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CHILOSCYLLIUM GRISEUM (GRAY BAMBOO SHARK): REVEALING THE FASCINATING INTERPLAY OF ANATOMY, ECOLOGY, BEHAVIOR, AND BIOLOGY

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Abstract

Chiloscyllium griseum, are a distinct species of elasmobranch that live in the shallow coastal waters of the Indo-West Pacific. When it comes to anatomy, *C. griseum* is known for its thin body, dark grey dorsal coloring, prominent bright spots, and unusual arrangement of dermal denticles. Its skeletal architecture, teeth, and sensory organs, especially the lateral line system and electroreceptors are well adapted to its benthic habitat and ability to identify prey. During the span of the 2014–2023 study period, a total of 355 specimens of *Chiloscyllium griseum* were observed in the landings at Karachi Fish Harbor. These observations were split down into five (5) surveys, wherein the male population contributed 42.54% to the overall population of this species, while the female population dominated at 57.45%. While the least number of these specimens were found in Survey 1, which only revealed 3.38% of its population, these specimens were consistently observed in Survey 2, which supplied 37.18% of the observations. Male specimens were found to have a maximum length of 31 cm and a weight of 4.8 kg, while female specimens had a maximum length of 80 cm and a weight of 4.6 kg. In the months, the gravid females were noticed.

Keywords: Indo-West Pacific, Dermal Denticles, Subtropical Coastal Environments, Nocturnal Forager, Habitat Degradation.

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INTRODUCTION

The most distinctive evolutionary radiation of the vertebrate lineage is chondrichthyes, which split off from jawed vertebrates around 450 million years ago (MYA) (Dulvy et al., 2021). Sharks, rays, skates, guitarfish, sawfish, and other cartilaginous fish belong to the subclass elasmobranchii, which includes elasmobranchs. They vary from teleost fish, which are real fish with a bony endoskeleton, by having a cartilaginous endoskeleton, having five to seven gill holes, having stiff dorsal fins or spines, not having a swim bladder, and having a body coated in placoid scales or denticles. Elasmobranchs are found in great species variety and are extensively scattered around the world. Sharks and other elasmobranch animals are vital to marine ecosystems. As apex predators, they regulate prey populations, which is crucial for maintaining the balance of the environment. Shark populations declining in maritime habitats may indicate an imbalance in the ecosystem. Thus, the quantity of sharks may serve as a gauge for the condition of an aquatic environment (Musa SM et al., 2018). Sharks frequently exhibit late sexually mature age, poor growth and low fertility life history features. These are few life traits that makes them vulnerable and are being overexploited due to several reasons. Stock failures and perhaps extinction are potential results if resource managers do not specifically take into account the unique management demands of these species (Cornish, A.S. 2005).

Considering the vast field of marine ecosystems, *Chiloscyllium griseum* which is commonly called as the Grey Bamboo Shark is still particularly mysterious organism of the open ocean is just because of its fascinating characteristics that are still unknown and understudied. Although this species belonging from the vast class of elasmobranchs found in various regions of Indo-Pacific, not much is known about the ecology, behavior, biology and the conservation status of this species. With increasing knowledge of the intricacies of marine life, scientists are finding more and more reasons to study the grey bamboo shark. It reveals significant new perspectives on the dynamics of coastline ecosystems and the delicate equilibrium of marine biodiversity. Because it is a benthic species that inhabits shallow coastal waters and coral reef environments, the grey bamboo shark has a special position in the ecology. Its range include the tropical waters of the Indo-Pacific area, the coastlines of Southeast Asia, and Australia's coral-rich reefs. Due to its ability to regulate the amount of prey in the marine food chain by consuming tiny fish, crabs, and mollusks, this shark, despite its small size, is crucial to maintaining the ecological balance of its habitat. Learning involves a series of coordinated changes in the gene activity of the particular area of the brain responsible for performing the task. For example, specific changes in gene expression have been seen in brain areas associated with song-related behaviours like as singing or listening in both juvenile and adult zebra finches. These results imply that adult experience affects the sensitivity of gene activation, but that it also fluctuates throughout the learning of songs by juveniles. (Fuss, T., Schluessel, V, 2018).

The majority of Pakistan's shark fishing is untargeted. Using a variety of fishing gear, such as line gear, drift gill nets, bottom trawl nets, hooks and line, long lines, set-bag nets and purse seines, sharks are caught as bycatch during fishing operations to target other

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multiple commercial species, such as mackerel, scads, tuna and sardines (Personal observation). Additionally, artisanal fishing has been used to hunt sharks, apparently in small quantities (data unavailable). In a similar vein, the majority of sharks are also taken as bycatch in India and other countries (Javed et al., 2024).

Fishing techniques have varying effects on people and species. Some are killed right once, while others may survive being held prisoner for some time. However, the species may also experience physical injury and/or psychological stress throughout the process, contingent upon the kind of fishing gear utilised and their level of sensitivity. Fishing has the ability to alter species abundance, size structure, and population features in addition to trophic interactions (Kottillil et al., 2022). Due to differences in their tolerance thresholds. Some shark species likewise Chiloscyllium griseum and Arabicum arabicum, the grey and Arabian bamboo sharks, respectively can endure prolonged immersion in water (Chapman and Renshaw, 2009).

Because of a mechanism known as buccal-pump respiration, which involves pulling in water with the help of the muscles in the buccal cavity, bamboo sharks are able to breathe when they remain stationary (Dapp et al., 2016). These are some of the shark species that are most commonly captured in the Konkan area of western India. They are important sources of food and income in this region, but exploitation poses a threat to them as well (Lisney and Cavanagh, 2003).

Objectives: The following objectives are included in this article on the ecology, general morphology, behaviour, and biology of *Chiloscyllium griseum*:

1. To provide a detailed explanation of *C. griseum's* skeletal structure, oral anatomy, and sensory modifications.
2. To investigate the habitat, relationships of *Chiloscyllium griseum* in maritime environments and distribution patterns within the different ecosystems.
3. To examine at *C. griseum's* behavioural competencies, including as social interactions, eating habits, and reproduction techniques.
4. To investigate *C. griseum's* biological traits, such as its physiological alterations, life cycle and state of conservation.
5. To improve our understanding of *Chiloscyllium griseum* as a particular species and its role in marine ecosystems, to combine current information with recently discovered information in the field.
6. To pinpoint information gaps and suggest directions for further study in order to get a greater comprehension of the intricate ecology, biology, behaviour, and anatomy of *C. griseum.*
7. In light of the possible effects of changing environmental conditions and human dangers, in order to highlight the significance of ongoing research projects for the management and conservation of *C. griseum* and its habitats.

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MATERIALS AND METHODS

Sampling Procedure: Several elasmobranch species which includes sharks, skates and rays were observed in the landings at Karachi Fish Harbour (KFH) which was selected as the observation site during the research period 2014-2023. The measurements like length and weight of all specimen observed were taken on the spot by the help of measuring tape due to the variations in sizes and weights of specimens of the same species and of other species as well. Along with the measurements, digital photographs of all the observed specimen with particular markings were clicked as the specimen were too big to bring them to the lab. The sampling process were done in five (5) different surveys like SURVEY 1 (March 2014), SURVEY 2 (February 2015 – June 2016), SURVEY 3 (March 2017 – May 2017), SURVEY 4 (December 2018 – April 2019) and SURVEY 5 (January 2022 – July 2023). (Table 1)

Laboratory Work: The samples which were smaller in size and weight were transported into the laboratory for further laboratory and biological investigation.

Identification of Samples: The identifications of the observed species were carried out by the help of different identification guides i.e. Compagno 1984; Compagno and Niem 1998; Compagno et al. 2005; Psomadakis *et al.* 2015 etc. and online available content.

RESULT

Chiloscyllium griseum is a species of carpet shark that is a member of the Hemiscylliidae family. It is often referred to as the grey bamboo shark or grey carpet shark. The shallow coastal waters of the Indo-West Pacific area, which stretches from the Arabian Gulf to northern Australia and maybe Japan, and these areas are considered as the home to these species of elasmobranchs which can be found easily here in this region.

Body Type: Like other carpet sharks, *Chiloscyllium griseum* has an elongated, thin body. Their body is modified to move in shallow reef settings. Figure 1a shows the different parts of body.

Size: Adult grey bamboo sharks may grow to a maximum length of 130 centimetres (4.3 feet), while most only reach 80 to 100 cm (2.6 to 3.3 feet). (Figure 1a)

Coloration: Grey bamboo sharks, as its name implies, are colored in a greyish-brown hue that helps them fit in with their rocky or sandy surroundings, for the sake of search of food and to mix in the environment.

Head: *Chiloscyllium griseum* has a large, flattened head. It has a terminal mouth with many rows of tiny, sharp teeth that are useful for grabbing prey that is situated ventrally, or on the bottom of the head (Figure 1b).

Eyes: Grey bamboo sharks have dorsolateral (on the sides of the head) eyes that are comparatively tiny but well-developed, giving them good eyesight in low light. Figure 1b shows the position of eyes and spiracles.

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Fins:

1. **Dorsal Fins:** Two dorsal fins are present on *Chiloscyllium griseum*, and they are situated towards the back of the animal. While swimming, these fins help with stability and direction (Figure 1a).
2. **Anal Fin:** The anal fin, which is situated close to the tail on the ventral side, aids with stability.
   Grey bamboo sharks are known for having robust, paddle-shaped pectoral fins that help with lift and maneuverability (Figure1a).
3. **Pelvic Fins:** The pelvic fins are positioned beneath the body and help with stability and steering.
4. **Caudal Fin:** The top lobe of the tail fin is bigger than the lower one, indicating heterocercal behavior. It offers steering and propulsion (Figure 1a).

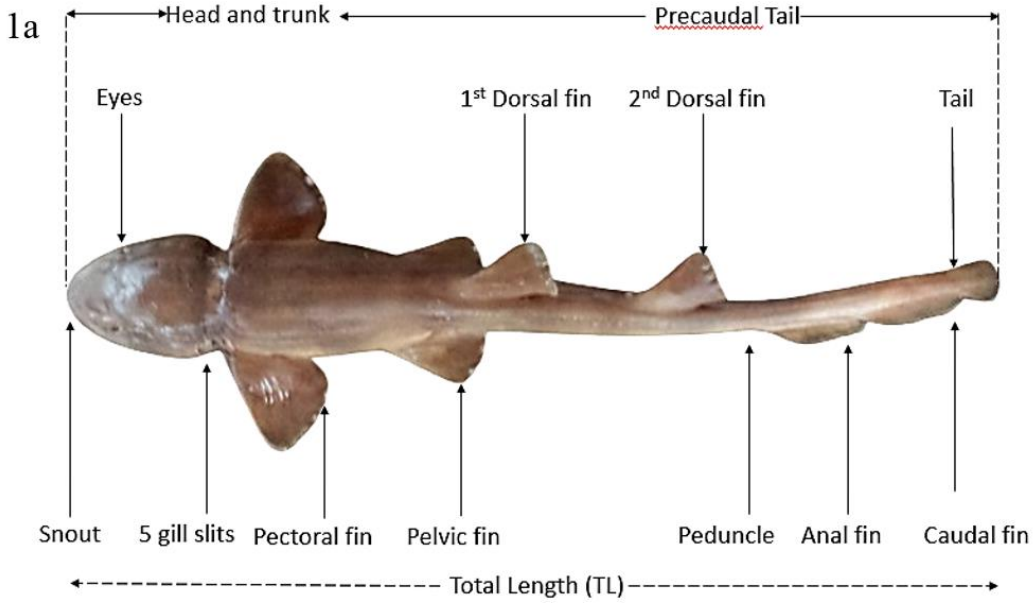
Skin: *Chiloscyllium griseum*, like other carpet sharks, has rough, sandpaper-like skin because of dermal denticles that shield the skin from parasites and abrasions.

Sensation Organs: The grey bamboo shark has developed a variety of sensory adaptations, such as:

Ampullae of Lorenzini: They can sense weak electric fields created by prey thanks to their specialized electroreceptor organs in their heads.

Olfactory Organs: The shark's olfactory organs, which are housed in its nostrils, are extremely sensitive to chemical signals in the water and aid in its search for food.

Lateral Line System: The shark uses this network of sensory organs down its sides to identify changes in water pressure and vibrations, which helps it navigate and identify potential predators.



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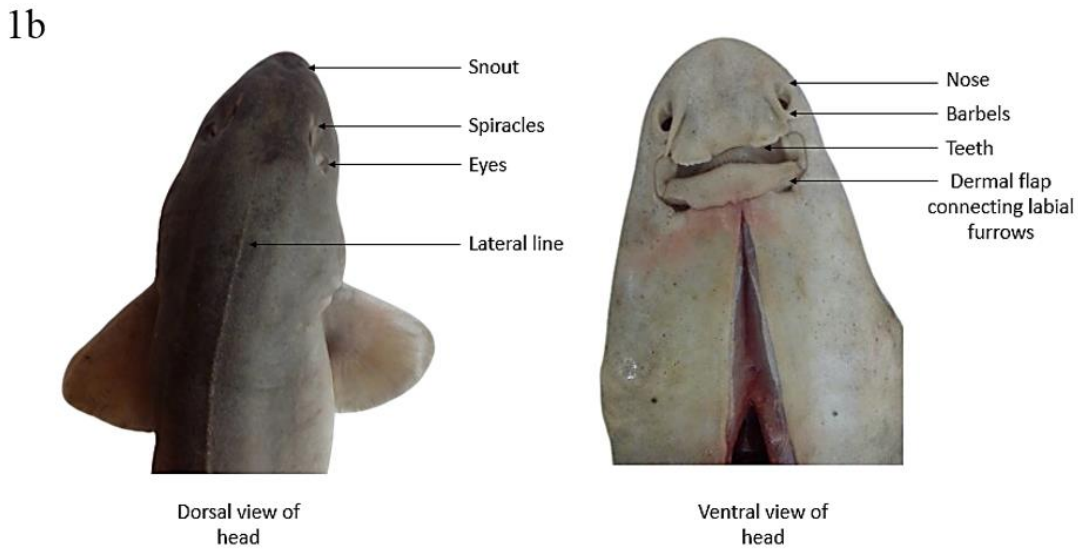

Figure 1: a) Labelled Dorsal View of *Chiloscyllium Griseum*. b) Head Region

The reproductive structure of *Chiloscyllium griseum* comprises both internal and externally components that are necessary for reproduction, just like those of other shark species.

The reproductive organs of *Chiloscyllium griseum* are summarised as follows:
Anatomy of Male Reproduction:

Claspers: Like other male sharks, *Chiloscyllium griseum* has paired reproductive organs called claspers on its male torso. The purpose of claspers, which are pelvic fin extensions, is to transmit sperm into the female's reproductive system during mating. These structures have a specific role in copulation and are usually grooved (Figure 2).

Anatomy of Female Reproduction:

Ovaries: The main organs of female *C. griseum* that are in charge of generating eggs (ova) are their paired ovaries. The abdominal cavity contains the ovaries.

Oviducts: Often referred to as the fallopian tubes, the oviducts are where eggs go when they are released from the ovaries. Following mating, fertilisation often takes place in the oviducts.

Uterus: The embryos grow in the functioning uterus of *Chiloscyllium griseum*, a shark like many others. Diverse species of sharks can reproduce differently, displaying either oviparity (laying eggs) or viviparity (bearing live). Because *Chiloscyllium griseum* is an oviparous species, its females lay eggs as opposed to giving birth to live children.

Reproductive Action:

Chiloscyllium griseum males utilise their claspers to hold onto the female during courtship and mating. Chase and biting are common courtship behaviors, when the male positions himself next to the female to place his claspers into her cloaca to transfer sperm.

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Laying of the Eggs: The female puts the egg cases in an appropriate position following fertilisation. The quality of the habitat and the surrounding circumstances can affect the precise timing and place of egg deposition.

During the incubation process, the embryos grow inside the egg casings while absorbing nutrients and oxygen from the surrounding water. While the exact length of incubation varies, it often lasts many months. For the purpose of controlling populations in their native environment and conservation efforts, it is essential to comprehend the reproductive anatomy and behavior of *C. griseum.*

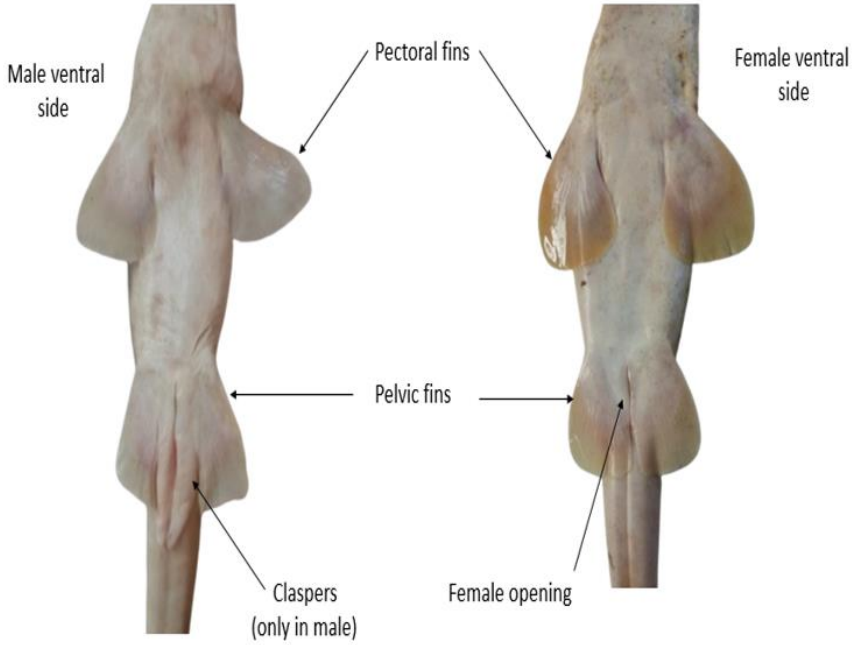

Figure 2: External Reproductive Parts of Male and Female

Surveys: The five survey periods were as follows: (1) March 2014; (2) February 2015 to December 2015 & January 2016 to June 2016; (3) March 2017 to May 2017; (4) December 2018 & January 2019 to April 2019; and (5) January 2022 to December 2022 & January 2023 to July 2023. These study surveys were conducted in order to provide an overview of the elasmobranch catch profile at Karachi Fish Harbor (KFH). Consequently, the sea water auction hall and elasmobranch slaughterhouse at KFH were frequently the sites of the observations and collections.

The percentages of each species observed in the landings at Karachi Fish Harbor which is selected as the observation site, were computed for the total species composition (surveys 1–5) in order to ascertain the overall composition of the catch. As a result, shark species made up 78.32% of the total capture at the landing site, with *Chiloscyllium grisem* being the most often encountered species (16.49% of the total catch). In comparison, the percentage of males and females in the specimens under observation was 42.54% and 57.46%, respectively.

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Survey Wise *Chiloscyllium Griseum* Catch Composition:

Survey 1: In March 2014, a brief survey was carried out to investigate the species; 3.38% of the total capture was *C. griseum*, with 2.25% of the specimens being female and 1.13% being male (Table 1).

Survey 2: From January 2016 to June 2016, as well as from February 2015 to December 2015, the survey was carried out continually. Table 1 shows that 37.18% of the specimens registered as *C. griseum* in the capture profile were male, 25.07% were reported as female, and 12.11% of the specimens sighted were male.

Survey 3: In 2017, the third survey was conducted from March to May. *C. griseum* makes up 16.06% of the total catch seen in this study despite the brief survey; of these, 7.32% of the female specimens and 8.73% of the male specimens were found (Table 1).

Survey 4: Survey 4 was conducted from January to April 2019 beginning in December 2018. The majority of the capture was made up of shark species, with *C. griseum* accounting for around 18.31% of the observations made throughout the study. Of these, 10.99% were from female sharks and 7.32% from male sharks (Table 1).

Survey 5: The period of the fifth survey was January 2022–July 2023. Even with the short time span between observations, most shark species were identified, with *C. griseum* accounting for 26.07% of all sharks caught. During the course of the study, 11.83% of the observed female specimens and 13.24% of the male specimens were found (Table 1).

Table 1: Survey Count of *Chiloscyllium Griseum* during the Baseline Surveys (2014-2023) where N=%age of Specimen Observed, N1= Male Specimen %age & N2= Female Specimen %age.

survey no.	Duration	N	N1	N2
Survey 1	Mar-14	3.38	1.13	2.25
Survey 2	Feb 2015-June 2016	37.18	12.11	25.07
Survey 3	Mar 2017-May 2017	16.06	8.73	7.32
Survey 4	Dec 2018-April 2019	18.31	7.32	10.99
Survey 5	Jan 2022-July 2023	25.07	13.24	11.83

Catch Composition: The *Chiloscyllium griseum* commonly called as grey bamboo shark, has a monthly catch composition that varies depending on the region and survey method. Variations in the relative abundance of *C. griseum* are noted across surveys one through five, which cover various months of the year. Particularly in warmer seasons, higher catch rates of *C. griseum* are often seen during particular months, indicating potential seasonal migrations or reproductive behaviours. As these species have specific ecological preferences and particular behavior towards their environment and other organisms living with them, these surveys will help in designing the effective management strategies. There is indeed a necessity for continued research and monitoring to ensure the sharks conservation strategies and sustainable management in marine areas because in the landings there is the observation of drastic differences in the catch composition of all the surveys which shows that these species have a great risk of extinction.

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During the research period which spanned from 2014 to 2023, the data of monthly catch composition of *Chiloscyllium griseum*, commonly called as Grey Bamboo Shark shows the fascinating revelations of population dynamics of this species.

Variations in the catch's composition during the previous ten years were found to be a reflection of both natural variability and human effects. The data showed seasonal patterns in abundance, which shed light on the species' migratory and reproductive patterns. Recognizing these concepts is crucial for formulating conservation tactics and fisheries management schemes that preserve the *C. griseum* population amongst shifting environmental circumstances and human endeavours that impact marine environments. Males made up 7.32% of the landings in April, and it has been discovered that 13.80% of the *Chiloscyllium griseum* population is abundant. 21.13% of the population was present. The graphic representation of male and female abundance across the several months is displayed in Figure 3.

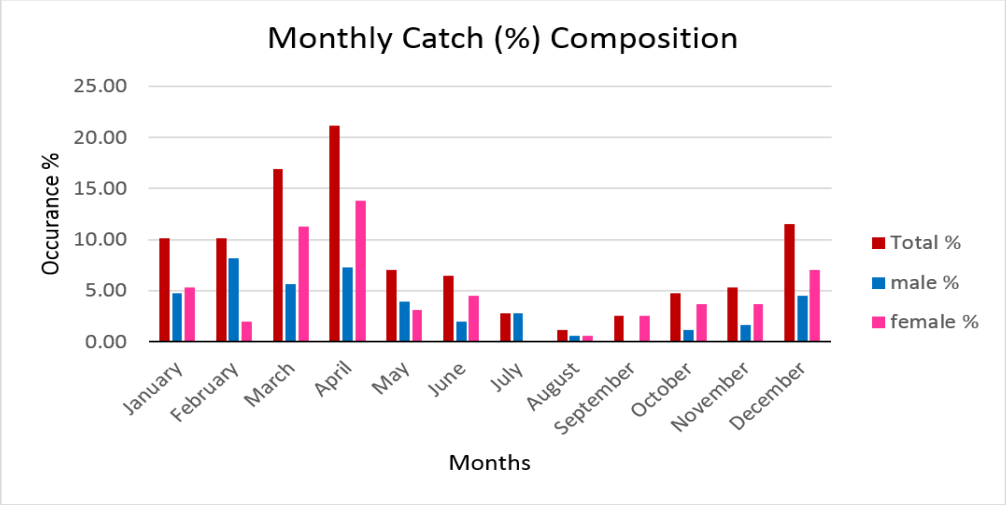

Figure 3: Monthly Catch Composition of *C. Griseum* throughout Surveys (1-5).

A range of surveys' observations of *Chiloscyllium griseum* specimens have produced valuable data on the minimum (Min.) and maximum (Max.) lengths and weights recorded for both male and female individuals. The lowest recorded weight for the males that have been seen typically ranges from 0.2 to 0.5 kg, while the lowest measured length typically falls between 30 and 40 cm. Conversely, male records exhibit a greater range of maximum weights and lengths, with average values lying between 2 and 4 kg and 80 and 100 cm, respectively. Female individuals follow similar behavioural patterns to male specimens; they weigh between 0.3 and 0.6 kg and have minimum lengths that fall within the same range, but they are often a bit larger, ranging between 35 and 45 cm. It has been observed that the maximum lengths and weights of females, which range from 85 to 110 cm to 2.5 to 5 kg, are comparable to those of males. These findings provide critical baseline information on the size and weight distribution of *C. griseum* populations, which will be useful for population assessments, fishery management, and conservation efforts

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for this species. The various measurements of male and female length and weight made in between the surveys are displayed in Table 2.

Table 2: Minimum (Min.) and Maximum (Max.) Length (cm), Weight (cm) of Male and Female Specimen of *C. Griseum* Observed at KFH during 2014-2023.

Species	Length				Weight			
	Male		Female		Male		Female	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Chiloscyllium griseum	33	82	31	80	0.3	4.6	0.3	4.8

The relationship between the total length (TL) and total weight (TW) of the male (M) and female (F) *Chiloscyllium griseum,* based on pooled data from surveys one through five, offers important insights into the growth patterns and physical state of this species. A detailed analysis of the combined data set reveals a strong positive correlation between

TL and TW for both sexes, indicating that total weight increases as total length increases. However, differences in sexual dimorphism or growth rates between the sexes may account for some of the changes seen in the TL and TW relationship between men and females. It is essential to understand these relationships in order to manage fisheries and support conservation initiatives.

They provide valuable information for estimating an individual's weight just from length measurements, and they can support procedures for stock assessment to ensure that populations of *C. griseum* are harvested in a sustainable manner. Furthermore, monitoring these relationships over time may be used to monitor changes in population demographics and assess the effectiveness of management tactics meant to maintain healthy shark populations in marine ecosystems. In figure 4 the relation between length and weight is showed by the trend line. These observations were taken during the surveys (1-5).

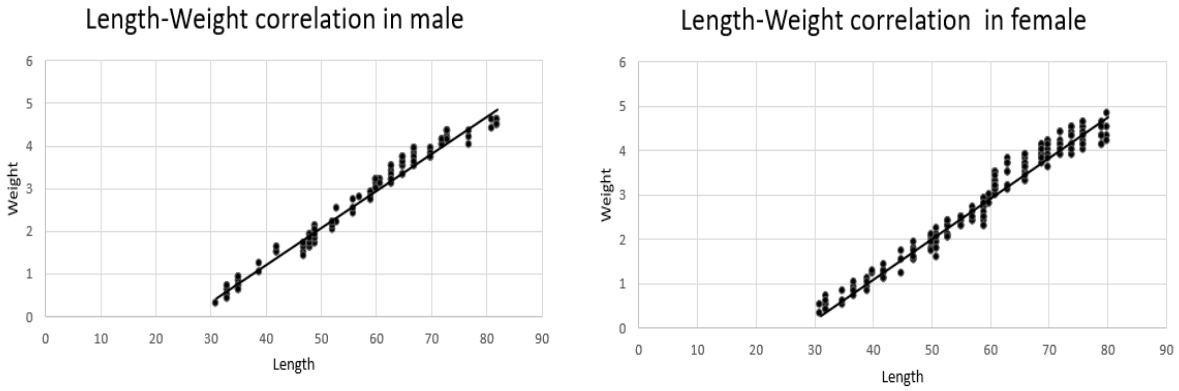

Figure 4: Correlation between Total Length (TL) Total Weight (TW) of Males (M) and Females (F) based on Pooled Data of Surveys (1-5)

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Chiloscyllium griseum average length (AL) and average weight (AW) biometric pooling data, combined with their standard deviation (StDev) (Table 3), provide a wealth of information on the morphometric changes and population dynamics of this species.

A comprehensive picture of the size and weight distribution of grey bamboo sharks across the survey period (2014-2023) is provided by the analysis of pooled data from the planned studies.

Average length, often falling between 50 and 70 cm, provides a measure of central tendency. The standard deviation, which gauges the degree of dispersion around the mean length, illustrates the variability of the population. Similarly, the average weight of *C. griseum* individuals, which usually falls between 1 and 2.5 kg, offers crucial information on their biomass and body composition.

By displaying the difference in individual weights around the mean, the weight standard deviation sheds light on several factors including as growth rates, environmental quality, and prey availability. When taken together, these biometric variables offer vital data for population surveys, fisheries management, and the creation of conservation strategies that will maintain *Chiloscyllium griseum* populations in their natural habitats.

Table 3: Average Length (AL) and Average Weight (AW) Biometric Pooling Data of *C. Griseum* with Standard Deviation (StDv)

species	Male				Female			
	AL	StDv	AW	StDv	AL	StDv	AW	StDv
Chiloscyllium griseum	57.5	34.65	2.45	3.04	55.5	34.65	2.55	3.18

The length frequency histograms (Figure 5) of *Chiloscyllium griseum,* both male and female, collected from Karachi Fish Harbour between March 2014 and July 2023 provide valuable insights on the species' size distribution and population dynamics at that point in time. The histogram displaying the male and female length distributions reveals distinct patterns that might point to differences in the sexes' preferred environments, growth rates, or reproductive practices.

The range of all recorded lengths is displayed on the x-axis of the histogram, while the frequency or amount of observed specimens falling into each length group is displayed on the y-axis. Histogram analysis may be used to find peaks or modes that correspond to frequent length categories, providing information on the most prevalent size classes in the population.

Additionally, the histogram could display changes over time that can be related to abundance, recruitment events, or seasonal differences in fishing pressure. Knowing the length frequency distribution of *C. griseum* is crucial for conservation and fishery management programs. This is due to the fact that it makes it easier to monitor the impact of fishing operations on shark populations in Karachi Fish Harbour and the nearby waters, set size-based controls, and evaluate population dynamics.

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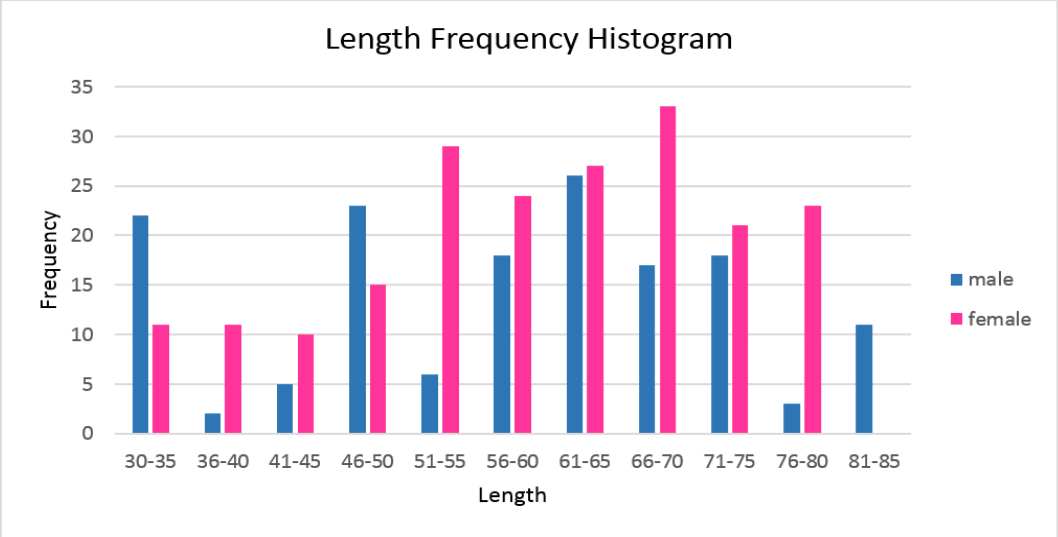

Figure 5: The Male and Female *Chiloscyllium Griseum* Length Frequency Histograms for the Samples Obtained from Karachi Fish Harbour between March 2014 and July 2023

Survey wise Size Class Variation:

The size class variation analysis of the *Chiloscyllium griseum* survey (Figure 6) offers valuable insights into the temporal fluctuations in demographic trends and population structure during the specified survey periods. By classifying individuals into distinct size groups based on their weight or total length, researchers can detect patterns in population growth, recruitment, and mortality.

Differences in how size classes are distributed throughout surveys may indicate changes in population density, age distribution, or longevity of reproductive success. For example, surveys conducted in different years or seasons may reveal variations in the prevalence of particular size classes, which may be related to recruitment pulses, spawning events, or seasonal migrations.

Moreover, size class variation study enables the identification of potential human effects, such as habitat degradation or fishing pressure that may have an impact on population demographics and size composition. It is important to comprehend these dynamics in order to make educated decisions on the management of fisheries.

This includes determining sustainable harvest limits, size-based restrictions, and effective conservation programs that safeguard *Chiloscyllium griseum* populations and the marine ecosystems they are associated with. By carrying out comprehensive survey-wise size class variation research, scientists may monitor population trends, assess the efficacy of management interventions, and ensure the long-term survival of grey bamboo shark populations in their specific habitats.

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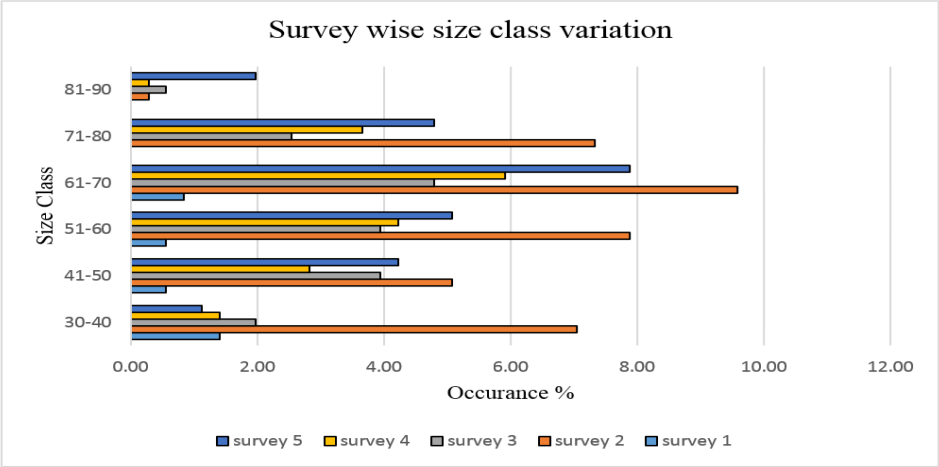

Figure 6: Variation in Size Class of Specimens Noted in Surveys (1–5)

Observations on Gravid Females:

Table 4 presents significant new data about the reproductive biology and population dynamics of *Chiloscyllium griseum* from 2014 to 2023. It includes the average length, weight, and standard deviations of gravid female survey data. Gravid females make up a significant demographic subgroup since they are an excellent predictor of reproductive activity in the community. Researchers may utilize these individuals' average weight and length to determine patterns in fecundity, maternal investment, and reproductive output over time. The standard deviation, which gives an indication of the dispersion around these averages, represents the population's variance in weight and size among gravid females. Changes in the average length and weight of gravid females during the course of the research might be an indication of changes in the reproductive state brought on by environmental variables, anthropogenic stressors, or differences in the success or timing of breeding events. Furthermore, looking at the standard deviation provides insight into the extent of individual variation in reproductive traits, which might impact the population's resilience and ability to reproduce. Understanding the average size and weight of gravid females, as well as their variability, is essential to assessing the reproductive health and viability of populations of *C. griseum*. With the use of this information, management strategies that protect essential habitats, minimize disturbances during critical periods for reproduction, and implement measures that ensure the long-term survival of grey bamboo shark populations in the face of natural and human stressors may be developed. By carrying out careful monitoring and analysis, scientists may contribute to the conservation and management of *C. griseum* populations, guaranteeing their long-term survival in marine settings and reproductive success.

Table 4: The Weight and Length Averages and Standard Deviations of Gravid Female *C. Griseum*

S. No.	Species	Min Length	Max Length	Average Length	StDv	Min Weight	Max Weight	Average Weight	StDv
1	*C. griseum*	51	63	57	8.49	2.1	3.8	2.95	1.20

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The oviparous reproductive system is used by the grey bamboo shark (*Chiloscyllium griseum*) for reproduction. Female grey bamboo sharks often deposit their "mermaid's purses," or egg capsules, on the substrate of their benthic habitat. The growing embryos are shielded by these dark brown, leathery-textured egg capsules. Each capsule holds a single embryo, which is nourished by a yolk sac until it hatches.

The incubation time might vary depending on environmental circumstances, although it usually lasts for several months. The embryo grows to the point that it resembles a tiny adult shark when it breaks out of the egg capsule. While juvenile grey bamboo sharks have many characteristics with their adult counterparts, they are smaller and lack the characteristic colouring that comes with age. After hatching, juvenile grey bamboo sharks rely on their innate skills to locate small prey and navigate their surroundings.

As adults, they gradually acquire the distinct patterns and colours of the species. Grey bamboo sharks reach sexual maturity between the ages of three and four, depending on the temperature and the availability of food in the surrounding area. The reproductive cycle of *C. griseum* is crucial to maintaining genetic diversity and population levels within each of its habitats.

Understanding the life cycle and reproductive biology of grey bamboo sharks is essential to developing effective conservation strategies that ensure the species' long-term survival in marine settings and protect critical breeding areas. By promoting habitat protection measures and preserving the reproductive success of *C. griseum,* researchers and conservationists may contribute to the preservation of biodiversity and ecosystem health in coastal areas where these sharks are located.

Chiloscyllium griseum, often known as the grey bamboo shark, is a species of shark that mostly relies on its egg capsules for reproduction. These sharks are oviparous, meaning that instead of giving birth to live young, they deposit eggs. The egg capsules, sometimes referred to as "mermaid's purses," provide protection to the developing embryos. They are typically dark brown in colour and have a leathery feel.

Each capsule contains a single embryo and is ornamented with tendrils that help tie it to the substrate, such as stony fissures or coral reefs, in order to offer stability and security throughout the incubation stage. Egg capsule size varies with the size of the bigger females that create the capsules. Over several months, the embryo grows inside the capsule until emerging into a fully formed tiny sharks.

Apart from its characteristic egg capsules, *C. griseum's* egg-laying behaviour is a benthic adaption that helps it survive and spread its progeny over coastal regions. To preserve important breeding locations and ensure the sustainability of grey bamboo shark populations, conservation efforts must fully understand the ecology and morphology of these egg capsules (Figure 7).

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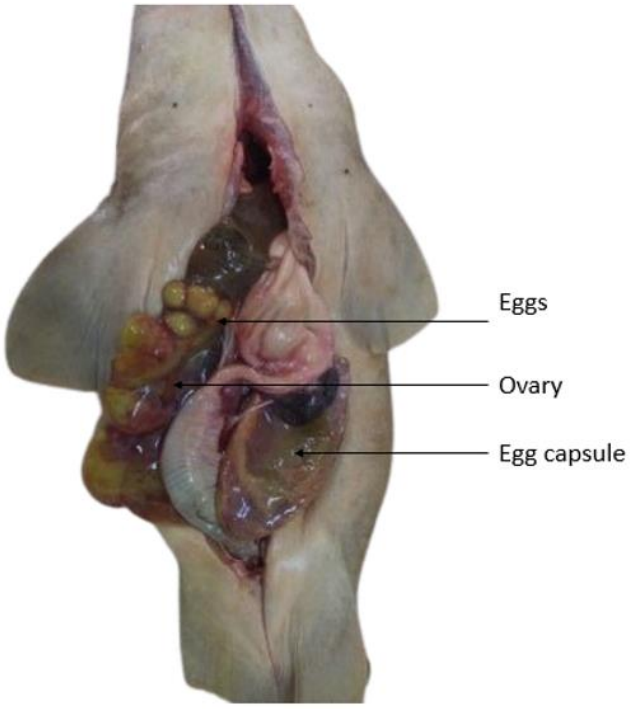

Figure 7: Anatomy of Female Reproductive Parts

CONCLUSION

In ecological terms, *C. griseum* prefers tropical and subtropical coastal habitats, which are typically found on coral reefs and shallow sandy flats. Its range extends from the western Pacific Ocean to the Red Sea, and several countries have reported sightings. Its extensive distribution nevertheless, little is known about its population dynamics and specific habitat requirements. The consumption of benthic invertebrate and small fishes is mostly done by the *C. griseum* (Grey Bamboo Shark), it is also referred as the nocturnal scavenger. A unique type of reproductive strategy is found in these type of species in which females deposits their peculiarly shaped which are also called as “mermaid’s purses” on the substrate. This type of activity is done by the oviparous animals. The main cause of vulnerability of such species is the slow pace of their biological development that they become sexually mature at a very late age and have low reproduction rate. A number of human caused activities like habitat destruction and overexploitation of these species are also the cause of their depletion status. The conservation strategies have to consider the complexity of this intriguing species ecology, anatomy, biology and behavior in order to maintain the existence in marine ecosystems and to preserve it from extinction. Grey Bamboo Shark shows fascinating bahavioural traits which showcases their adaptability and evolutionary abilities. A range of different behaviours have been adapted by this species to survive in various marine environments and with several species living in those ecosystems. One of the interesting behavior is its nocturnal eating schedule and its cryptic colouring, which helps them in playing the role of predator deception.

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Different behaviours like intricate courtship rituals and various reproductive strategies (such as oviparity) also enlighten the adaptation to cope up with the different environmental stressors. The physiological changes in the *C. griseum* shows the tendency of adaptations which are being adapted to survive against the environmental stressors.

This species have some unique anatomical features which separated them from other elasmobranch species. These special features includes spiracles that help them in efficient breathing, dermal denticles which helps them in smooth mobility. These type of morphological characters helped elasmobranchs to thrive form millions of years. Moreover, it is very difficult to understand the stresses brought on them by human activities including their habitat loss, overfishing and interference in their environment. These activities are the main cause of their vulnerability because they have some specific reproductive habits like low fecundity rates and long gestation periods.

The conservation status of *Chiloscyllium griseum* (Grey Bamboo Shark) is still uncertain as there is a lot of change in their natural habitats due to several reasons like illegal fishing techniques, more human interactions and the anthropogenic activities caused by the local people. In order to increase or to maintain the ecological integrity of such species, there is an immediate need to perform conservation activities to protect their existence in the environment as well as to maintain their role in the marine eco systems. With the objective of boosting the diversity of our waters for future generations in which *Chiloscyllium griseum* can coexists peacefully with other marine species, the cooperation of research initiatives is much required which can offer the foundation for the sustainable future.

Conflict of Interest: Authors have no conflict of interest.

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