

While looking at the activities along the coast of Mumbai during this period, the Satellite based remote sensing of the wind vectors during the period along Mumbai coast *also* confirms favorable features for upwelling (**Figure 7 to 10**).

It was also observed that there was a sudden change in the wind direction after last week of September along the coast of Mumbai. Analysis of satellite imagery of wind vectors proved that strong wind that was blowing straight towards the coast suddenly changed direction from the first week of October and started blowing parallel to the coast. Weekly averaged images for the last week of September and first three weeks of October are reproduced below in **Figures 7 to 10**.

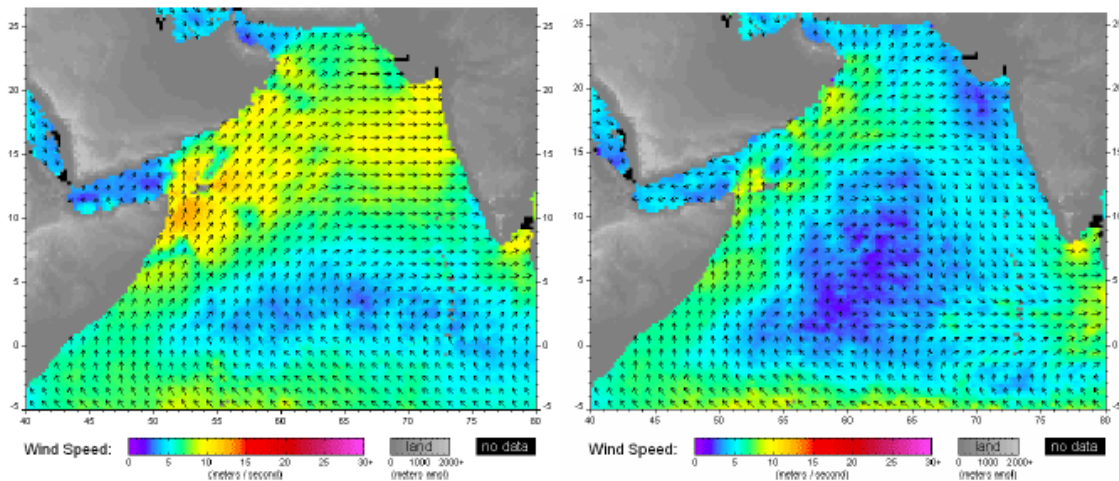
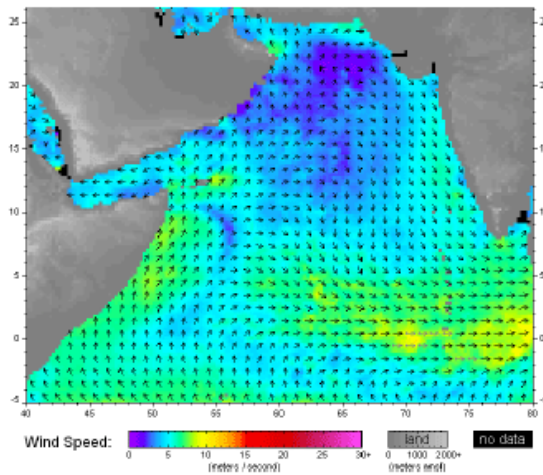
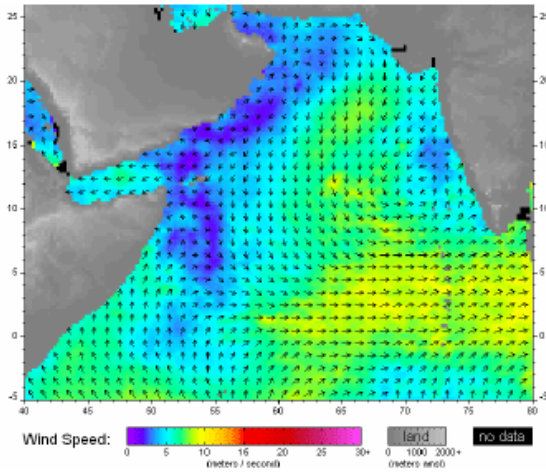


Figure 7 : Wind Vectors of Arabian Sea Averaged for the week ending 24.09.2005

Figure 8 : Wind Vectors of Arabian Sea Averaged for the week ending 01.10.2005



**Figure 9 : Wind Vectors of Arabian Sea
Averaged for the week ending
08.10.2005**



**Figure 10 : Wind Vectors of Arabian Sea
Averaged for the week ending
15.10.2005**

Upwelling is rising of oxygen deficient deeper sea water to shallower depths. Upwelling occurs when winds blowing parallel to the coastline shift surface waters from the coast to offshore and water rises from deeper levels to replace the surface water that has drifted away.

As a result, some fish population move in to the shallow surface waters while the others move offshore, away from the centre of strong upwelling. Most fishes that are active swimmers like mackerel, oil sardine and whitebaits avoid temporarily areas of intense upwelling. **However, since eels are not active swimmers, there is a probability of their getting trapped in the rising water with unfavorable environs and getting washed ashore in dead condition.**

Fish Deaths at Dadar and Khar Danda

The third case of dead fish being washed ashore was recorded at Dadar and Khar Danda beaches. These sites are very close to sewage discharge points of the diffusers that are in operation after implementation of marine outfall project of the municipal corporation. After receiving the reports of about five species of dead fishes that were found along the streak of almost one kilometer, a team of scientists from the CIFE visited the area and collected seawater and fish samples. The analysis is in progress at CIFE and results are expected soon and may indicate fish kill due to deteriorating environmental factors.

Recurring fish mortalities along the Mumbai coast have been reported earlier by various agencies and these mortalities are attributed to synergistic or combined effect of all the complex processes going on in the ecosystem due to varied sources of pollution. Various uses of the Mumbai coast are in conflict with developmental work and exploitation of traditional fishery resources.

Three different incidents of dead fishes found floating or washed ashore simultaneously have generated panic reaction in the public and media. Due to proper intervention by

various agencies, that too in an integrated manner, reasons could be investigated in near real time frame. Now, the need for having an arrangement to respond quickly and provide mitigation to such issues is vital for long term sustainability of the resource and ecosystem. Internationally, due to fragility of the coastal ecosystem a system has been established to develop linkages and manage the local issues. This report highlights the need for such system in the present context.

RECOMMENDATIONS

The current state of environmental resources warrant progressive thinking from point of view of not command and control but long term plan and achieve. The panic generated by these incidents and their investigated above highlights the public concern for environmental deterioration, which is inevitable in a scenario where rapid development is taking place. It may always not be true that certain changes and episodes take place due to environmental issues as we have witnessed here. The first case was improper management of fishing activities in the sea and combined with irresponsible behaviour of fisherfolks-traders, where economic consideration led to throwing of rotting fish. In the other case it was distinctly natural phenomena resulting large fish mortality. However, mortality in Dadar and Khar Danda points to local pollution and also possible impact of outfall, which need to be ascertained through proper study. Mumbai being a mega metropolitan city had witnessed an escalation of rapid industrial and economic growth that has touched alarming proportions in the recent past. Though advance corrective planning is being undertaken by the policy makers, the impact is not at the desirable level and new impetus should be given to addressing local issues. The better quality of life for the city could be achieved only if we take preventive steps and take decisions in light of proper scientific knowledge. In view of the above facts that all the episodes which took place almost during similar period had different reasons, which can not be otherwise understood and communicated. Based on the limited study that has been accomplished by various scientific institutes and people, following recommendations are made which can make everyone understand our nature better and take appropriate steps:

Fishing activities though regulated from various agencies do not take into account some of the situations which leads to abandonment of the catch. Though it is irresponsible behaviour, currently we do not have management plan and facilities to tackle the situation if all these kind of catches are brought on-shore.

Real time tracking of fish catch and economic activities would provide answer.

Awareness creation along with management plan formulation would solve the problems to recur as it was noticed near Gateway of India.

Upwelling related fish mortality though known and reported elsewhere, for Mumbai it has not been investigated in detail.

In light of satellite information being available as also various research institutions being present in Mumbai who can investigate such activities and integrated plan should be initiated through some central agencies such as DOD.

Low scale but varied fish kills at regular interval in some part of sea is cause of concern.

Wastewater either through the sewerage network or through diffused sources has deteriorated nearshore water quality.

Urgent steps have to be undertaken to reduce and over a fixed time frame stop this kind of coastal pollution as it is harming the basic ecology of the marine water body ecosystem.

Local network among various organizations should be established.

EIA studies are an essential component of all coastal area management planning procedures that are gaining international support and funding due to the fragility of the coastal ecosystems. In 1995, Article 10 of FAO code of conduct for responsible fisheries led to Integration of fisheries into coastal area management. Traditionally, fishers are the largest stakeholders of the Mumbai city and their concerns should be addressed through EIA to avoid conflicts.

Careful management can limit these disturbances and minimize conflicts. This can be achieved through continuous scientific monitoring and contacts between all types of prospective users and stakeholders, researchers and law enforcing agencies. For coastal city like Mumbai, it is imperative to adopt principles of Integrated Coastal Zone Management (ICZM) for sustainable exploitation of renewable and non-renewal resources.

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ACKNOWLEDGEMENTS

ICAR,CMFRI, NEERI, CIFE, MPCB and all others who contributed for this report.

SELECTED CLIPPINGS OF NEWSPAPER REPORTS

...तर फिशिंग ट्रॉलर्सवर कारवाई करणार!

प्रतिनिधी
सर्दारांसार मुंबईच्या किनाऱ्यावर सोबेले घाते जेवणाच्या
 झडेमध्ये सोबेले रंग दिवसात पाहू बाब झाली आहे. त्या घटनेचे गूढ अंधार उकलले नाही. या घटनेमागे जवळपास हे कारण असण्याची शक्यता अधिकतर मूळ असल्याचे मातृवैद्य तटस्थक दस्तावेजात आहे. सोबेले साधारत ब्राउन मासेमारी करणाऱ्या मंडळा किशिल ट्रॉलर्सकडून हे अन्वयकारक माने पुढे दाखून देण्याचा अन्वय पाहिलेला क्षमाणाची शक्यता स्थानिक आहे. असा अन्वय करताना अडकणाऱ्या फिशिंग ट्रॉलर्सवर काढणे काढावे इतरात येईल, असे तटस्थक दस्तावेजात अन्वयाने मुंबई कुतूहल ची बोलाताना स्पष्ट होते. किनाऱ्यादोऱ्या सोबेलेच्या जवळवारी वगैरे

समुद्रातील प्रदूषण रोखण्याची जबाबदारीही तटस्थक दस्तावेज आहे. त्या संदर्भात तटस्थक दस्तावेजात अतिशयचरी देण्यात आले आहेत. अशी स्थिती देऊन तटस्थक दस्तावेजात प्रस्तावने सांगितले की, मुंबई आणि परिसरात समुद्रामध्ये बुट्टे रोवण्यात आलेले नाही. त्यामुळे प्रदूषणामुळे पाणे भेदण्याची शक्यता कमी आहे.

समुद्राच्या पाण्याची चाचणी वेद परिसरात मुंबई फोर्ट ट्रस्ट आणि एचबी महासभे राज्य प्रदूषण नियंत्रण मंडळाकडे आहे. त्यांच्या अहवालातून इतर सर्व बाबी स्पष्ट होतील. मंडळाच्या अधिकाऱ्यांनी सांगितले की, त्यांनी पाण्यात नमुने निती पाहिले तटस्थकचे फोटोले आहेत. पुढील अडकणाऱ्या त्या संदर्भातील अहवाल स्वतः मिळवल्यानंतर, इतर बाबी स्पष्ट होतील.

दरम्यान, एम्बेकर पणिकाक तळांनी दिलेल्या माहितीनुसार, तेरावज्जी किना प्रदूषण वनाडत समुद्रातील प्रवाह नैसर्गिकरित्या बदलल्यानंतरही असा अन्वय पाणे प्रत्यक्षात प्रवाह पाहू शकतो. समुद्रातील लष्ठा व शीत प्रवाह असतात. त्यांचा मार्ग अचानक बदलल्यास त्याचा मंडळा परिणाम समुद्रातील जीवसृष्टीवर होतो. ही शक्यताही याकारत घेत नाही. याच तत्वासाठी अधिक संशोधन होणे आवश्यक आहे, असेही त्याने सांगितले.

जेव्हा बाजी दिल्यापासून मुंबईच्या गेट वे ऑफ इंडिया, रिखाजी पार्क तसेच गुरू चौपटीक इतर अशा अशा जवळीचे सोबेले घाते स्वतःसोबत मंडळा प्रवाहावर किनाऱ्यावर घेत आता

MUMBAI Newsline The Indian EXPRESS

SKYWATC
 FORECAST: Partly cloud
 skies, Mumbai temperature
 to be around 30°C
 TEMPERATURES
 Colaba: 30.5°C, Juhu: 28.5°C
 RELATIVE HUMIDITY 65
 WINDSPEED: MAX 35.4 C.M.H. 25.1
 RELATIVE HUMIDITY 35

Slippery Surprise ■ Civic contractors clear snake-like fish. Experts puzzled
Dead eels wash up on Juhu beach

ANUMEHA YADAV
 OCTOBER 13

AFTER 'diamonds', it's eels. Wonders and shopkeepers on Juhu beach have been intrigued to see hundreds of dead eel-like snake-like fish with elongated mouths and very small fins washed ashore and lined behind Elip Star Hotel, Juhu Hotel and adjoining buildings.

In June-end, hundreds had thronged the popular suburban beach after people claimed to have found diamonds in the sand.

"Yesterday, municipal trucks carried tonnes of them away, this morning, there were more," said Gopal Sharma, a coconut seller. Ashraf Chahil, who works for the contractor in charge of clearing the garbage from the beach, confirmed this.

"These fish are usually found near reefs 3 km to 5 km from the shore, at depths of more than 50 metres," said a senior scientist from the Central Marine Fisheries Research Institute (CMFRI). "How they reached shoals or shallow waters near the beach and how they died is puzzling," he added.

This incident comes two days after 400 dead catfish were found floating in the water between Gateway of India and Sassoon Dock on Monday. While those fish were probably caught discarded by a fishing trawler, in this case, even that has been ruled out.

"Eels are never targeted for fishing," said the CMFRI official who was part of the team investigating the Gateway incident. "Also," he added, "the distance at which they live from the shore rules out any possibility of pollution as pollutants do not spread beyond 2 km to 3 km from the shore."

With neither the water nor the fish being tested, there are no definite conclusions. But experts say oceanic currents could have played a part.

"Sometimes, during an 'upwelling' (movement of colder water from the bottom of the sea towards the surface) fish fall in the way of this current," explained Dr B F Chhapera, a retired State Fisheries Department official. "The temperature of the water and the oxygen may not be suitable as compared to the colder water. This may cause death in large numbers."

But even Chhapera, who was the curator of Baraporeva aquaria for six years, concluded that because eels did not move in schools, their dying in large numbers was unusual.

anumehayadav@expressindia.com

There are 14 kinds of eels found in the waters around Mumbai—Paroma Mohapatra

THE TIMES OF INDIA, MUMBAI
October 14, 2005



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is always led.
— C.G. Jung

NEWS DIGEST

Dead fish at Juhu beach:
Several dead deep sea fish were washed ashore at Juhu beach on Thursday and environmentalists are trying to find out the reason for this. P 3

The Times of India, Mumbai **
Friday, October 14, 2005

TIMES

Deep sea fish wash up at Juhu

TIMES NEWS NETWORK

Mumbai: Dozens of dead deep sea fish were found at Juhu Beach on Thursday, but environmentalists are still trying to find out what exactly could have caused it. "The dead fish at Juhu have been identified as species of ribbon fish, which is only found in deep seas," said D B Boralkar, member secretary of the Maharashtra State Pollution Control Board (MPCB).

Though Boralkar felt it may not have anything to do with marine pollution as it concerns deep sea fish, nothing definite can be said about the cause at the moment. "We have asked the National Environmental Engineering Research Institute (NEERI) to investigate the matter and have also



found dead at Gateway of India, Sassoon Dock and Shivaji Park beach. NEERI is likely to submit its preliminary report to MPCB by next week.

Talking to TOI on Thursday, regional officer of Indian Coast Guard Commandant Parveer Vasistha, said: "Since the fishing season has just begun following the end of monsoon, it is likely that fishermen themselves have been discarding fish that are unfit for human consumption on the shores."

Commandant Vasistha added that there has not been any oil spill or other source of sea pollution near Mumbai's coast that could have harmed the aquatic life.

The fish have been identified as a species of ribbon fish. The pollution board is investigating the cause of death

give them some of the dead fish found on the city shores in the last few days," he said.

In the past two weeks, smaller fish like catfish and singada have also been

THE TIMES OF INDIA, MUMBAI
16.10.2005

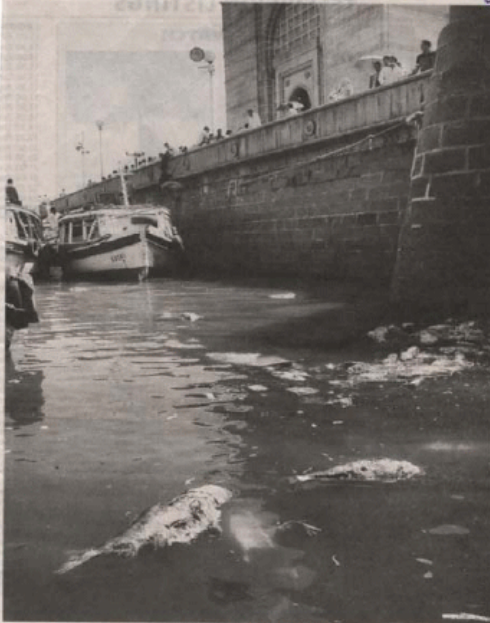
Dead fish at Juhu may have been dumped

Mumbai: The dead fish recently found on Juhu beach have been identified as 'moray eels' by the marine conservation NGO, Reef Watch. Marine biologist, Sarang Kulkarni told TOI: "Moray eels are found in inter-tidal areas in the sea, in rocky substratum. These are not commercially viable fish and are therefore discarded by fishermen." It is possible that the fish may have been dumped as they are not edible.

Kulkarni also added that due to the absence of predators, such as sharks, in coastal waters, the population of eels and other smaller fish have increased in recent years. "There has been rampant shark hunting due to their highly prized fins and shark meat," he said.

Another theory links the incident to a phenomenon called 'upwelling' which the state's coastline experiences after the rains. Upwelling occurs at the edge of the continental shelf in the ocean, when deep water currents hit the shallow shelf and come to the surface, with lots of nutrients. DNA

The Indian Express Mumbai 12/10/05



About 400 dead fish were found floating in the sea between the Gateway of India and Sassoon Dock on Monday. A team of officials from the Maharashtra Pollution Control Board and scientists from the National Environmental Engineering Research Institute and Central Marine Fisheries Research Institute inspected the site. They believe the decomposed fish—mainly catfish and bhargada—died two to three days ago. The fish are now being tested for the presence of toxic metals. Water samples from Gateway and Sassoon Dock have also been collected for testing.—Pradeep Kocharekar

Mumbai Mirror 15/10/05

'We did not dump those eels at Juhu'

Local fishermen say large trawlers that go to the high seas are the culprits

RAM PARMAR

PALGAR: It's the large trawlers that have dumped the dead fish found at Juhu beach recently and not small fishermen from Mumbai and Thane coastal district, said Rambhau Patil, president, Maharashtra Machimar Kri-ti Samiti, a fishermen welfare association.

The Coast Guard (CG) had blamed small fishermen for the incident saying that as eels have no market value, fishermen discard them after they are netted.


However, Patil said such eels were normally found in the high seas, where only huge trawlers operated. Patil said that such trawlers hailed not only from India but also from Japan, Korea and other South Asian countries. Ever since the Union Government had allowed foreign trawlers to operate in India seas, there has been a rise of such deaths, alleged Patil.

Multinational fish companies employ a fishing method where nets running up to 15 km are used in a purse-like shape to sweep the sea-floor, Patil said. As a result, a variety of marine creatures are caught. Once hauled on board, these are segregated through automatic machines and unwanted fish such as eels and sardines (called tarli in the local language) are thrown back into the sea. Due to the tide these dead fish land up at the shores, said Patil.

The CG has conveniently blamed the small fishermen in a bid to hide the main reason. No small fishermen will deliberately throw away such dead fish when there is a currently a drought in marine catch," said Patil. He also said that local fishermen would protest if the CG initiated action against them.

"The CG could bring to book the guilty large scale shipping companies, who dump diesel, industrial waste, oil and other lubricants in the sea. They threaten the environment and kill marine life.

But instead, the officials target us. We are already leading a hand-to-mouth existence," said Patil.



The fish had apparently been dumped because they have no market value

डॉ. व. कालसा, मराठी, फ्रीडॉम, ओक्टोबर 14, 2005

ज्वलंत हिंदुत्वाचा पुरस्कार करणारे एकमेव मराठी दैनिक

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संपादक : बाळू ठाकरे

मुंबईच्या किनाऱ्यांवर माशांचा महापूर

मुंबई, दि. १३ (ज्योतिषी) - गेल्या १५ दिवसांपासून मुंबईच्या समुद्रकिनाऱ्यांवर इतक्या मोठ्या प्रमाणात मृत माशांचा महापूर होत आहे. या माशांना मुंबईच्या किनाऱ्यांवर आणण्यासाठी 'मटकरी' मुंबईकरांना नाक पुढेढी घालण्यात येत आहे. दरम्यान, मोठ्या प्रमाणात मृत माशांचा महापूर होत आहे. या माशांचा महापूर मुंबईच्या किनाऱ्यांवर होत आहे.

गेल्या १५ दिवसांपासून मुंबईच्या किनाऱ्यांवर मृत माशांचा महापूर होत आहे. या माशांचा महापूर मुंबईच्या किनाऱ्यांवर होत आहे. या माशांचा महापूर मुंबईच्या किनाऱ्यांवर होत आहे.



मुंबईच्या किनाऱ्यांवर मुंबईच्या किनाऱ्यांवर मृत माशांचा महापूर होत आहे.

हे घडले कसे?

या घटनेची माहिती घेऊन मुंबईच्या किनाऱ्यांवर मृत माशांचा महापूर होत आहे. या माशांचा महापूर मुंबईच्या किनाऱ्यांवर होत आहे.

REAL TIME PHOTOGRAPH, DETAILS OF THE FISH SPECIES AND DISTRIBUTION etc. OF THE FISHES BELONGING TO CATFISH GENUS *Arius* FOUND FLOATING AT GATEWAY OF INDIA

A. REAL TIME PHOTOGRAPHS



1. *Arius dussumieri* Valenciennes, 1840 -Blacktip sea catfish

Family:	Ariidae (Sea catfishes)
Order:	Siluriformes (catfish)
Class:	Actinopterygii (ray-finned fishes)
FishBase name:	Blacktip sea catfish
Max. size:	62.0 cm SL (male/unsexed; Ref. 4967); max. published weight: 1,400 g (Ref. 4883)
Environment:	demersal; freshwater; brackish; marine; depth range 20 – 50 m
Climate:	tropical
Importance:	
Resilience:	Medium, minimum population doubling time 1.4 - 4.4 years($t_{max}=7$; $k=0.16$)
Distribution:	Indian Ocean. Also found in lower reaches of rivers flowing into the ocean (Ref. 3876).
Morphology:	Anal soft rays: 14 – 16. Body dark brown, lower surfaces completely covered with fine brown pigment specks (Ref. 3976). Has a prominent protuberance between nostril and eye.
Biology:	Found along the coast (Ref. 5213). Enters the lower parts of rivers of the east coast of Africa (Ref. 3876). Feeds on invertebrates and small fishes. Marketed fresh and dried-salted (Ref. 3290). Air bladder utilized for isinglass.

2. *Arius thalassinus*

Family: Ariidae (Sea catfishes)
Order: Siluriformes (catfish)
Class: Actinopterygii (ray-finned fishes)
FishBas: Giant seacatfish
name:
Max. size: 185 cm TL (male/unsexed; Ref. 30573); max. published weight: 1,000 g (Ref. 4883)



Environment: demersal; amphidromous (Ref. 51243); freshwater; brackish; marine; depth range 10 – 195 m

Climate: subtropical

Importance: fisheries: commercial; gamefish: yes

Resilience: Medium, minimum population doubling time 1.4 - 4.4 years (tm=2-4; tmax=19)

Distribution: **Western Indian Ocean:** known with certainty from the Red Sea and the northwestern Indian Ocean. A closely related form occurs in the Philippines and Gulf of Thailand. The wider distribution usually given for this species stems from misidentifications of similar species overlapping its range. Also reported from Australia, Polynesia and Japan and rarely in the Mekong delta (Ref. 12693).

Biology: A marine species often found in estuaries, but rarely enters freshwater. Typically euryhaline (Ref. 3876). Reported to occasionally ascend into fresh water (Ref. 12693). Recorded at temperatures ranging from 26-29°C. Feeds mainly on crabs, prawns, mantis shrimps (*Squilla* species) but also on fishes and mollusks. An important food fish. Marketed mostly fresh; often dried.

A. CATCH RECORD OF *ARIUS* SPS.

DATE	FISHING GEAR / NUMBER	AVERAGE LANDING	AVERAGE PRICE (RS.)
07.10.2005	PURSE SEINE / 5	750 KG	20.00
10.10.2005	PURSE SEINE/10	7000 KG	5.00
14.10.2005	PURSE SEINE/ 5	1500 KG	15.00

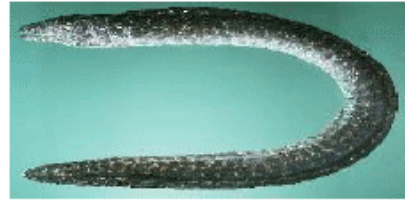
REAL TIME PHOTOGRAPH, DETAILS OF THE FISH SPECIES AND DISTRIBUTION etc. OF THE FISHES BELONGING TO CATFISH GENUS *Gymnothorax* FOUND WASHED ASHORE AT JUHU BEACH

A. REAL TIME PHOTO



B. SPECIES DETAILS

1. Gymnothorax pictus Peppered moray



***Gymnothorax pictus* (Ahl, 1789)**

Family:	Muraenidae (Moray eels), subfamily: Muraeninae
Order:	Anguilliformes (eels and morays)
Class:	Actinopterygii (ray-finned fishes)
FishBase name:	Peppered moray
Max. size:	140 cm TL (male/unsexed; Ref. 30573)
Environment:	reef-associated; marine; depth range 5 – 100 m
Climate:	tropical; 30°N - 26°S
Importance:	fisheries: minor commercial
Resilience:	
Distribution:	Indo-Pacific and Eastern Pacific: East Africa (Ref. 26165) to the Galapagos, Cocos, and Clipperton islands, north to the Hawaiian and Ryukyu islands, south to Australia and the Kermadec Islands.

Gazetteer

Morphology:	Dorsal spines (total): 0 - 0; Dorsal soft rays (total): 0; Anal spines: 0; Anal soft rays: 0. Greyish and speckled with irregular, dark markings (Ref.3257). Young yellowish with hollow-centered spots which becomes less conspicuous with age (Ref. 3257). Lacks the molariform teeth as well as the depressible vomerine fangs present in most <i>Gymnothorax</i> and have two rows of vomerine teeth (Ref. 37816).
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Biology:	Inhabits reef flats and rocky intertidal shorelines. Feeds on small fishes and crustaceans, sometimes leaving the water in pursuit of prey (Ref. 9710, 48635). Caught with various nets (Ref. 30573).
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***Gymnothorax meleagris* (Shaw, 1795)**

- Family:** Muraenidae (Moray eels), subfamily: Muraeninae
- Order:** Anguilliformes (eels and morays)
- Class:** Actinopterygii (ray-finned fishes)
- FishBase name:** Turkey moray
- Max. size:** 120 cm TL (male/unsexed; Ref. 1602)
- Environment:** reef-associated; brackish; marine; depth range 1 – 36 m
- Climate:** tropical; 32°N - 32°S
- Importance:** fisheries: minor commercial; aquarium: commercial
- Resilience:**
- Distribution:** Indo-Pacific: Red Sea and East Africa (Ref. 33390) to Marquesas and Mangaréva, north to the Ryukyu and Hawaiian islands, south to Lord Howe Island.
- Morphology:** Dorsal spines (total): 0 - 0; Dorsal soft rays (total): 0; Anal spines: 0; Anal soft rays: 0; Vertebrae: 127 – 131. Mouth white inside, contrasting the outer dark skin with small white spots (Ref. 30404, 48635). Tip of tail white.
- Biology:** Occurs in coral-rich areas of lagoon and seaward reefs from depths of 1m to at least 36 m. Prefers very shallow depth and juveniles often in intertidal zones (Ref. 30404). Often seen hunting during low tide among partly exposed reefs (Ref. 48635). Feeds mainly on fishes, also on crustaceans, by day and probably also at night (Ref. 13550). Caught with various nets (Ref. 30573).