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Feeding biology of flat needle fish, *Ablennes hians* (Valenciennes, 1846) from Veraval fishing harbour, Gujarat

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Abstract

The Present study investigated the feeding biology of Flat Needle Fish, (*Ablennes hians*) in the Veraval fishing harbour, Gujarat, a total of 300 specimens were collected in August 2024 to May 2025, and different indices of Feeding intensity, Index of Relative Importance (IRI), and GaSI (Gastro-somatic Index) were taken into consideration. Stomach fullness analysis showed that 29.33% of specimens had empty stomachs, while the remaining individuals exhibited varying degrees of feeding activity. Diet composition revealed that *A. hians* is predominantly carnivorous, feeding mainly on fishes, crustaceans, and molluscs. Fish constituted the dominant prey group with the highest IRI (63.71%), followed by crustaceans (29.96%) and molluscs (6.34%). Semi-digested fish remains formed the major dietary component (52.58%). Sardines sp., *Stolephorus* sp., *Bregmaceros maclellandi*, and *Nemipterus japonicus* were also recorded in varying proportions throughout the year. Among crustaceans, *Acetes* sp. was most abundant in March, September, and October, while squid peaked in November and was absent in March. Seasonal variations in feeding activity were evident from GaSI values, with the highest overall value recorded in October (3.677 ± 0.740) and the lowest in March (1.959 ± 0.090).

Keywords: Feeding Biology, *Ablennes hians*, Feeding Intensity, Index of Relative Importance (IRI), Gastro somatic Index (GaSI), Veraval, Gujarat

1. Introduction

The fish and fisheries sector has been of tremendous importance for India's food, nutrition, way of World fisheries and aquaculture production rose to 223.2 million tonnes (MT), with 185.4 MT of aquatic animals. The total world capture fisheries production is 92.3 MT, with aquatic animals accounting for 91.0 MT, including 79.7 MT from marine waters and 11.3 MT from inland waters (FAO, 2024).

The Belonidae family is made up of 10 genera and 34 known species throughout the world. *Tylosurus* and *Ablennes* are solely marine, whereas the genus *Belone* is found in marine as well as brackish habitats (Pauly and Froese, 2024) [11]. The genus *Ablennes* is represented by the Flat Needle Fish, *Ablennes hians* (Sabrah *et al.*, 2017) [14]. Because of their excellent flavor, these fishes are highly commercially important in pelagic fisheries. They are predominantly caught on the Indian coast and surrounding islands with gill nets and hook-and-line, and sold in fresh, frozen, or smoked conditions (Collette, 2003) [4]. Family Belonidae comprises surface-dwelling fishes with a blue or green back and silvery white belly, giving them camouflage in their surroundings. The fish possess a slender body and may be very long or short, with a maximum length of 2 meters.

The *Ablennes* species have a long, thin, slightly compressed body usually with vertical stripes. The upper and lower jaws are both extended into beak-like teeth, each lined with a series of small, pointed teeth, while the vomer and palate are toothless. A broad dark blue stripe runs along the sides with about 12 to 14 prominent dark vertical bars on the body. They are big, vicious predators that occur mostly in tropical and subtropical seawater. The scales and bones are green in colour (Fischer and Bianchi, 1984) [7]. Its distribution includes the Pacific Ocean, the Atlantic Ocean and the Indian Ocean. These pelagic fish, which inhabit surface waters, are carnivorous, primarily feeding on small pelagic fishes. (Collette, 2003) [4].

Their distribution is restricted to shallow depths, ranging from 1 to 10 meters. According to Jawad (2017) needlefish can jump 60 km/h when they are not in the water.

Understanding food and feeding habits plays a crucial role in identifying a species' habitat, dietary preferences, and its relationships within different trophic levels. Gaining insight into the reproductive biology of fish is equally important for the sustainable management and effective utilization of fish populations (Cochrane, 2002; Temesgen, 2017) [3]. Changes in feeding behaviour can reveal key aspects of ecological interactions between predators and their prey, offering valuable information for the conservation and management of fishery resources.

2. Materials and Methods

2.1. Study area and Specimen collection

Specimen of the Flat Needle Fish, *Ablennes hians* (n=300), were collected monthly over ten months from August 2024 to May 2025. Sampling was conducted at Veraval fishing harbour (20°54'912"N and 70°21'355"E), Gujarat, India. Veraval is one of the major fish landing centers on the Gujarat coast, with high fish landings, harbour size, and number of boats operating, among which trawlers are most frequent.

2.2. Biological measurement and laboratory processing

Following collection, each specimen was transported on ice to the laboratory. For every individual, The Total Length (TL) and Total Body Weight (W) was recorded. Specimens were dissected for the removal of gut. The gut was also analyzed to determine the food items, with their number and weight per category.

2.3. Feeding biology

2.3.1 Feeding intensity of *A. hians*

The stomachs were classified as full, 3/4 full, 1/2 full, 1/4 full, trace full, and empty. The intensity of feeding was determined by the degree of stomach distension due to food consumption and the amount of food present (Manojkumar *et al.*, 2015) [10].

2.3.2 Index of Relative Importance (IRI)

Fish diet research is primarily centered on three aspects: the quantity of prey (n), their weight (w), and the frequency of their appearance (f). The gut of the fish is opened, and different food material is extracted and sorted to the finest

taxonomic level.

The IRI is an aggregate measure of the number, volume, and occurrence frequency to assist in evaluating the relationship between various food items in the stomach. It is obtained by summing the number percentage and volume percentage values and then multiplying the result by the occurrence frequency percentage.

The gut was dissected, and each type of food item present was identified and counted. The numerical percentage (N%) was calculated using the formula:

$$N\% = (\text{Total number of a specific food item in a month} / \text{Total number of all food items}) \times 100$$

$$F\% = (\text{Frequency of a specific food item} / \text{Frequency of all food items}) \times 100$$

$$W\% = (\text{Weight of a specific food item} / \text{Total weight of all food items}) \times 100$$

The Relative Importance Index (IRI) of the different foods in the gut was computed following the protocol described by Pinkas *et al.* (1971).

$$IRI = (\%N + \%W) \times \%F$$

Where, N = Number, W = Weight, and F = Frequency of occurrence

2.3.3 Gastro-somatic index (GaSI)

Gastro-somatic Index (GaSI) is a useful measure for comparing feeding patterns between different months and evaluating the influence of environmental and physiological factors on feeding behaviour. GaSI was computed through the formula given by Desai (1970) [5].

$$GaSI = (\text{Total weight of gut} / (\text{Total weight of fish}) \times 100$$

2.4. Statistical Analysis

The statistical analysis of the research was conducted based on Microsoft Excel 2019 software as guided in the standard literature by Snedecor and Cochran (2014) [3].

3. Results and Discussion

3.1. Feeding Intensity

Table 1: Monthly variation of feeding intensity of *A. hians*

Month	Empty	Trace	¼ Full	½ Full	¾ Full	Full stomach	Gorged
Aug	33.333	13.333	20.000	13.333	10.000	6.667	3.333
Sep	26.667	16.667	13.333	13.333	13.333	13.333	3.333
Oct	16.667	10.000	23.333	20.000	10.000	13.333	6.667
Nov	23.333	13.333	16.667	13.333	16.667	10.000	6.667
Dec	20.000	20.000	20.000	16.667	10.000	10.000	3.333
Jan	26.667	16.667	20.000	10.000	10.000	13.333	3.333
Feb	40.000	16.667	13.333	13.333	6.667	6.667	3.333
Mar	36.667	23.333	16.667	10.000	6.667	6.667	0.000
Apr	33.333	16.667	16.667	10.000	13.333	10.000	0.000
May	36.667	10.000	16.667	13.333	13.333	10.000	0.000

In the present study, the feeding intensity percentages of *A. hians* were ascertained as follows: 29.33% with empty stomachs, 15.67% with trace amounts, 17.67% with ¼ full stomachs, 13.33% with ½ full stomachs, 11.00 with ¾ full

stomachs, 11.00 with full stomachs, and 3.00 with gorged stomachs. The highest percentage of empty stomachs was observed in February, while trace stomachs were most frequent in March. The ¼ and ½ full stomachs were most

commonly observed in October. The $\frac{3}{4}$ full stomachs peaked in November, and full stomachs were most prevalent in September, October and January. The gorged stomachs were mainly observed in October and November.

Similar findings, Roul *et al.* (2023) ^[13] studied the feeding intensity of *A. hians* and reported that 349 specimens had food filled stomachs, while 47 specimens (11.87%) had empty stomachs, indicating seasonal variation in feeding habits. Similarly, Chaari *et al.* (2016) ^[1] observed that 55.4% of *Tylosurus acus imperialis*, specimens had empty stomachs, while 44.6% contained food. They suggested that feeding intensity was influenced by reproductive cycles,

with reduced feeding during spawning periods, and noted the species showed opportunistic feeding behaviour. Sever *et al.* (2009) ^[16] analysed the feeding intensity of garfish *Belone belone* and found that 20.85% empty guts and 79.2% contained food guts.

The feeding intensity of *A. hians* appears to be influenced by both sex and age, with variations in the number and weight of prey consumed, but overall, the species maintains a consistent feeding behaviour across different groups (Roul *et al.*, 2023) ^[13].

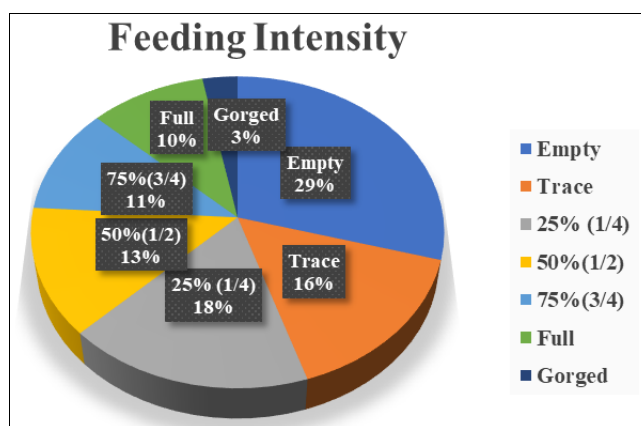


Fig 1: Variation in the feeding intensity of *A. hians*

Empty stomach conditions in fish may occur due to regurgitation, feeding schedules, limited food availability, low digestibility, physiological changes, health problems, or weak metabolic activity. Feeding activity often decreases during peak breeding, as the stomach space becomes restricted by the fully developed gonads (Kiran & Puttaiah, 2004).

3.2 Analysis of gut content

According to present study, *A. hians* is a carnivorous fish that predominantly feeds mainly on small fish and crustaceans. Of the stomach contents analysed, fish was the most dominant group.

The most commonly identified fish species in the diet included *Sardine* sp., *Stolephorus* sp., *Bregmaceros*

mccllellandi and *Nemipterus japonicas* along with semi-digested fish. Species identification was difficult because the fish remains were partially digested, consisting of degraded parts like vertebrae, damaged heads, scales, otoliths, and various other body fragments. Within the crustacean group, *Acetes* sp. was commonly found while among molluscs group, squid sp were identified in the gut of *A. hians*. Most of the digested material was fully decomposed, exhibiting black, yellow or white coloration in both crustacean and molluscs group. A related study by Roul *et al.* (2023) ^[13] along the southwest coast of India (Kerala), also reported that flat needlefish are carnivorous pelagic predators, which mainly prey on teleost fishes, molluscs, and crustaceans.

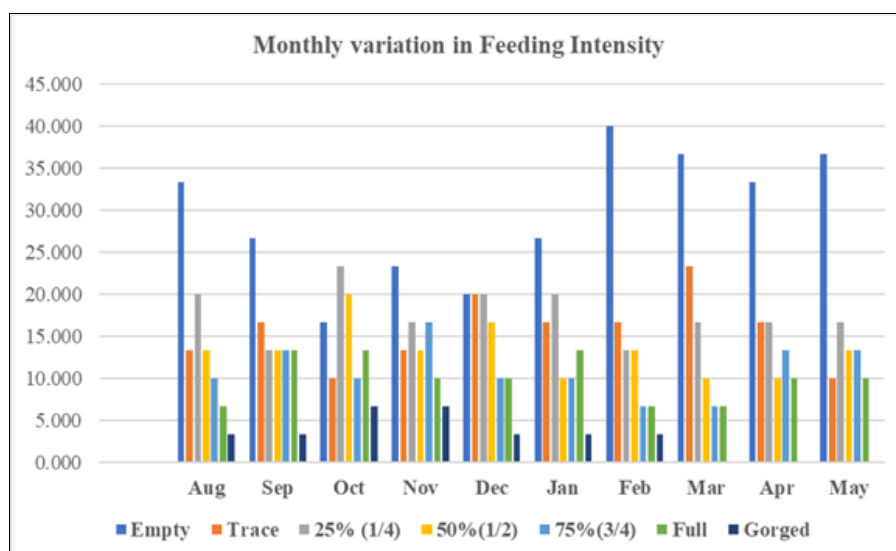


Fig 2: Monthly variation in feeding intensity of *A. hians*

3.3 Index of Relative Importance (IRI)

Table 2: Monthly Index of Relative Importance (IRI) of different food items of *A. hians*

Food items	Months									
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fishes										
<i>Sardine sp.</i>	3.29	5.23	7.52	3.52	17.54	3.09	5.48	7.66	0.00	3.11
<i>Stolephorus sp.</i>	1.48	1.34	3.68	7.89	0.51	2.36	0.85	1.98	3.97	0.90
<i>Nemipterus sp.</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	2.95	2.90
<i>Bregmaceros sp.</i>	2.07	3.39	7.68	3.03	2.90	2.08	0.22	0.35	1.64	0.00
Semidigested fish	62.34	45.14	68.18	33.41	46.03	65.38	47.56	43.66	53.87	60.25
Crustacean										
<i>Acetes sp.</i>	11.80	16.66	15.79	13.04	9.94	6.66	4.99	24.37	12.08	6.09
Semidigested material	12.24	19.00	14.49	18.85	17.19	15.61	18.80	21.35	22.51	18.03
Molluscs										
Squid sp.	4.56	4.07	0.10	11.25	4.57	4.10	1.12	0.00	2.28	6.26
Semidigested material	2.18	5.13	3.14	8.96	1.28	0.68	0.31	0.26	0.67	2.43

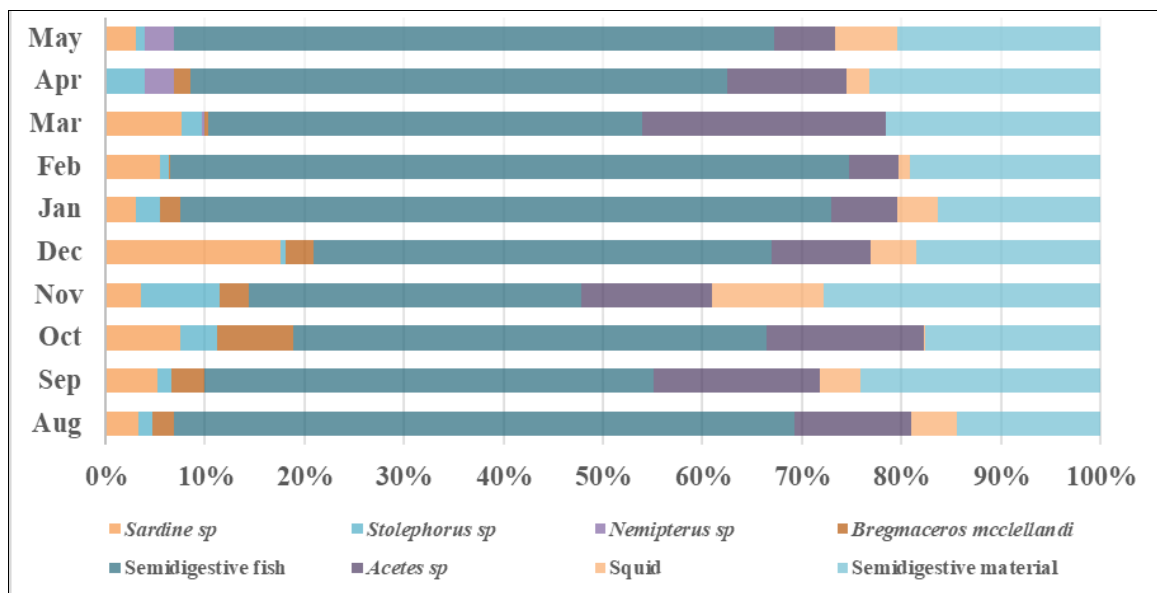


Fig 3: Monthly variation in Index of Relative Importance (IRI) of different food items of *A. hians*

Table 3: Monthly Index of Relative Importance of different food groups of *A. hians*

	Months									
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Fishes										
% N	30.1	35.42	47.3	31.3	53.7	37.5	41.8	35.2	34.7	33.7
% W	58.2	54.9	57.5	52.5	61.5	66.3	68.4	64.6	53.8	58.6
% F	62.6	51.3	61.7	52.7	60	61.4	62.9	57.6	62	59.2
IRI	2473	1716	2041	1351.3	2186.4	2723	3514	2136	2237	2432
% IRI	69.2	55.1	66.5	47.8	66.9	73	74.8	54.1	62.5	67.2
Crustaceans										
% N	42.1	45.8	46.3	43.7	42.1	38.8	43.7	64.9	43	35.2
% W	30.9	33.4	36.8	31.8	29.2	25.7	27.8	34.4	37.8	29.8
% F	25	29.7	25.5	26.3	27.5	29.2	29.6	38.5	31	25.9
IRI	859	1110	930.6	900.2	885.7	832.1	1118	1808	1239	873.9
% IRI	24	35.6	30.3	31.9	27	22.3	23.8	45.8	34.6	24
Molluscs										
% N	27.7	18.7	16.3	25	19	23.8	14.5	1.8	22.2	31.0
% W	10.9	11.6	5.7	34.5	9.3	7.9	3.8	1.0	8.5	11.6
% F	12.6	18.9	12.8	21	12.5	9.7	7.4	3.8	6.8	14.8
IRI	241	286	139.1	570.5	191	179	67.8	10.6	105	314.9
% IRI	6.7	9.21	3.25	20.2	5.8	4.8	1.	0.27	2.95	8.7

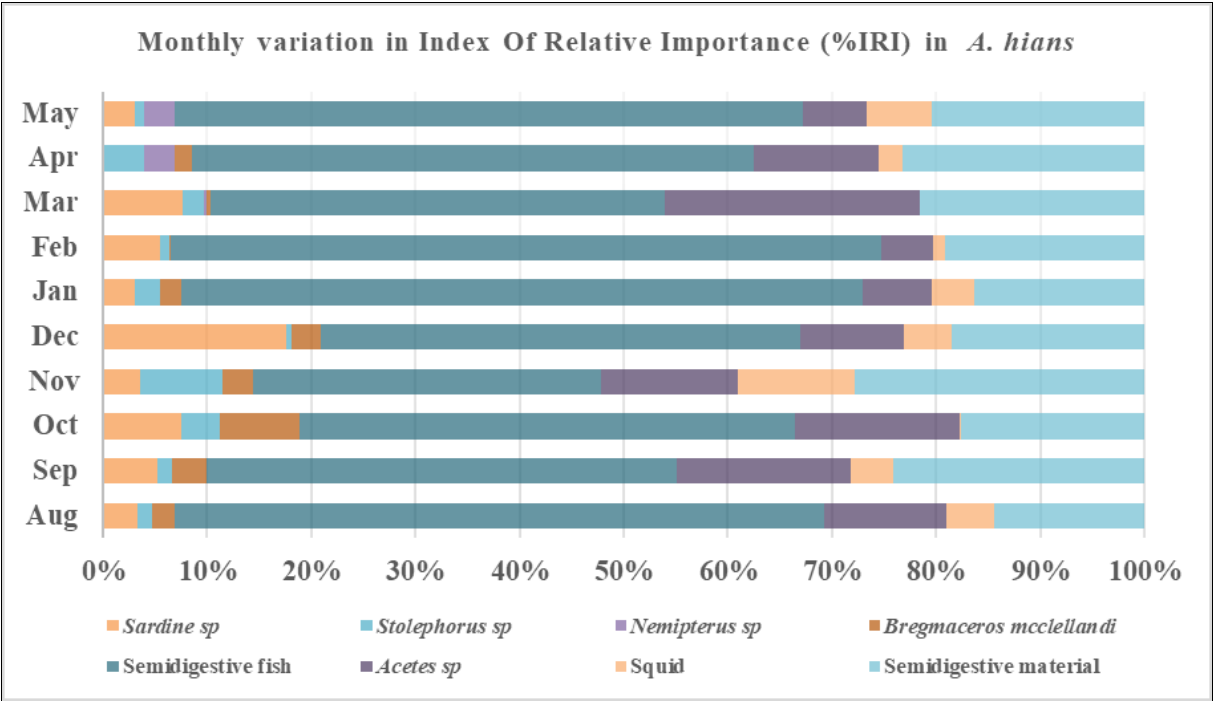


Fig 4: Monthly variation in IRI of different food groups of *A. hians*

Table 4: Index of Relative Importance (IRI) of different food items of *A. hians*

Food items	% N	% W	% F	IRI	% IRI	Rank
Fishes						
Sardine spp.	6.41	13.52	8.27	197.35	5.63	5
Stolephorus spp	4.97	4.18	8.24	82.99	2.6	6
Nemipterus spp	1.02	1.3	2.52	22.4	0.62	9
Bregmaceros spp.	4.84	3.76	6.97	75.76	2.32	8
Semidigested fishes	20.07	36.83	33.11	1902.6	52.59	1
Crustaceans						
Acetes spp.	33.1	11.32	9.1	421.96	12.14	3
Semidigested crustaceans	11.45	20.42	19.64	633.87	17.81	2
Molluscs						
Squid spp.	16.02	5.65	5.29	126.99	9.17	4
Semidigested molluscs	3.87	5.94	6.52	78.59	2.5	7

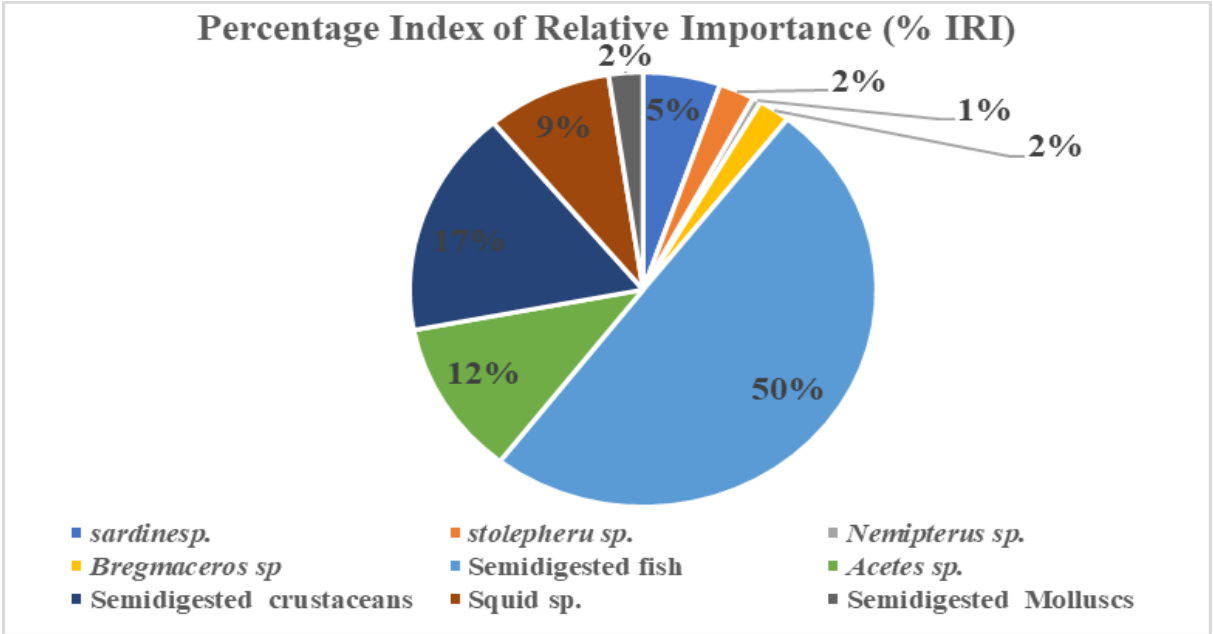
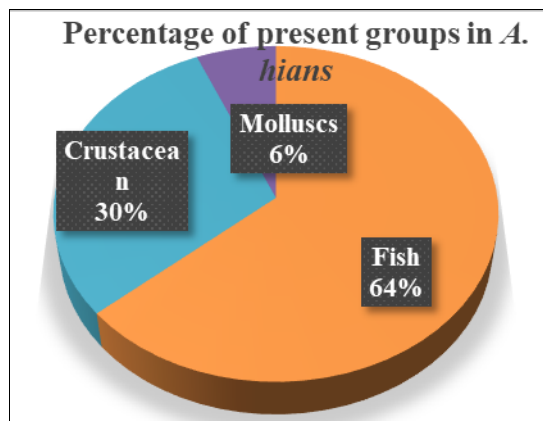


Fig 5: Index of Relative Importance (IRI) of different food items of *A. hians*

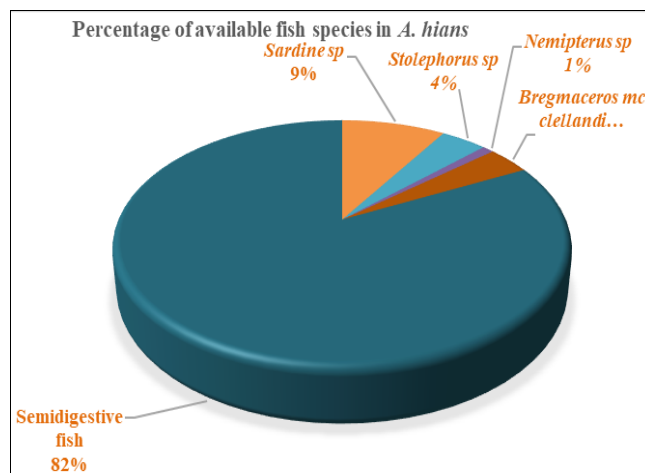
Table 5: Index of Relative Importance (IRI) of different food groups of *A. hians*

Food items	% N	% W	% F	IRI	% IRI	Rank
Fishes	38.07	59.63	59.14	2281.2	63.71	1
Crustaceans	44.56	31.76	28.82	1055.9	29.96	2
Molluscs	20.01	10.48	12.04	210.68	6.34	3

In the present study, the Index of Relative Importance (IRI) revealed that fish (IRI=63.71%) ranked first among the food item ingested by *A. hians*, followed by crustaceans (IRI=29.96%) in second place and molluscs (IRI= 6.34%) in third. (Table 5 and Figure 6).

**Fig 6:** Index of Relative Importance (IRI) of different food groups of *A. hians*

Among the fish remains, semi-digested fish constituted the highest percentage (52.58%), with peak occurrences in month of August, January, February and May and less occurrences in November, December and March. *Sardine* sp. made up 5.64%, with the highest percentage observed in December, October and March. *Stolephorus* sp. accounted for 2.50% and was available during a majority of the year, such as August, September, October, November, December, January, February, March, April and May. *Bregmaceros maclellandi* comprised 2.34% of the diet, with the highest percentage found in September, October and November. *Nemipterus japonicus* accounted 0.61% found in March, April and May. Among the crustacean, *Acetes* sp. showed peak abundance in March, September and October, while its lowest numbers were recorded in January, February and May. For molluscs, squid spp. showed the highest abundance in November, with the lower occurrences in February, October and April. Notably, squid was completely absent in month of March.

**Fig 7:** Percentage of available fish species in diet of *A. hians*

In the present study, semi-digested fish were found in the stomachs of *A. hians* throughout all months of observation. Similarly, Roul *et al.* (2023) [13] have also documented the same observations while making an analysis of the composition of food in flat needle fishes along the Kerala coast. According to their research, the Index of Relative Importance (IRI) showed that teleosts were the most frequently encountered food constituents, with 65.43% contribution towards the diet, followed by molluscs and crustaceans with 32.91% and 1.66%, respectively. They also noted the most commonly encountered food items in the diet were teleosts, comprising *Decapterus russelli* (%IRI = 17.75), *Sardinella longiceps* (%IRI = 0.51), *Bregmaceros maclellandi* (%IRI = 0.14), and *Nemipterus japonicus* (%IRI = 0.05), followed by crustaceans and molluscs. Similar findings, Chaari *et al.* (2016) [2] also provided information on the diet of the Tunisian coast Mediterranean needlefish (*Tylosurus acus imperialis*), where it comprised 62.6% fish. The identified fish families included Mugilidae, Gobiidae, and Belonidae. Crustaceans were 37.3% of the diet, where decapods were found to be the most prevalent, with *Sicyonia carinata* comprising 5.4% of the overall diet.

3.4 Gastro-Somatic Index (GaSI)

Table 6: Monthly variation in GaSI of *A. hians* (Mean± S.E)

Month	Mean GaSI		
	Male	Female	Pooled data
August	3.626 ± 0.970	2.734 ± 0.151	3.229 ± 0.431
September	3.879 ± 0.815	2.778 ± 0.238	3.291 ± 0.413
October	4.616 ± 2.051	2.708 ± 0.199	3.677 ± 0.740
November	3.224 ± 0.464	2.550 ± 0.159	2.719 ± 0.196
December	2.462 ± 0.254	2.509 ± 0.209	2.430 ± 0.178
January	2.359 ± 0.191	2.376 ± 0.132	2.359 ± 0.113
February	2.124 ± 0.131	2.173 ± 0.167	2.203 ± 0.127
March	2.118 ± 0.122	1.88 ± 0.098	1.959 ± 0.090
April	2.012 ± 0.105	2.225 ± 0.170	2.083 ± 0.110
May	2.291 ± 0.143	2.365 ± 0.107	2.309 ± 0.095

In the present study, male *A. hians* showed the highest Gastro-Somatic Index (GaSI) value found in the month of October (4.616), followed by September (3.879), August (3.626), November (3.224), December (2.462) and January (2.359). In contrast the lowest GaSI values for males were recorded in the month of April (2.012), then March (2.118), February (2.124) and May (2.291). The GaSI value was highest in female *A. hians* was observed in the month of September (2.778) followed by August (2.734), October (2.708), November (2.550), December (2.509), January (2.376), and May (2.365) on the other hand the lowest

values were recorded in March (1.880), February (2.173) and April (2.225). In pooled data showed the highest GaSI value found in the month of October (3.677) followed by September (3.291), August (3.229), November (2.719) and December (2.430). In contrast the lowest GaSI values observed in March (1.959), April (2.083), February (2.203), May (2.309) and January (2.359). Roul *et al.* (2023)^[13] indicated that the maximum count of prey items in *A. hians* from the southwest coast of Kerala, India, was recorded during October and November, followed by June to September, and then March to May.

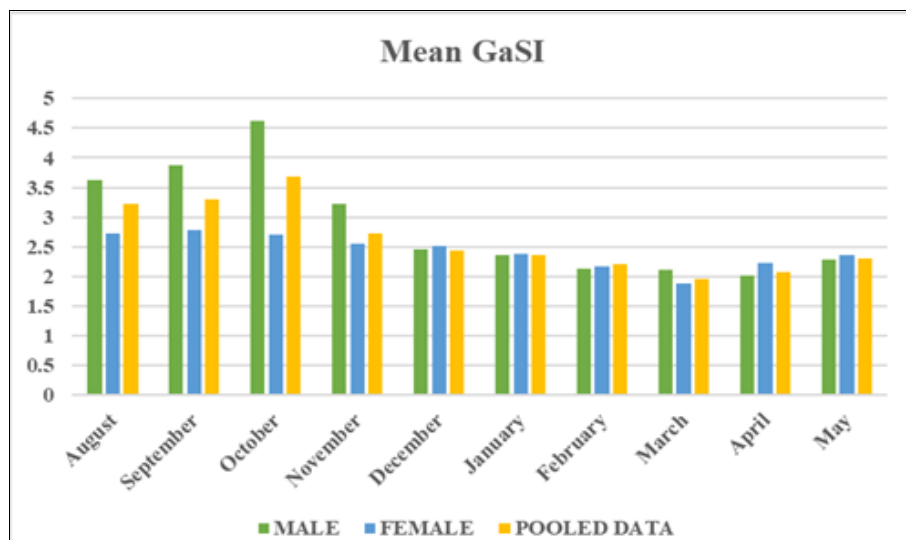


Fig 8: Monthly variation in the mean GaSI of *A. hians*

4. Conclusion

The study provides valuable insights into the feeding ecology of *A. hians* landed at Veraval Fishing Harbour along the Gujarat coast of north western India. Analysis of stomach contents revealed that *A. hians* is a carnivorous species, with fishes and crustaceans constituting its principal diet, indicating its role as a mid-to-upper trophic level predator in the coastal marine ecosystem. The population examined was dominated by females throughout the study period, suggesting possible differences in distribution, behavior, or habitat utilization between sexes. Seasonal variation in feeding intensity was evident from the Gastro-somatic Index (GaSI), which reached its maximum value in October (3.677 ± 0.740) and minimum value in March (1.959 ± 0.090), reflecting temporal changes in feeding activity that may be associated with reproductive cycles and prey availability. These findings contribute to the limited biological information available for *A. hians* in Indian waters.

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