et al., 2023). However, the flying fish catch in Ceram Sea which is also part of Indonesian water was dominated by *H. oxycephalus* (Tuapetel et al., 2015). This simply shows that the species composition of the flying fish fishery differs from fishing ground to fishing ground.

The sizes and weights of the flying fish species caught in Guiuan are also presented in Table 4. In general, the sizes of the catch did not seem to vary much. The smallest flying fish measured 20.80 cm (*C. poecilopterus*) while the largest measured 33.50 cm (*C. spilopterus*). The highest range value of 8.5 cm was recorded from *C. intermedius* which comprised the bulk of the catch. On the other hand, the lowest range of just 3.2 cm was recorded from *C. suttoni*. The narrow size ranges of the flying fish catch implies that the fishing gear used (surface gillnet) in the locality is generally size selective.

Length and Weight Relationship

A length and weight relationship (LWR) analyses were conducted for the three species of flying fish including *C. intermedius*, *C. spilopterus* and *C. poecilopterus*. For other species, LWR was not conducted due to the limited number of samples taken during the actual sampling. The coefficient of determination (R^2) values obtained by *C. intermedius* (Figure 2), *C. spilopterus* (Figure 3) and *C. poecilopterus* (Figure 4) were 0.78, 0.75 and 0.64, respectively. The R^2 values suggest a positive relationship between the body length and weight of the species especially *C. intermedius* and *C. spilopterus*. The study of Gomez (2020) also showed a positive LWR for *C. poecilopterus* with R^2 value ranging from 0.877 to 0.963.

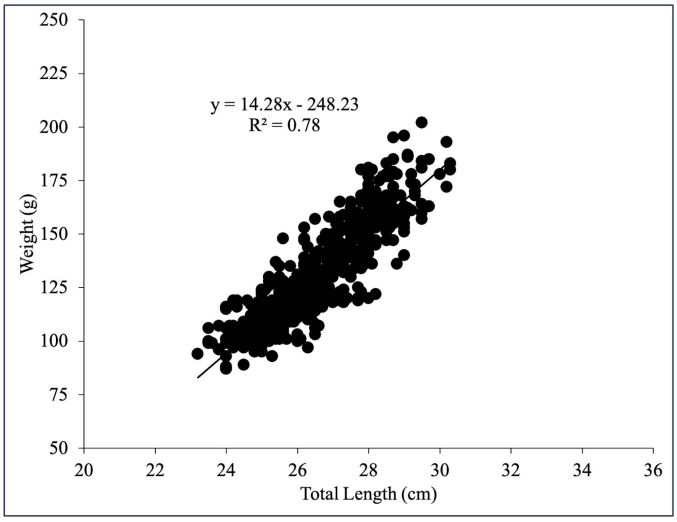

Figure 2. Scatter plot diagram showing the length-weight relationship of *Cheilopogon intermedius* (n=591)

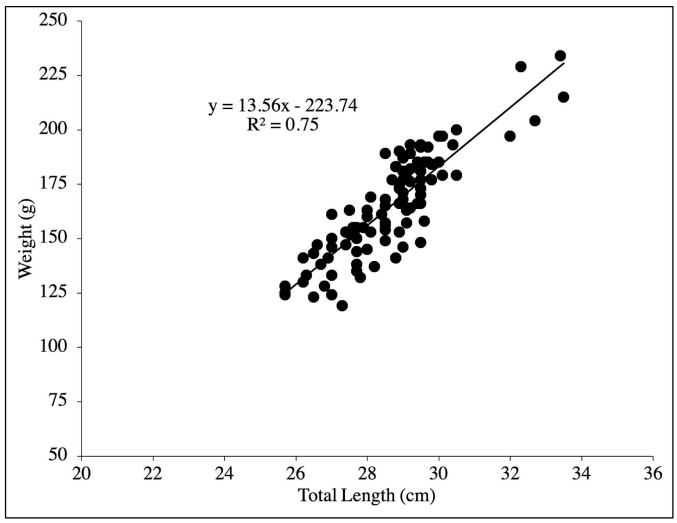

Figure 3. Scatter plot diagram showing the length-weight relationship of *Cheilopogon spilopterus* (n=97)

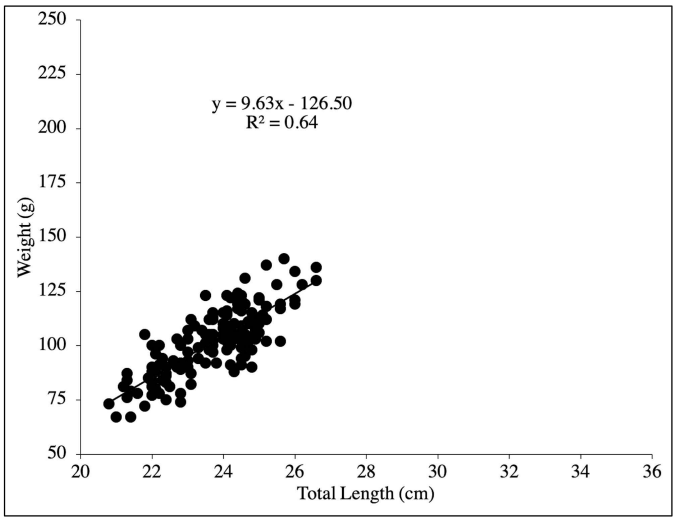

Figure 4. Scatter plot diagram showing the length-weight relationship of *Cypselurus poecilopterus* (n=150)

Bycatch Species

Based on the actual observation and reports of the fishers, bycatch in the flying fish fishery in Guiuan, Eastern Samar was relatively low, comprising of only 1-5 individuals per fishing operation representing only about 1% of the total catch. The recorded bycatch was comprised of seven species including needlefish *Tylosurus* sp., short mackerel *Rastrellliger brachysoma*, halfbeak *Hemiramphus* sp., Indo-pacific sailfish *Istiophorus platypterus*, skipjack tuna *Katsuwonus pelamis*, dolphinfish *Coryphaena hippurus* and common remora *Remora remora*.

Bycatch of the flying fish fishery in Guiuan except for *R. remora* are evidently economically and/ or commercially valuable species. These bycatch species are either sold or kept for household consumption by the fishers. Those large pelagic bycatch (i.e., sailfish, skipjack tuna, dolphinfish) are sold at the landing sites. Some fishers sell it to the middlemen present at the site, while others do sell it to the fish market.

Bycatch species caught in the flying fish fishery are observed to be all pelagic which proves that the fishery does not impact the bottom environment. On the other hand, some bycatch species generally cause damage to the target species, and the gear used particularly the large pelagic species such as swordfish and tuna which prey on flying fish. The gear gets damaged due to the heavy weight of these big fishes, especially that the gear is not designed to catch them. Molina et al. (2018), also recorded large bycatch species associated in the flying fish fishery in Cagayan which include dolphin, blue marlin, shark, and tuna. Contrarily, Harsha et al. (2017) reported no discards in the gillnet fishery targeting flying fish in Tharuvaikulam coast, India.

Product Flow and Catch Utilization of Flying Fish

The product flow of the fresh flying fish landed by the fishers in Guiuan, Eastern Samar, Philippines is simple and straightforward (Figure 5). The product basically goes to three routes — to the fish processors/ driers, tuna fishers, and middlemen as first-level buyers. After which, the product is finally distributed to two end users — the household consumers and tuna fishers.

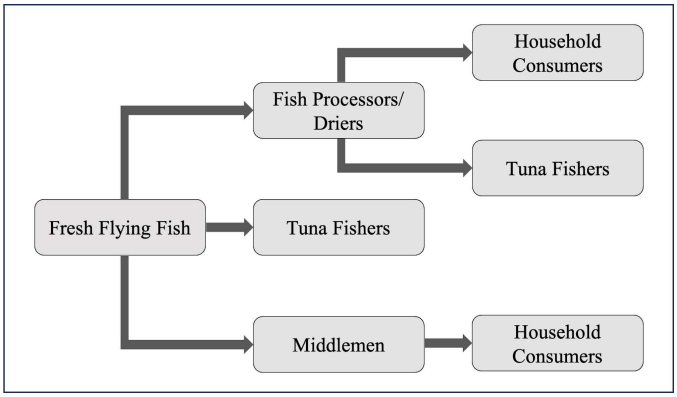

Figure 5. Product flow of the flying fish landed in Guiuan, Eastern Samar, Philippines

About 97% of the fresh flying fish are sold to fish processors/ driers. Since the bulk of the flying fish goes directly to the processors, the tuna fishers buy fresh flying fish from them to be used as bait for their tuna fishing. Processors provide to some fishers a capital for gasoline that they use in their fishing trips. So, in return, fishers are obliged to sell all their catch to them. As such, tuna fishers often cannot buy directly from the flying fish fishers. On the other hand, the processed/ dried flying fish are sold to the household consumers. In rare cases, usually during peak season when the flying fish catch is abundant, middlemen such as wholesalers and retailers from outside the municipality, as well as tuna fishers, buy directly from the fishers. The middlemen then sell the flying fish to the household consumers. In total, 80% are utilized by household consumers either fresh or dried (10% as fresh while 70% as dried fish and roe), and 20% as fresh (as bait for tuna fishing) by tuna fishers. In Sta. Ana Cagayan, 97-100 % of the flying fish catch is sold to the middlemen/ traders. Flying fish in the area are primarily utilized for human consumption (Molina et al., 2018). Similarly, the flying fish in Surigao del Norte are mainly used for local consumption. The catch is sold directly to the consumers as fresh or dried fishery product. The eggs particularly of the *Hirundichthys affinis* is also sold for the caviar production (Gomez et al., 2019). On the other hand, some fishers use the species as bait in line fishing. In Batanes, flying fish is also used for human food and as bait (Sui, 2013).

Socio-economic Importance of Flying Fish in Guiuan

Flying fish are primarily targeted for human consumption since they are a good source of protein. Its meat is an excellent source of amino acid, and its lipid contains high level of docosahexaenoic acid (Harewood et al., 1993). The fishery for flying fish is undeniably a valuable source of livelihood for specific areas in the Philippines such Sarangani province and Surigao del Norte (Emperua et al., 2017; Gomez et al., 2019). In Guiuan, Eastern Samar, flying fish, play an important role in the livelihood and sustenance of the municipal fishing households, who rely mostly on the flying fish fishery. Not only the fishers can benefit from the fishery but also the middlemen, vendors, peddlers and other fisherfolk who are engaged in the flying fish supply chain. The tuna fishers also benefit from the fishery where they use flying fish as bait.

The municipal fishers in Guiuan catch flying fish to meet their daily needs. According to the survey results, the average catch of fishers from their daily trips ranges from 200-500 pieces. Depending on the season, flying fish are sold per piece at varied costs. According to the interviewed fishers, the flying fish fishery in the area has two peak seasons. The first peak is from March to May, while the second is from September to November. Flying fish species are usually sold at a higher price during the first two months (March and April) of the first peak season because the demand is high. During these months, flying fish are usually priced between PHP 15.00 to PHP 20.00 per piece. In contrast, flying fish are sold at a lesser price, between PHP 8.00 to PHP 10.00 during the month/s of May and June, since supply is already abundant during the past months.

An average of 97% of the total flying fish catch are sold to fish processors being the direct buyers. Processors buy the catch at a wholesale price and pay the fishers at the agreed time, that is, when processors have already sold the dried flying fish, usually within a week. In the case of tuna fishers, they incur greater expenses as they typically purchase flying fish from processors. On the other hand, smaller-sized flying fish (<24 cm) caught in the fishery, which was observed during the data collection, are considered as rejects with no market value. These "rejects", which comprise only about 5% of the total catch, are brought home by the fishers and used for household consumption.

The "iliw" (dried flying fish) is undeniably starting to be known as a fishery commodity. In fact, it is one of the most wanted products in Guiuan, which tourists always look for, and Taytay specifically is the famous producer of dried flying fish in the region. The price of dried flying fish varies depending also on the season. For instance, during the first two months of the peak season, its usual price ranges between PHP 20.00 to PHP 25.00 per piece. But for the succeeding months, price drops to only PHP 10.00 to PHP 15.00 per piece.

Conclusion

The present study is the first comprehensive documentation of the flying fish fishery in Guiuan, Eastern Samar, Philippines. This provides significant information on the demographic profile of the fishers, the fish catch and fishing practices, the product flow, and the importance of the fishery to the socio-economic dimension of the local community. Being a valuable fishery in the area, particularly among the local municipal fisherfolk and tuna fishers, the results of this study may serve as an important scientific baseline information that may help in crafting sound local management plans specific for the flying fish fishery and for the sustainable utilization of the commodity in Guiuan, Eastern Samar.

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Compliance With Ethical Standards

Author's Contribution

NQB: Conceptualized and conducted the study, analyzed and interpreted the data, and prepared the draft of the manuscript.

RMPG: Helped in the conceptualization of the study, finalized the study design, helped in the data analysis and interpretation, reviewed and finalized the manuscript.

SAM: Helped in the conceptualization of the study, and reviewed the manuscript.

BBCS: Helped in the conceptualization of the study, and reviewed the manuscript.

All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required.

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Data Availability Statement

The datasets generated during the current study are available from the corresponding author on reasonable request.

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