ZIBELINE INTERNATIONAL™ PUBLISHING

ISSN: 2521-0858 (Print)
ISSN: 2521-0866 (Online)
CODEN: SHJCAS

Science Heritage Journal (GWS)

DOI: http://doi.org/10.26480/gws.01.2026.09.18

RESEARCH ARTICLE

PRELIMINARY GUT CONTENT AND MICROPLASTIC SCREENING IN FOUR COMMERCIAL MARINE FISH FROM JOHOR, MALAYSIA

Chee Kong Yap*, Mohamad Izzuddin Mohd Hadir, Muhammad Ammar Ramlee, Muzammil Mohd Latif, Muhd Aqil Syukran Baharuddin, Anis Yasmin Hafizan, Wan Farhanah Qistina Khairulnizam, Anis Izzani Mohd Liza, Bazlin Nadhirah Mohd Zaki, Fitrah Athirah Mohd Fauzi, Nur Aliyaa Aqilah Mohd Basahri, Puteri Nur Fatihah Rahim, Ezani Ishak Hashim, Helmy Rozario Ahmad Yusoff, Rosimah Nulit and Wan Mohd Syazwan

Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
****Corresponding Author Email: yapchee@upm.edu.my***

ARTICLE DETAILS

Article History:

Received 23 December 2025
Revised 28 December 2025
Accepted 24 January 2026
Available online 13 February 2026

ABSTRACT

Microplastic pollution is increasingly found in seafood, but there is a lack of baseline data for many Malaysian commercial fish. This preliminary study sought to (i) characterize stomach content composition and (ii) carry out a preliminary visual search for possible microplastics in four popular commercial species of fish sold in Johor, Peninsular Malaysia: Indian mackerel (*Rastrelliger kanagurta*), herring scad (*Alepes vari*), donkey croaker (*Pennahia anea*), and Indian threadfin (*Leptomelanosoma indicum*). Fresh and unblemished fish were measured (total and standard length), dissected, and stomach contents analyzed under a light microscope (100×-400×) after gentle agitation with distilled water. In general, natural prey consisted mainly of planktonic fractions (e.g., copepods and phytoplankton fragments) with supplementary benthic cues such as polychaetes, crustacean parts, eggs, detritus, and shell fragments, suggesting pelagic-demersal linkages in coastal food webs. Fibrous and other non-cellular particles without overt biological detail were sporadically encountered and recorded as possible microplastics based on morphology (shape, uniformity, and color), but polymer identification was not attempted. In any case, the findings offer a preliminary descriptive baseline for these market fishes and demonstrate the utility of gut content ecological studies in conjunction with preliminary microplastic analysis to inform future quantitative surveys with contamination control, density fractionation, and spectroscopic analysis. These observations are timely because all four species are popular in Malaysian cuisine. Future research should extend coverage, sample size, procedural blanks, particles per fish and per gram, and polymer identification by FTIR spectroscopy.

KEYWORDS

microplastics; stomach content; commercial fish; Johor; Malaysia

1. INTRODUCTION

Marine plastic pollution, especially microplastics, has emerged as a pressing global issue because of its persistence, widespread distribution, and potential interactions with marine organisms across trophic levels. Microplastics have been generally described as plastic particles <5 mm in size and have been widely reported in marine environments, sediments, and organisms (Hidalgo-Ruz et al., 2012; Wright et al., 2013). Of special concern is the ingestion of microplastics by fish, which are a vital link between lower and higher trophic levels and higher predators, including humans (Rochman et al., 2013; Smith et al., 2018). Ingestion of microplastics has been demonstrated to occur incidentally when they resemble natural prey items in size, shape, or density, especially in environments where plastic debris co-occurs with plankton and detrital particles (Boerger et al., 2010).

Feeding ecology is a critical determinant of exposure pathways to microplastics. Pelagic and semi-pelagic fish that feed on plankton are especially susceptible to microplastic ingestion because microplastics tend to co-occur with planktonic prey in the water column (Wright et al., 2013). Traditional food-web analyses have long demonstrated that copepods and other small zooplankton are a central energy conduit in coastal marine ecosystems, while phytoplankton ingestion may occur either directly or indirectly through trophic transfer (Kiørboe, 2011; Banse, 1995; Turner, 2004). In contrast, demersal and benthic-associated fish tend to consume crustaceans, polychaetes, eggs, and small fishes, reflecting benthic–pelagic coupling and seasonal prey availability (Pauly and Christensen, 1995; Thorson, 1950). Such differences in feeding ecology suggest that microplastic ingestion is more closely linked to ecological strategy than to taxonomic identity.

In Southeast Asia, and especially in Malaysia, marine waters are facing growing human pressure due to population density, urbanization, and riverine discharge, thus being considered potential microplastic hotspots (Lebreton et al., 2017). Recent Malaysian data has ascertained the presence of microplastics in commercially valuable pelagic fish species, such as Indian mackerel and yellowtail scad, with quantifiable particle abundances reported from the east coast of Peninsular Malaysia (Ahmad Nawawi et al., 2025). At the species level, additional dietary information further refines these considerations: Indian mackerel are well-documented filter feeders ingesting large amounts of zooplankton and phytoplankton, herring scad primarily feed on crustaceans and small fishes, donkey croaker display seasonal shifts between crustacean and fish prey, and Indian threadfin are bottom-dwelling predators that feed on crustaceans, polychaetes, and small fishes (Al-Mamun et al., 2022; Luo et al., 2024; Fishes of Australia, 2025; Dhuri and Kamble, 2025). These contrasting feeding strategies make these species useful models for examining how trophic behaviour mediates exposure to microplastic-like

Quick Response Code	Access this article online	
	Website: www.jscienceheritage.com	**DOI:** 10.26480/gws.01.2026.09.18

Cite The Article: Chee Kong Yap, Mohamad Izzuddin Mohd Hadir, Muhammad Ammar Ramlee, Muzammil Mohd Latif, Muhd Aqil Syukran Baharuddin, Anis Yasmin Hafizan, Wan Farhanah Qistina Khairulnizam, Anis Izzani Mohd Liza, Bazlin Nadhirah Mohd Zaki, Fitrah Athirah Mohd Fauzi, Nur Aliyaa Aqilah Mohd Basahri, Puteri Nur Fatihah Rahim, Ezani Ishak Hashim, Helmy Rozario Ahmad Yusoff, Rosimah Nulit and Wan Mohd Syazwan (2026). Preliminary Gut Content and Microplastic Screening in Four Commercial Marine Fish from Johor, Malaysia. Science Heritage Journal, 10(1): 09-18.

particles.

Despite increasing attention to this issue, baseline information linking gut content composition with potential microplastic ingestion in Malaysian commercial fishes remains limited, particularly for market-based samples that reflect real consumption pathways. Many existing studies focus on confirmed polymer identification, while relatively few integrate traditional stomach content analysis with preliminary microplastic screening.

Therefore, this preliminary study aims to characterise gut content composition and visually assess the occurrence of potential microplastics in four widely consumed pelagic and demersal fish species from Johor, Malaysia: *Rastrelliger kanagurta*, *Alepes vari*, *Pennahia anea*, and *Leptomelanosoma indicum*. By combining feeding ecology observations with morphology-based screening, this study provides an initial ecological baseline to inform future, more detailed investigations incorporating contamination control, polymer verification, and quantitative risk assessment for seafood safety and coastal ecosystem health.

2. MATERIALS AND METHODS

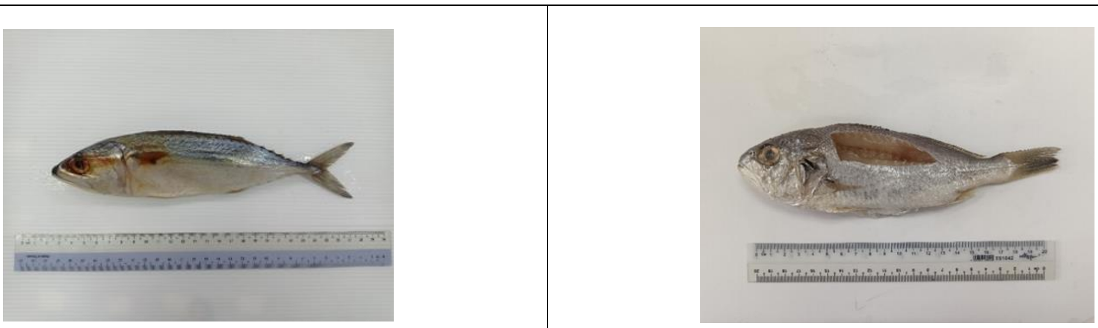
Two pelagic and two demersal commercial fish species (Figure 1) were selected to examine stomach contents and to note the potential presence of microplastics. Only fresh, intact, and undamaged individuals were included. Frozen specimens, if present, were defrosted at room temperature prior to dissection. For each specimen, total length (TL) and standard length (SL) were measured to the nearest 0.1 cm using a measuring ruler. Standard length was measured from the anterior tip of the mouth to the end of the caudal peduncle (tail muscle), whereas total length was measured from the anterior tip of the mouth to the end of the caudal fin. Table 1 summarises the specimens analysed, including scientific and common names, sampling locality, purchase date, and body size (TL and SL, cm).

Table 1: Species name (common name), sampling locality, purchase date, and morphometric measurements (total length and standard length, cm) of selected commercial marine fishes purchased from Johor, Malaysia (February 2025).

Species (common name)	Locality	Purchased Date	Total length	Standard length
Rastrelliger kanagurta (Indian Mackerel /Kembung)	Kesang, Johor	26/2/2025	16.2-25.8	14.3-22
Alepes vari (Herring Scad/Pelata)	Parit Jawa, Johor	27/2/2025	19.5-22.5	16.5-18.5
Pennahia anea (Donkey Croaker/ Gelama)	Parit Jawa, Johor	27/2/2025	19.2-23.5	17-20
Leptomelanosoma indicum (Indian Threadfin/ Kurau)	Parit Jawa, Johor	27/2/2025	21.7-36.5	17.7-24

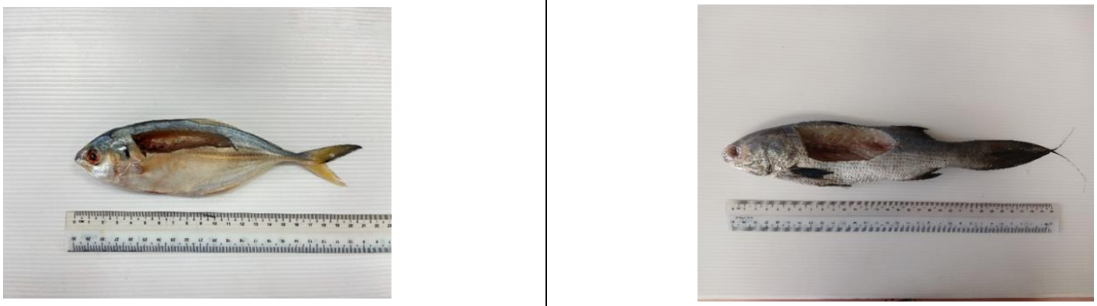
For gut content observation, each fish was placed ventral side up on a dissecting tray and a ventral incision was made from the anal opening towards the head to expose the visceral cavity. The stomach (foregut) was identified, excised, and opened longitudinally using forceps. All stomach contents were transferred into a clean Petri dish. Approximately 5–10 mL of distilled water was added to disperse the contents, followed by gentle stirring to homogenise the mixture. A small aliquot was pipetted onto a clean glass slide, covered with a coverslip, and examined microscopically. Large undigested items were placed directly on a clean white background and photographed with a smartphone camera alongside a scale for size reference. No filtration, sieving, or density separation procedures were applied.

Microscopic observations were performed using a camera light microscope (Olympus CX33) equipped with a digital camera (Accu-Scope Excelis) and a compound microscope at 100× to 400× magnification. Natural diet components were recorded (for example, diatoms, algae, zooplankton, detritus, and other biological materials). Putative microplastics were noted and categorised visually by colour and morphology (fibres, fragments, films). Suspected particles were defined operationally as items lacking visible cellular structure and exhibiting uniform, synthetic-like appearance under light microscopy.



Indian Mackerel/Kembung. N=8

Donkey Croaker/ Gelama. N=7



Herring Scad/Pelata. N=6

Indian Threadfin/ Kurau. N=4

Figure 1: Representative specimens of the four commercial marine fish species examined for gut content observation and potential microplastic occurrence, namely Indian mackerel (*Rastrelliger kanagurta*; Kembung, N = 8), donkey croaker (*Pennahia anea*; Gelama, N = 7), herring scad (*Alepes vari*; Pelata, N = 6), and Indian threadfin (*Leptomelanosoma indicum*; Kurau, N = 4), with measuring scales shown to indicate total and standard lengths.

Cite The Article: Chee Kong Yap, Mohamad Izzuddin Mohd Hadir, Muhammad Ammar Ramlee, Muzammil Mohd Latif, Muhd Aqil Syukran Baharuddin, Anis Yasmin Hafizan, Wan Farhanah Qistina Khairulnizam, Anis Izzani Mohd Liza, Bazlin Nadhirah Mohd Zaki, Fitrah Athirah Mohd Fauzi, Nur Aliyaa Aqilah Mohd Basahri, Puteri Nur Fatihah Rahim, Ezani Ishak Hashim, Helmy Rozario Ahmad Yusoff, Rosimah Nulit and Wan Mohd Syazwan (2026). Preliminary Gut Content and Microplastic Screening in Four Commercial Marine Fish from Johor, Malaysia. Science Heritage Journal, 10(1): 09-18.

3. RESULTS

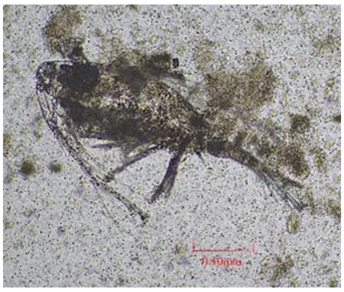
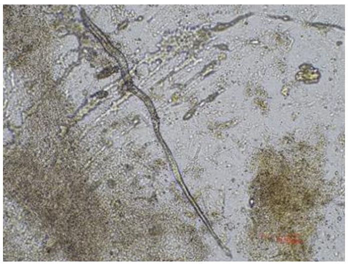
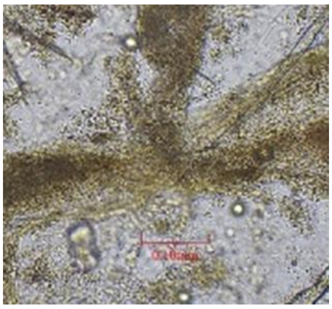
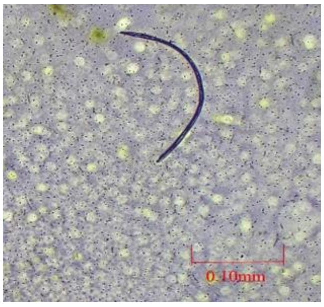
3.1 *Rastrelliger kanagurta* (Indian mackerel/Kembung)

Microscopic screening of the stomach contents of *R. kanagurta* showed a diet dominated by planktonic items, together with a small number of non-biological, fibre like materials (Figure 2). Copepod like zooplankton were repeatedly observed at high magnification (400X), including individuals or fragments with morphology consistent with small calanoid or harpacticoid copepods, although species level confirmation was not possible (Figure 2a, 2c). Phytoplankton related material was also present, including structures interpreted as phytoplankton debris and dinoflagellate like cells or fragments under 400X and lower magnifications (Figure 2b, 2d, 2h), indicating active feeding within a plankton rich water column. In addition, multiple fibre like particles were recorded. These fibres appeared as elongated, uniform strands with no visible cellular architecture under 100X, including a dark fibre embedded among digested material (Figure 2e) and a more distinct blue coloured fibre with smooth margins (Figure 2f). Other ingested hard remains were present as tiny shell fragments (Figure 2g), supporting the occurrence of incidental ingestion of calcareous particles or small shelled prey. Overall, the stomach contents suggest predominantly plankton based feeding with occasional ingestion of suspected anthropogenic fibres (Figure 2).

The gut contents of *R. kanagurta* in the present study contained numerous planktonic items such as copepods, dinoflagellates and other phytoplankton fragments, alongside occasional shell fragments and several fibre-like particles (Figure 2). Our observations of copepods, dinoflagellates and shell debris align with recent studies showing that *R. kanagurta* is a filter-feeding planktivore. A year-long study from western India reported that zooplankton accounted for 44.1% and phytoplankton 39.7% of the Indian mackerel's food, whereas algae contributed only about 3.00 % and the remainder consisted of miscellaneous matter and semi-digested items (Dhuri and Kamble, 2025). The same study described *R. kanagurta* as a filter feeder consuming surface-water organisms such as diatoms, dinoflagellates, copepods, larvae, nauplii and fish eggs (Dhuri and Kamble, 2025), consistent with the dominance of planktonic prey in our stomach analyses.

The occurrence of fibrous, non-cellular particles in several stomachs suggests incidental ingestion of anthropogenic material. Microplastics have been documented in *R. kanagurta* at other Malaysian sites; an examination of livers from Indian mackerel and yellowtail scad reported a microplastic abundance of 0.067 particles/fish, with particles mainly fragments and filaments coloured red, black and grey (Nawawi et al., 2025). Similarly, a multi-species survey of commercial fishes in India found microplastics in 21 species and reported 11 items in *R. kanagurta*, accounting for 3.60% of total plastics recovered (Doss, 2024). Such findings, together with the present detection of fibres, suggest that planktivorous fishes like Indian mackerel are vulnerable to microplastic ingestion. Evidence from the North Pacific gyre showed that about 35% of planktivorous fish contained plastic pieces, averaging 2.1 pieces/fish. These data underscore that plankton-feeding fishes can ingest anthropogenic debris along with their natural diet.

Overall, the present findings confirm that Indian mackerel feed predominantly on zooplankton and phytoplankton, corroborating previous reports that zooplankton and phytoplankton comprise the bulk of their diet (Dhuri and Kamble, 2025). The presence of fibre-like materials in the stomachs matches regional studies documenting microplastic contamination in this species (Nawawi et al., 2025). Continued monitoring is warranted given the importance of Indian mackerel for food security and the potential human health implications of microplastic ingestion.

Stomach contents	Description
(a) Magnification: 400X - Zooplankton/ Type: Copepod 	(b) Magnification: 400X- Phytoplankton" Species unidentified. 
(c) Magnification: 400X- Zooplankton/ Type: Copepod: Species unconfirmed. 	(d) Magnification: 400X - Dinoflagellate: Species unconfirmed 
(e) Magnification: 100X- Unidentified fibre 	(f) Magnification: 100X- Unidentified fibre 

Cite The Article: Chee Kong Yap, Mohamad Izzuddin Mohd Hadir, Muhammad Ammar Ramlee, Muzammil Mohd Latif, Muhd Aqil Syukran Baharuddin, Anis Yasmin Hafizan, Wan Farhanah Qistina Khairulnizam, Anis Izzani Mohd Liza, Bazlin Nadhirah Mohd Zaki, Fitrah Athirah Mohd Fauzi, Nur Aliyaa Aqilah Mohd Basahri, Puteri Nur Fatihah Rahim, Ezani Ishak Hashim, Helmy Rozario Ahmad Yusoff, Rosimah Nulit and Wan Mohd Syazwan (2026). Preliminary Gut Content and Microplastic Screening in Four Commercial Marine Fish from Johor, Malaysia. Science Heritage Journal, 10(1): 09-18.

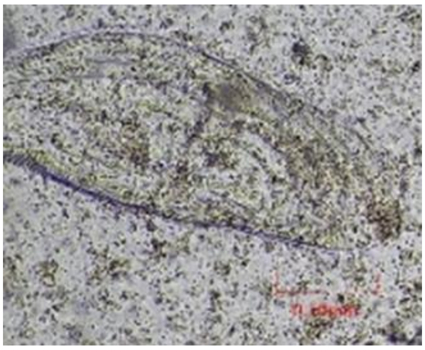
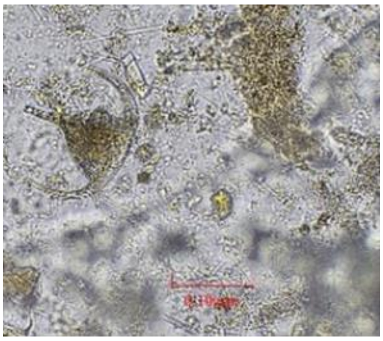
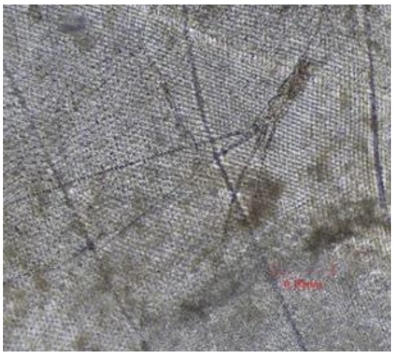
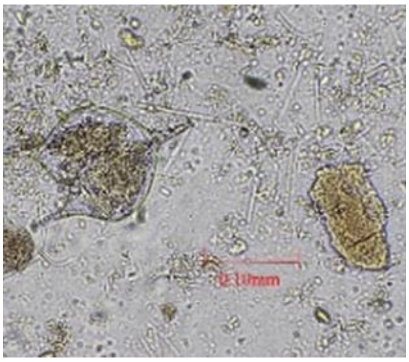
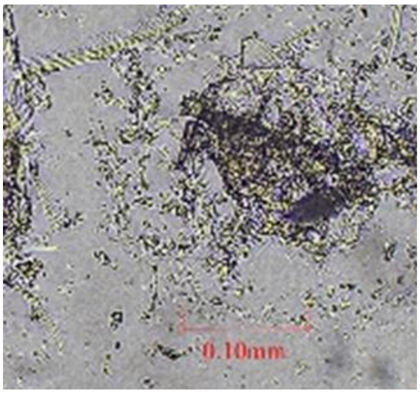
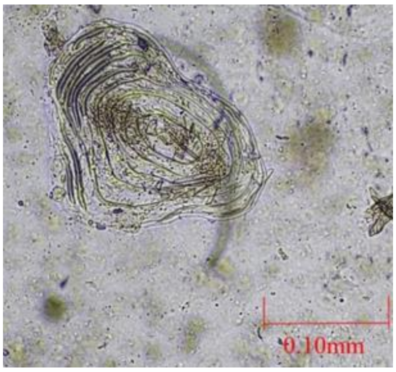
(g) Magnification: 100X - Tiny shell fragment 	(h) Magnification: 10X- Dinoflagellate 
(i) Magnification: 100X- Zooplankton fragment among digested fish scales 	(j) Magnification: 1000X- Dinoflagellate 
(k) Magnification: 4000X- Digested zooplankton  	(l)Magnification: 400X- Shell fragment 
(m) Magnification: 100X- Unidentified fibre  	(n) Magnification: 400X- Unidentified, possibly phytoplankton fragments 

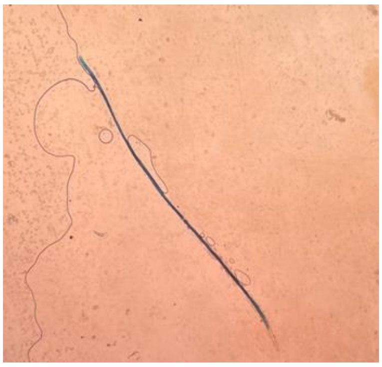
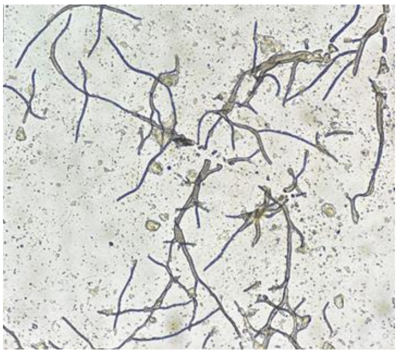
Figure 2: The materials including fibres, copepods and unknown substances found in the gut contents of *Rastrelliger kanagurta*.

3.2 *Alepes vari* (Herring scad/Pelata)

The stomach contents of *A. vari* contained a mixed assemblage of planktonic and benthic associated materials, together with several fibre like or unclassified elongated objects (Figure 3). A dinoflagellate like organism with a distinct body outline was observed at 400X (Figure 3a), and phytoplankton related material was recorded as possible phytoplankton and phytoplankton fragments under both 400X and 100X (Figure 3b, 3e, 3g). In parallel, the gut contents contained multiple "unidentified" items that were filamentous, thread like, or irregular in form (Figure 3c, 3f, 3h, 3i), indicating either partially digested biological material or non-biological debris that could not be confidently assigned using light microscopy alone. A prominent fibre like strand was observed at 100X (Figure 3d), appearing long and continuous with relatively uniform thickness, consistent with a suspected fibre particle. Importantly, a polychaete was directly observed at 400X (Figure 3j), suggesting that *A. vari* may opportunistically ingest benthic derived prey or larvae and fragments resuspended into the water column. Taken together, the findings indicate a broader feeding spectrum than *R. kanagurta*, combining phytoplankton associated matter, and occasional animal material.

The stomach contents of *Alepes vari* were more heterogeneous than those of *R. kanagurta*. Microscopic analysis revealed a mixture of dinoflagellates, filamentous phytoplankton, and unidentified planktonic fragments, as well as polychaete material and several fibre-like objects (Figure 3). These results imply that *A. vari* feeds across both planktonic and benthic food sources. In contrast, the authoritative Fishes of Australia database notes that herring scad "feed mostly on crustaceans and small fishes" (Fishes of Australia, 2025). Thus, although crustaceans and small fishes may dominate in some habitats, our observations of phytoplanktonic material and polychaete fragments suggest that this species is opportunistic and may shift from crustacean/fish prey to planktonic prey when circumstances warrant.

Our examination detected several thin, curved fibres lacking cellular structure, which were interpreted as potential anthropogenic fibres. However, fibre counts were low relative to those in *R. kanagurta*. Published microplastic studies have rarely focused on *A. vari*, and therefore data on its microplastic ingestion are scarce. Given that herring scad consume larger prey such as crustaceans and fishes (Fishes of Australia, 2025), their exposure to plankton-associated microplastics may be less than that of filter-feeding mackerel, but the presence of fibres in our specimens suggests incidental ingestion cannot be ruled out. Future work should quantify microplastics across varying size classes and habitats to clarify whether microplastic ingestion increases when herring scad feed on planktonic prey.

Stomach Contents	**Description**
(a) Magnification: 400X- Dinoflagellate 	(b) Magnification: 400X - Possible phytoplankton 
(c) Magnification: 400X - Unidentified object 	(d) Magnification: 100X- Unidentified fibre 
(e) Magnification: 100X - Phytoplankton fragment 	(f) Magnification: 100X - Unidentified object 
(g) Magnification: 100X- Phytoplankton fragment	(h) Magnification: 100X - Unidentified object

Cite The Article: Chee Kong Yap, Mohamad Izzuddin Mohd Hadir, Muhammad Ammar Ramlee, Muzammil Mohd Latif, Muhd Aqil Syukran Baharuddin, Anis Yasmin Hafizan, Wan Farhanah Qistina Khairulnizam, Anis Izzani Mohd Liza, Bazlin Nadhirah Mohd Zaki, Fitrah Athirah Mohd Fauzi, Nur Aliyaa Aqilah Mohd Basahri, Puteri Nur Fatihah Rahim, Ezani Ishak Hashim, Helmy Rozario Ahmad Yusoff, Rosimah Nulit and Wan Mohd Syazwan (2026). Preliminary Gut Content and Microplastic Screening in Four Commercial Marine Fish from Johor, Malaysia. Science Heritage Journal, 10(1): 09-18.

	
(i) Magnification: 100X - Unidentified object 	(j) Magnification: 400X – Polychaete 

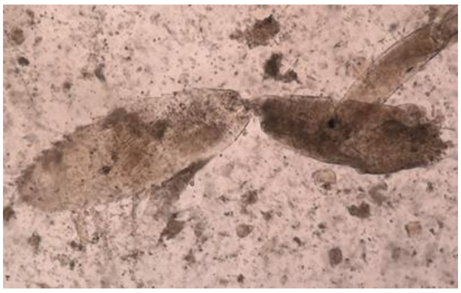
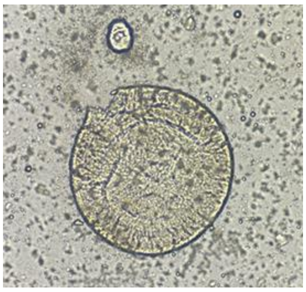
Figure 3: The materials including fibres, copepods and unknown substances found in the gut contents of *Alepes vari* (herring Scad/Pelata).

3.3 *Pennahia anea* (Donkey croaker/Gelama)

The gut contents of the demersal *P. anea* showed clear evidence of animal based feeding, including benthic invertebrate material, eggs, and fish remains (Figure 4). A digested zooplankton exoskeleton was present at 400X (Figure 4a), and a crustacean limb or zooplankton appendage was also observed (Figure 4c), indicating ingestion of small crustaceans or fragments. Reproductive material was notable, with a polychaete egg observed at 400X (Figure 4b) and an additional unidentified egg like structure recorded at 400X (Figure 4d), suggesting consumption of benthic eggs or egg masses, or ingestion of prey containing eggs. A polychaete organism or substantial polychaete fragment was observed (Figure 4e), further supporting benthic foraging consistent with the ecology of croakers. At the macroscopic scale, a digested small fish was recorded among the stomach contents (Figure 4f), indicating piscivory or scavenging on fish tissue, at least opportunistically. Compared with the pelagic species, the stomach contents of *P. anea* were more strongly dominated by animal tissues and benthic derived items, with no dominant phytoplankton signal in the observed fields of view (Figure 4).

Stomach content analysis of *P. anea* showed a strongly carnivorous profile. We observed digested zooplankton exoskeletons, crustacean appendages, polychaete eggs, whole polychaetes, and partially digested fish carcasses (Figure 4). Unlike the pelagic species, no fibre-like particles were recorded, implying negligible microplastic ingestion in the examined specimens. These findings accord with recent work that characterised *P. anea* as a demersal predator. A study comparing two sympatric *Pennahia* species in the Beibu Gulf reported that the diet of *P. anea* varied seasonally: Macrura (decapod crustaceans such as shrimps) dominated the diet in spring and winter, whereas fish (Pisces) were more important in summer and autumn (Luo et al., 2024). The same study found that *P. anea* prey was dominated by Alpheus, Bregmaceros and Stolephorus species, and the proportion of fish in its diet was significantly higher than in its congener *P. pawak* (Luo et al., 2024).

Our observation of a complete polychaete, numerous eggs, crustacean limbs and a digested small fish is consistent with this seasonal and taxonomic diversity of prey. The absence of fibres suggests that benthic foraging may reduce contact with floating microplastics, though plastics buried in sediments could still pose a threat. Further research using larger sample sizes and different demersal habitats is needed to assess whether *P. anea* accumulates microplastics over longer periods or via trophic transfer.

Stomach Contents	**Description**
(a) Magnification: 400X - Digested zooplankton exoskeleton 	(b) Magnification: 400X -Polychaete egg 

Cite The Article: Chee Kong Yap, Mohamad Izzuddin Mohd Hadir, Muhammad Ammar Ramlee, Muzammil Mohd Latif, Muhd Aqil Syukran Baharuddin, Anis Yasmin Hafizan, Wan Farhanah Qistina Khairulnizam, Anis Izzani Mohd Liza, Bazlin Nadhirah Mohd Zaki, Fitrah Athirah Mohd Fauzi, Nur Aliyaa Aqilah Mohd Basahri, Puteri Nur Fatihah Rahim, Ezani Ishak Hashim, Helmy Rozario Ahmad Yusoff, Rosimah Nulit and Wan Mohd Syazwan (2026). Preliminary Gut Content and Microplastic Screening in Four Commercial Marine Fish from Johor, Malaysia. Science Heritage Journal, 10(1): 09-18.

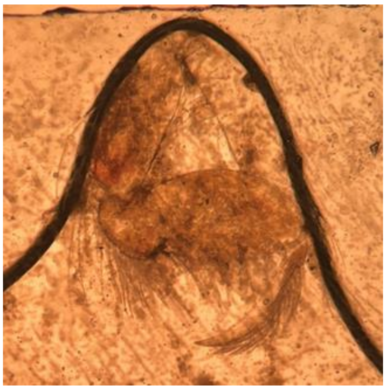
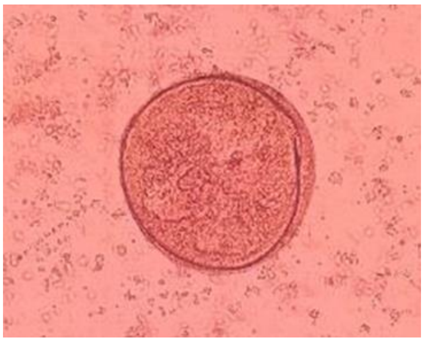
(c) Magnification: 400X- Crustacean @ zooplankton limb 	(d) Magnification: 400X -Unidentified egg 
(e) Polychaete 	(f) Digested small fish 

Figure 4: The materials including fibres, copepods and unknown substances found in the gut contents of *Pennahia anea* (Donkey Croaker/ Gelama).

3.4 *Leptomelanosoma indicum* (Indian threadfin/Kurau)

Stomach observations for *L. indicum* indicated predation on larger, animal prey, consistent with a higher trophic feeding habit (Figure 5). A shrimp prey item, plausibly *Acetes* sp. based on general body form and size, was recorded (Figure 5a), providing direct evidence of crustacean predation. Polychaete material was also prominent, including an intact or near intact polychaete like organism observed at 400X (Figure 5b), and additional polychaete associated material at 100X (Figure 5c), suggesting active feeding on benthic or demersal invertebrates. Relative to *R. kanagurta* and *A. vari*, planktonic micro items were not the dominant feature in the presented observations, and the recorded contents were instead characterized by macro prey remains and sizeable benthic invertebrate material (Figure 5). This species therefore showed the clearest signal of carnivorous feeding based on shrimp and polychaete prey (Figure 5).

Stomach contents of *L. indicum* contained whole shrimp (identified as *Acetes* sp.) and polychaetes, with no fibre-like particles observed (Figure 5). This diet profile reflects a demersal predatory lifestyle. A general account of the Indian threadfin notes that it is a bottom-dwelling predator that feeds on small fish, crustaceans and other benthic invertebrates, using its sensitive barbels to locate prey (Al-Mamun et al, 2022). Our detection of a whole shrimp and polychaetes fit these descriptions and underscores the importance of benthic crustaceans and worms in the diet of this species.

Although no microplastics were recorded in the examined specimens, demersal fishes can still be exposed to plastics via sedimentary deposits or through trophic transfer. However, the lack of fibres in our sample and the carnivorous diet suggest that *L. indicum* may have lower direct exposure to microplastic fragments than planktivorous species like *R. kanagurta*. To assess potential contamination, future studies should analyse larger sample sizes and include sediment microplastic data and chemical characterisation of ingested particles.

Stomach Contents	**Description**
(a)Shrimp, possibly *Acetes* sp. 	(b) Magnification: 400X -Polychaete 

(c) Magnification: 100X -Polychaete

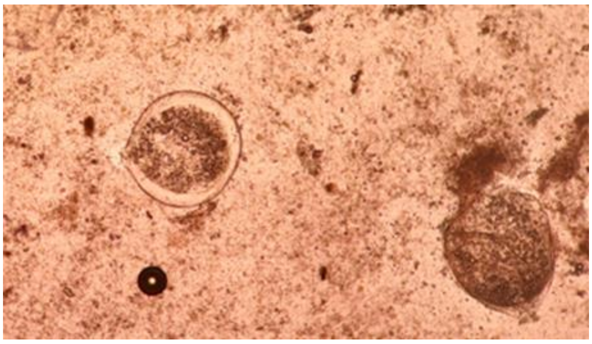


Figure 5: The materials including fibres, copepods and unknown substances found in the gut contents of *Leptomelanosoma indicum* (Indian Threadfin/ Kurau).

3.5 Integrated cross species summary (linking Figures 2–5)

Across all four species, the combined summary (Table 2) highlights a feeding gradient from plankton dominated contents in the pelagic *R. kanagurta* (Figure 2) to more mixed plankton plus benthic signals in *A. vari* (Figure 3), and strongly animal and benthic derived contents in the demersal *P. anea* and *L. indicum* (Figure 4–5). Suspected fibre like particles were most clearly documented in the pelagic species, particularly *R. kanagurta* (Figure 2) and *A. vari* (Figure 3), where elongated, uniform strands without visible cellular structure were repeatedly observed under 100X. In contrast, the demersal species were characterized primarily by recognizable animal remains such as polychaetes, eggs, crustacean fragments, and fish tissue, reflecting benthic feeding opportunities and higher trophic prey capture (Figures 4–5).

Table 2: Summary of stomach content items observed in the four commercial marine fish species, showing natural dietary components and suspected anthropogenic materials identified through microscopic examination.

Species (common name)	Ecological group	Natural gut content items observed (examples from micrographs)	Suspected anthropogenic items noted
Rastrelliger kanagurta	Pelagic	Zooplankton copepods (including one specimen resembling *Euterpina acutifrons* but not confirmed), dinoflagellates, possible phytoplankton material, zooplankton fragments among digested fish scales, digested zooplankton remains, tiny shell fragment	Unidentified fibres (multiple observations)
Alepes vari	Pelagic	Dinoflagellate, possible phytoplankton, phytoplankton fragments, a polychaete (one image), several unidentified biological objects/fragments	Unidentified fibre (at least one observation)
Pennahia anea	Demersal	Digested zooplankton exoskeleton, crustacean or zooplankton limb, polychaete, polychaete egg, unidentified egg, digested small fish (prey item)	No clear microplastic item recorded in the shown images (fibres not evident)
Leptomelanosoma indicum	Demersal	Shrimp prey item (possibly *Acetes* sp.), polychaete (multiple observations, 100X and 400X views), additional round-bodied particles consistent with digested biological material	No clear microplastic item recorded in the shown images (fibres not evident)

4. DISCUSSION

4.1 Trophic Structure and Natural Prey Composition across Species

The combined analysis of stomach contents from the four commercial fish species shows a clear trophic structure dominated by both planktonic and benthic prey, reflecting their position along a pelagic–demersal continuum. Zooplankton remains, particularly copepods and fragments of their exoskeletons, were consistently found across species and were especially common in pelagic and semi-pelagic feeders. This pattern aligns well with classic dietary studies that identify copepods as a key pathway for energy transfer in coastal marine food webs (Banse, 1995; Turner, 2004).

Phytoplankton components, including dinoflagellates and unidentified algal fragments, were also frequently observed. These likely entered the diet either through direct consumption by planktivorous fishes or indirectly via zooplankton prey (Kiørboe, 2011). Notably, the prominence of copepods, dinoflagellates, and phytoplankton fragments in the stomach contents closely matches known filter-feeding and plankton-feeding habits of Indian mackerel, where zooplankton and phytoplankton can make up approximately 44% and 40% of the diet, respectively, along with diatoms, larvae, and fish eggs (Dhuri and Kamble, 2025).

Clear signs of demersal feeding were observed through the frequent presence of polychaetes, crustacean limbs, eggs, and shell fragments, highlighting strong benthic–pelagic connections in coastal environments. Such mixed feeding strategies are common among shallow-water commercial fishes and provide flexibility in response to changing prey availability (Pauly and Christensen, 1995). This interpretation is supported by species-specific ecological information showing that herring scad primarily feed on crustaceans and small fishes (Fishes of Australia, 2025), while croakers exhibit seasonal shifts in diet, relying more heavily on macruran crustaceans during spring and winter and on fish prey in summer and autumn, reflecting opportunistic feeding in response to prey availability (Luo et al., 2024). Similarly, the presence of shrimp and polychaete remains in the larger-bodied threadfin aligns with a bottom-dwelling predatory lifestyle that targets small fish, crustaceans, and other benthic invertebrates (Al-Mamun et al., 2022). Overall, the observed prey composition confirms that all four species occupy lower to intermediate trophic levels and play an important ecological role in transferring energy from primary producers and benthic resources to higher-level predators.

4.2 Digestive State, Fragmentation, and Feeding Dynamics

A clear pattern across all species was the extensive fragmentation of prey items. Stomach contents commonly included partially digested zooplankton, broken phytoplankton cells, crushed shell material, and amorphous organic matter. This high level of fragmentation likely reflects rapid digestion and mechanical breakdown during feeding, particularly in species that lack strong teeth. Previous work has shown that pelagic fishes feeding on small prey often consume food in bulk, which results in substantial breakdown of prey within the stomach (Hyslop, 1980). In this study, fragmented copepod remains, small algal pieces, and degraded soft-bodied prey were frequently found alongside more intact items such as recognizable polychaetes and eggs. This mixture suggests that the fishes consumed prey with varying resistance to digestion, and that the stage of digestion strongly influences what can be detected during microscopic examination.

The occurrence of eggs (such as polychaete eggs) and larval fragments further points to opportunistic feeding, particularly during reproductive periods when planktonic life stages are abundant in coastal waters (Thorson, 1950). While this feeding strategy likely improves energy intake efficiency, it also increases the chance of ingesting non-nutritive particles suspended in the water column, including anthropogenic debris. This is especially relevant for pelagic fishes that rely on filter-feeding or particulate-feeding strategies (Dhuri and Kamble, 2025), where bulk consumption of suspended material can lead to the accidental intake of non-food particles when these overlap with plankton in size and buoyancy.

4.3 Occurrence of Fibres and Unidentified Particles: Indicators of Anthropogenic Influence

Across all four species examined, fibre-like structures and other unidentified elongated particles were repeatedly observed under different magnifications. These fibres showed uniform thickness, smooth edges, an absence of cellular structure, and unnatural colours—characteristics commonly used to distinguish potential microplastics from natural fibres (Hidalgo-Ruz et al., 2012). Although polymer identification was beyond the scope of this study, the observed morphology strongly suggests an anthropogenic origin. The consistent presence of fibre-like particles in species that occupy different feeding zones, from pelagic to demersal habitats, indicates that these particles are not confined to a single layer of the environment but likely circulate throughout the coastal water column and resuspension zones.

Similar fibre-dominated microplastic patterns have been widely reported in the digestive tracts of marine fish worldwide (Boerger et al., 2010; Jovanović, 2017). In Malaysia, microplastics have also been documented in pelagic commercial species, with Indian mackerel and yellowtail scad reported to contain an average of 0.067 particles per fish along the east coast of Peninsular Malaysia (Ahmad Nawawi et al., 2025). More broadly, coastal waters in Southeast Asia are recognised as microplastic accumulation hotspots due to high population densities and substantial riverine inputs (Lebreton et al., 2017). Taken together, even though the present observations are based on morphology alone, the repeated detection of fibre-like particles across all species provides strong evidence that anthropogenic debris is already interacting with everyday feeding pathways in Malaysian commercial fishes.

4.4 Feeding Mode as a Driver of Microplastic Exposure

Taken together, these results indicate that feeding strategy, rather than taxonomic identity, is the main factor influencing microplastic exposure. Fish that feed on plankton or use filter-feeding strategies are particularly vulnerable because microplastics often overlap with planktonic prey in terms of size and buoyancy (Wright et al., 2013). This “prey-mimic” pathway is well supported by field evidence showing that around 35% of planktivorous fishes examined had ingested plastic, with an average of 2.1 particles per fish (Boerger et al., 2010). In the present study, the frequent co-occurrence of natural planktonic prey—such as copepods, dinoflagellates, and phytoplankton fragments—together with fibre-like particles points to the same exposure mechanism, particularly in filter-feeding pelagic species that consume suspended organisms including diatoms, dinoflagellates, copepods, larvae, and fish eggs (Dhuri and Kamble, 2025).

Demersal feeders are also affected, as microplastics can enter their diets through resuspended sediments and benthic prey, providing secondary exposure pathways (Browne et al., 2011). This interpretation is supported by the simultaneous presence of benthic indicators (polychaetes, eggs, crustacean limbs, and shell fragments) and fibre-like materials in the same stomach samples. The mixture of natural prey and synthetic fibres highlights the challenge fish face in distinguishing between nutritious food and non-nutritive particles. Experimental studies have shown that fish readily ingest microplastics when they resemble prey in size, shape, or movement (Ory et al., 2017), underscoring a subtle but important ecological risk: microplastic ingestion is largely unintentional and driven by feeding behaviour rather than active selection.

4.5 Ecological and Food-Safety Implications

From an ecological standpoint, the ingestion of microplastics by commercially important fish at lower trophic levels raises concerns about their transfer to higher predators, including humans. Microplastics can act as carriers for chemical additives, persistent organic pollutants, and heavy metals, potentially increasing toxicological risks as they move through the food web (Rochman et al., 2013; Smith et al., 2018). The present findings, which show fibre-like particles occurring in both pelagic and demersal feeders, therefore represent more than a simple pollution signal. They indicate that everyday feeding pathways may also function as routes through which anthropogenic particles enter and circulate within coastal food webs.

Because all four species examined are widely consumed in Malaysia and across Southeast Asia, these results highlight the importance of incorporating gut content screening into routine seafood safety and environmental monitoring programmes. This need is further supported by existing Malaysian studies reporting measurable microplastic levels in commercially important pelagic fishes (Ahmad Nawawi et al., 2025). Although the present study relies on visual and morphological identification, it establishes an important baseline for future research that includes spectroscopic polymer confirmation and quantitative exposure assessments. Ultimately, improving our understanding of how feeding ecology influences microplastic ingestion is essential for connecting marine pollution to ecosystem health, fisheries sustainability, and potential implications for human well-being.

5. CONCLUSION

This preliminary study offers a descriptive characterization of stomach contents and a first visual screening for possible microplastic presence in four frequently consumed commercial fish species from Johor, Malaysia. Overall, the stomach contents showed a clear pelagic–demersal connection, with planktonic prey such as copepods and phytoplankton fragments commonly found alongside benthic-associated materials including polychaetes, crustacean fragments, eggs, detritus, and shell fragments. Together, these prey indicators confirm that the four species occupy lower to intermediate trophic levels and play an important role in linking primary producers and benthic resources to higher-level consumers in coastal food webs.

Fibrous and other non-cellular particles were occasionally observed and recorded as potential microplastics based on their morphology, including uniformity, lack of visible cellular structure, and overall appearance. This suggests that exposure to anthropogenic particles may occur across the range of feeding strategies represented by these species. However, because polymer identification and strict contamination-control procedures (such as procedural blanks, density separation, and spectroscopic verification) were not applied, these results should be viewed as an initial screening rather than a definitive assessment of microplastic contamination. Future studies should build on this baseline by expanding sampling coverage and sample size, standardising particle quantification, and confirming polymer types to better evaluate ecological risks and support seafood monitoring efforts in Malaysia.

REFERENCES

Al-Mamun, M. A., Shamsuzzaman, M. M., Schneider, P., Mozumder, M. M. H., and Liu, Q., 2022. Estimation of stock status using the LBB and CMSY methods for the Indian Salmon Leptomelanosoma indicum (Shaw, 1804) in the Bay of Bengal, Bangladesh. Journal of Marine Science and Engineering, 10(3), 366. https://doi.org/10.3390/jmse10030366

Banse, K., 1995. Zooplankton: Pivotal role in the control of ocean production. ICES Journal of Marine Science, 52(3–4), Pp. 265–277. https://doi.org/10.1016/1054-3139(95)80043-3

Boerger, C. M., Lattin, G. L., Moore, S. L., and Moore, C. J., 2010. Plastic ingestion by planktivorous fishes in the North Pacific Central Gyre. Marine Pollution Bulletin, 60(12), Pp. 2275–2278.

Cite The Article: Chee Kong Yap, Mohamad Izzuddin Mohd Hadir, Muhammad Ammar Ramlee, Muzammil Mohd Latif, Muhd Aqil Syukran Baharuddin, Anis Yasmin Hafizan, Wan Farhanah Qistina Khairulnizam, Anis Izzani Mohd Liza, Bazlin Nadhirah Mohd Zaki, Fitrah Athirah Mohd Fauzi, Nur Aliyaa Aqilah Mohd Basahri, Puteri Nur Fatihah Rahim, Ezani Ishak Hashim, Helmy Rozario Ahmad Yusoff, Rosimah Nulit and Wan Mohd Syazwan (2026). Preliminary Gut Content and Microplastic Screening in Four Commercial Marine Fish from Johor, Malaysia. Science Heritage Journal, 10(1): 09-18.

https://doi.org/10.1016/j.marpolbul.2010.08.007

Browne, M. A., Crump, P., Niven, S. J., Teuten, E., Tonkin, A., Galloway, T., and Thompson, R., 2011. Accumulation of microplastic on shorelines worldwide: Sources and sinks. Environmental Science and Technology, 45(21), Pp. 9175–9179. https://doi.org/10.1021/es201811s

Dhuri, U. S., and Kamble, N. P., 2025. Dietary composition and feeding behavior of Rastrelliger kanagurta (Cuvier, 1816) in the coastal water of Sindhudurg, Maharashtra, India. Journal of Emerging Technologies and Innovative Research, 12(5), Pp. C776–C778.

Doss, M. M. A., 2024. Assessment of microplastics in commercially important fishes collected from Thondi fish landing centre. International Journal of Creative Research Thoughts, 12(1), J253–J292.

Fishes of Australia., 2025. Feeding and diet information for species 4255. https://fishesofaustralia.net.au/home/species/4255 (Retrieved December 23, 2025, from https://fishesofaustralia.net.au/home/species/4255#:~:text=Feeding)

Hidalgo-Ruz, V., Gutow, L., Thompson, R. C., and Thiel, M., 2012. Microplastics in the marine environment: A review of the methods used for identification and quantification. Environmental Science and Technology, 46(6), Pp. 3060–3075. https://doi.org/10.1021/es2031505

Hyslop, E. J., 1980. Stomach contents analysis: A review of methods and their application. Journal of Fish Biology, 17(4), Pp. 411–429. https://doi.org/10.1111/j.1095-8649.1980.tb02775.x

Jovanović, B., 2017. Ingestion of microplastics by fish and its potential consequences from a physical perspective. Integrated Environmental Assessment and Management, 13(3), Pp. 510–515. https://doi.org/10.1002/ieam.1913

Kiørboe, T., 2011. How zooplankton feed: Mechanisms, traits and trade-offs. Biological Reviews, 86(2), Pp. 311–339. https://doi.org/10.1111/j.1469-185X.2010.00148.x

Lebreton, L., van der Zwet, J., Damsteeg, J.-W., Slat, B., Andrady, A., and Reisser, J., 2017. River plastic emissions to the world's oceans. Nature Communications, 8, 15611. https://doi.org/10.1038/ncomms15611

Luo, K., Yang, X., Zhou, Y., Yi, X., Zhao, C., Wang, J., He, X., and Yan, Y., 2024. The sympatric coexistence mechanism: A case study of two Penahia species in the Beibu Gulf, South China Sea. Animals, 14(6), Pp. 849. https://doi.org/10.3390/ani14060849

Nawawi, A. W. N. A., Ezraneti, R., Miskon, M. F., and Mohamed, J., 2025. Microplastic contamination in pelagic fishes from the east coast of Peninsular Malaysia. Journal of Marine Studies, 2(1), Pp. 2105. https://doi.org/10.29103/joms.v2i1.21125

Ory, N. C., Sobral, P., Ferreira, J. L., and Thiel, M., 2017. Amberstripe scad Decapterus muroadsi (Carangidae) fish ingest blue microplastics resembling their copepod prey along the coast of Rapa Nui (Easter Island) in the South Pacific subtropical gyre. Science of the Total Environment, 586, Pp. 430–437. https://doi.org/10.1016/j.scitotenv.2017.01.175

Pauly, D., and Christensen, V., 1995. Primary production required to sustain global fisheries. Nature, 374, Pp. 255–257. https://doi.org/10.1038/374255a0

Rochman, C. M., Hoh, E., Kurobe, T., and Teh, S. J., 2013. Ingested plastic transfers hazardous chemicals to fish and induces hepatic stress. Scientific Reports, 3, 3263. https://doi.org/10.1038/srep03263

Smith, M., Love, D. C., Rochman, C. M., and Neff, R. A., 2018. Microplastics in seafood and the implications for human health. Current Environmental Health Reports, 5(3), Pp. 375–386. https://doi.org/10.1007/s40572-018-0206-z

Thorson, G., 1950. Reproductive and larval ecology of marine bottom invertebrates. Biological Reviews, 25(1), Pp. 1–45. https://doi.org/10.1111/j.1469-185X.1950.tb00585.x

Turner, J. T., 2004. The importance of small planktonic copepods and their roles in pelagic marine food webs. Zoological Studies, 43(2), Pp. 255–266.

Wright, S. L., Thompson, R. C., and Galloway, T. S., 2013. The physical impacts of microplastics on marine organisms: A review. Environmental Pollution, 178, Pp. 483–492. https://doi.org/10.1016/j.envpol.2013.02.031