BEFORE THE NATIONAL GREEN TRIBUNAL

SOUTHERN ZONE, CHENNAI

Original Application No. 32 of 2024 (PB OA No. 691 of 2023)

In re: News item appeared in Hindu Bureau dated 17.10.2023 titled "Beach-goers stunned as sea in Puducherry turns red"

... Applicant

v.

Central Pollution Control Board &2 Others

…Respondents

INDEX

Date: 15.03.2024
Place: Puducherry

Dr. N. RAMESH
Member Secretary
Puducherry Pollution Control Committee

BEFORE THE NATIONAL GREEN TRIBUNAL

SOUTHERN ZONE, CHENNAI

Original Application No. 32 of 2024 (PB 691 of 2023)

In re: News item appearing in Hindu Bureau dated 17.10.2023 titled "Beach-goers stunned as sea in Puducherry turns red"

REPORT FILED BY THE COMMITTEE APPOINTED BY THE TRIBUNAL

1.0 Preamble:

Based on the news item titled "Beach – goers stunned as sea in Puducherry turns red" which had appeared in "Hindu Bureau" on 17.10.2023. The matter was registered on suo moto basis in the principal bench Hon'ble NGT. The matter was heard on 22.11.2023 and passed *an order "to form a Committee comprising of Nominee of Member Secretary, Central Pollution Control Board (CPCB), Member Secretary, PPCC and one nominee of the HOD of Marine Biology Department of University of Puducherry and nominated Sr. Scientist by the Director, Centre of Advanced Study in Marine Biology, Parangipettai, Tamil Nadu. The Member Secretary, PPCC will act as nodal agency. The Committee will visit the site, collect the present sample as also the sample analysis report of the samples which were collected on 16th October, 24th October and 1st November, 2023 and also ascertain the cause of such a colour changed in the sea and the remedial action to prevent such incident".*

2.0 Constitution of the Committee:

In compliance with the Hon'ble NGT order dated 22.11.2023, the Member Secretary, Puducherry Pollution Control Committee (PPCC) has constituted a Committee

comprising the following officials from PPCC, CPCB, Department of Ocean Studies and Marine Biology and Centre for advance Study in Marine Biology:

1. Dr. N. Ramesh, Member Secretary,
   Puducherry Pollution Control Committee
   Puducherry
2. Smt. H.D. Varalaxmi, Regional Director
   Central Pollution Control Board
   Chennai – 600058
3. Dr. R. Mohanraju, Professor & Head
   Department of Ocean Studies and Marine Biology
   Pondicherry Central University
   Port Blair Campus, Andaman
4. Dr. S. Kumaresan, Assistant Professor
   Centre for Advance Study in Marine Biology
   Faculty of Marine Biology, Annamalai University

3.0 Meeting & Field visit of the committee:

The Committee met on 20.12.2023 in the Office of the Puducherry Pollution Control Committee Member Secretary, Puducherry Pollution Control Committee (PPCC) briefed about the repeated incidences (16th October, 24th October, 1st November, 7th November and 16th November 2023) of red coloration of the coastal water at Kuruchikuppam and disappearance of colour **in 3 to 5 hr**. The Committee reviewed the reports submitted by the National Centre for Coastal Research, Chennai and Centre for Advanced Marine Biology. The Committee also examined the analysis reports submitted by the Department of Sciences, Technology & Environment, Govt. of Puducherry and M/s. Chennai Mettex, a NABL accredited laboratory, Chennai.

The committee inspected the canal and the sea along with the Scientists and Engineers of DSTE & PPCC. During the inspection no change in colour of the sea was observed. The drainage canal carrying sewage was mixing in the sea. No stain of colour was noticed on the rocks and beach. The Scientist of DSTE have collected samples in the canal and sea for further analysis.

The committee also **inspected M/s. Sri Aurobindo Handmade paper unit** which is

located adjacent to the canal leading to the sea and made following observations:

(i) The unit is involving in producing of Handmade paper @ 200kg/week by using waste hosiery cotton (white & block) as a raw material.

(ii) The process consists of Segregation → Size reduction → Soaking → Beating to make slurry (adding Talcum of 4%, Starch of 1% and Calcium Carbonate of 4%). The slurry is evenly poured in mold which contains two frames, the screen holds the pulp and pressed to make thick sheet and to drains out the water. The wet sheet is taken for drying. To achieve the required colour, Chrysophenine G Extra is added in the range of 3 – 160 gm/100 kg of pulp

(iii) The unit informed that Soaking and beating operation is being carried out only two days in a week, during this operation around 2000 litre of waste water from the process is being generated.

(iv) The other source of waste water is cleaning operation of floor and other accessories of printing section, it is reported that an average 1000 to 1500 liter/day of waste water being generated.

(v) As per the information given by the unit, the waste water generation is 3000 to 3500 litre/day which includes effluent from soaking & beating and washing.

(vi) The unit has ETP comprises of collection tank, Baffle type settling tank followed by falling film aeration.

(vii) As per the Earlier Consent, the unit was allowed to discharge the treated effluent into the drain which is carrying domestic sewage and joining the sea.

(viii) The Committee verified the dates of operation of soaking and beating process taken by the unit during October-November, it is observed that no dates are coincident with the incidences of the discoloration of sea water at Promenade Beach

(ix) The hand made paper unit has stopped discharging their effluent into the drainage as per the direction of PPCC.

4.0 Review of Analysis reports and Study reports :

Followings are observations made based on the examination of the available reports and physical verification;

4.1 Samples collected and analyzed by Puducherry Pollution Control Committee.

i. Puducherry Pollution Control Committee was collected the sea water samples at Kuruchikuppam on different dates, in which two samples are much before the incidence, one is after incidence and one is before the incidence, the Committee reviewed the analysis reports of samples taken before and after the discoloration, the analysis reports are given in Table 1;

Table 1: Water quality parameters of Kuruchikuppam beach at different dates

Sl.No.	Parameters	Location of Sample – Kuruchikuppam Beach				Primary Water Quality Criteria for Class SW-II Waters
		11.05.2023 12:45 pm	07.08.2023 11:30 am	17.10.2023 4:30 pm	06.11.2023 12:45 pm	
1	Temperature	31	30	31	32	-
2	pH	7.93	7.73	6.67	7.90	6.5-8.5
3	Turbidity (NTU)	2.8	9.5	12.2	-	30 NTU
4	BOD (mg/L)	2.9	1.3	4.2	BDL	3 mg/L
5	DO (mg/L)	6	5.5	5.7	5.9	4.0 mg/L or 50% saturation value whichever is higher
6	Faecal Coliform MPN/100 mL	1600	1600	-	-	100/100 mL (MPN)
7	tal Coliform MPN/100 mL	-	1600	-	-	-
8	ecal Streptococci MPN/100 mL	-	130	-	-	-
Note: BDL- Below Detection Limit, DL- Detection Limit						

Based on the result of analysis, the following observations have been made

a) The pH of the sea water on all day were within the limits as per the criteria defined for Primary Water Quality Criteria for Class SW-II Waters, the pH of sea water on 17.10.2023(i.e one day after the incidence) was slightly acidic whereas on other days sea water samples were alkaline.

b) The Biochemical Oxygen Demand (BOD) was slightly higher than the prescribed limit on 17.10.2023 indicating slightly higher amount of organic matter.

c) The amount of Dissolved Oxygen (DO) present in sea water samples were within the limit.

d) Presence of Faecal coliforms were much higher than the prescribed limit of 100/100 mL indicating inception of sewage.

ii. PPCC has taken samples of Sea as well as Drain which is confluence at Kuruchikuppam beach two on incidence days and one after the incidence day, the analysis reports are tabulated in Table 2;

Table 2: Comparison of Water Quality Parameters between Sea and Drain which is joining sea at Kuruchikuppam beach at different dates

SI NO	**Parameters**	**07.11.2023**		**16.11.2023**		**17.11.2023**			**Primary Water Quality Criteria for Class SW-II Waters**
		Sea	**Drain**	**Sea**	**Drain**	**Sea**	**Drain**	**Sea Control area**	
1	Temperature	32	31	30	30	29	29.5	30.0	-
2	pH	7.64	7.11	6.75	6.65	7.76	7.01	7.96	6.5-8.5
3	Turbidity NTU	6.2	-	38.5	-	11.5	7.1	2.1	30 NTU
4	BOD (mg/L)	5.2	41.0	2.4	24	3.0	31.0	BDL	3 mg/L
5	DO (mg/L)	5.6	-	5.8	-	6.1	1.3	6.3	-
6	COD	-	-	-	56	-	64	-	-
	Nitrate-N (mg/L)	-	-	-	BDL	BDL	BDL	BDL (DL: 0.3)	
	Nitrite-N (mg/L)	-	-	-	BDL	BDL	BDL	BDL (DL: 0.02)	
	Sulphate (mg/L)	-	-	328.	71.67	278.1	94.82	1119.37	

				88		6			
	Ortho Phosphate (mg/L)	-	-		BDL	BDL	BDL	BDL	
	Ammonia mg/L	-	-	-	8.85	1.82	9.25	0.49	
	Ferrous Iron (mg/L)	-	-	-	-	**35.31**	**27.55**	0.63	
	Total Iron (mg/L)	-	-	-	-	**36.83**	**28.13**	0.110	
	Note: BDL- Below Detection Limit, DL- Detection Limit								

Based on the result of analysis, the following observations have been made

a. The temperature of both the sea water and drain water were nearly same.
b. The pH of both the sea water and drain were in prescribed limit and no noticeable difference was found in pH of the both water barring that sea water was slightly alkaline compared to drain water.
c. The Turbidity of the sea water was more than the standard limit on 16.11.2023.
d. The concentration of Nitrate-N, Nitrite-N and Ortho Phosphate were Below Detection Limit (BDL).
e. The Biochemical Oxygen Demand (BOD) of drain water was reported in the range of 24 – 41 mg/L which indicates the drain carrying untreated sewage. BOD in Sea water on 07.11.2023 was slightly higher than standard limit defined for Primary Water Quality Criteria for Class SW-II Waters.
f. The amount of Dissolved Oxygen (DO) present in sea water samples were within the limit.
g. The concentration of Ferrous Iron and Total Iron was found as high as 35.31 mg/L 36.83 mg/L respectively on 17.11.2023 i.e after the incident. However, the samples were taken on two days (November 7th as well as on November 16th of 2023) but not analyzed the Ferrous Iron and Total Iron for both samples, because when the incident took place in first and second times it was presumed that it sea colour change was caused by algal bloom. Hence only biologically parameters were analyzed.

iii. During Committee visit, samples of sea water at Kuruchikuppam, drain confluence, drain which carrying domestic sewage and confluence at Kuruchikuppam and Sea sample from distant place where no inception of canal/drain as reference. The samples

were analysed at PPCC Laboratory, the analysis reports are depicted at Table 3 & 4;

Table 3: Water Quality Parameters and metal concentration of Samples taken at different points of Kuruchikuppam on 20.12.2023

S I NO	Parameters	Sea (Kuruchikuppam)	Drain Confluence point (Kuruchikuppam)	Sea Reference point	Drain/Canal-westernside (Kuruchikuppam)
1	Temperature	29.0	29.0	29.0	30.0
2	Ph	7.67	7.4	7.93	7.27
3	Conductivity	41.0 ms/cm	1439 µs/cm	47.2 ms/cm	3.44 ms/cm
4	DO (mg/L)	6.1	-	6.7	-
5	COD (mg/L)	-	64.5	-	64.0
6	Turbidity NTU	2.6	3.9	2.2	3.1
7	Nitrate -N (mg/L)	BDL (DL – 0.3)			
8	Nitrite-N (mg/L)	BDL (DL - 0.02)		0.03	BDL (DL - 0.02)
9	Nitrate (mg/L)	0.059	BDL	0.084	BDL
10	BOD (mg/L)	4.0	28.0	BDL	24.0
11	P. Alkalinity	BDL (DL - 5 0)		10	BDL (DL - 5.0)
12	Total Alkalinity (mg/L)	141	285	99	297
13	Chloride (mg/L)	13893.5	596.8	16535.2	538.1
14	Total Hardness as $CaCO_3$ (mg/L)	4078.8	429.66	5781.6	392.04
15	Calcium Hardness as $CaCO_3$(mg/L)	2930.40	279.18	3247.20	300.96
16	Magnesium Hardness as $CaCO_3$ (mg/L)	1148.4	150.48	2534.4	91.08
17	Calcium as Ca^{2+} (mg/L)	1 172.16	1 1 1.67	1298.88	120.38

18	Magnesium as Mg^{2+} (mg/L)	279.06	36.57	615.86	22.13
19	TDS (mg/L)	34130	107.3	41102	1605
20	TSS (mg/L)	102.0	76.0	10.0	16.0
21	FDS/TFS (mg/L)	102.0	76.0	10.0	16.0
22	Ammonia -N	4.55	6.05	0.77	7.35
23	Sodium (mg/L)	7686.0	333.6	8896.0	300.9
24	Potassium (mg/L)	264.6	24.02	315.7	21.29
25	Hexavalent Chromium	BDL			
26	Sulphate (mg/L)	253.6	74.5	314.16	77.39
27	Ortho phosphate (mg/L)	0.07	0.28	0.081	8.49
28	% Sodium	79.03	61.07	75.67	00.87
29	SAR	52.2	7	50.7	6.6
Note: BDL- Below Detection Limit, DL- Detection Limit					

Based on the result of analysis, following observation have been made

a. The pH, Temperature, Conductivity, Dissolved Oxygen (DO), Turbidity and Chemical Oxygen Demand were within limits and there is no substantial difference in the value of above parameters for the sea water sample collected at kuruchikuppam and reference location which is having no inception of any canal/drain.

b. The concentration of Nitrate-N, Nitrite-N and Hexavalent Chromium were Below Detection Limit (BDL) in both the locations of sea.

Table 4: Heavy Metal Analysis at Kuruchikuppam beach

SI No	Parameter	Sea Water Sample	Water sample at confluence point	Water Sample at Canal	Soil Sample at canal
1	Nickel as Ni	0.020 mg/L	0.016 mg/L	BDL (DL:0.01mg/L)	5.37 mg/kg

2	Lead as Pb	BDL (DL:0.005 mg/L)	BDL (DL:0.005 mg/L)	BDL (DL:0.01 mg/L)	30.8 mg/kg
3	Total Chromium as Cr	0.220 mg/L	0.033 mg/L	BDL (DL:0.01 mg/L)	14.6 mg/kg
4	Cadmium as Cd	BDL (DL:0.001 mg/L)	BDL (DL:0.001 mg/L)	BDL (DL:0.01 mg/L)	BDL DL:1.0 mg/kg
5	Tin as Sn	BDL (DL:0.1 mg/L)	BDL (DL:0.01 mg/L)	BDL (DL:0.01 mg/L)	BDL (DL:1.0 mg/kg)
6	Iron as Fe	1.33 mg/L	1.38 mg/L	0.041 mg/L	6466 mg/kg
7	Total Iron as Fe	1.41 mg/L	1.47 mg/L	0.41 mg/L	-
8	Total Arsenic as As	0.012 mg/L	BDL (DL:0.005 mg/L)	BDL (DL:0.01 mg/L)	BDL (DL:1.0 mg/L)
9	Copper as Cu	BDL (DL:0.02 mg/L)	BDL (DL:0.02 mg/L)	BDL (DL:0.01 mg/L)	40.1 mg/kg
10	Zinc as Zn	BDL (DL:0.05 mg/L)	BDL (DL:0.05 mg/L)	BDL (DL:0.01 mg/L)	262 mg/kg
Note: BDL- Below Detection Limit, DL- Detection Limit					

Based on the result of analysis, following observation have been made

a. Concentration of Nickel and Lead is not as high to have any impact on the discoloration of sea water. Also, presence of Nickel turns water into green color not red whereas Lead under normal conditions do not react with water.

b. Concentration of Tin, Cadmium, Arsenic, Copper and Zinc were Below Detection Limit (BDL).

c. The concentration of Ferrous Iron & Total Iron was found 1.33 mg/L and 1.41 mg/L respectively in Sea water at Kuruchikuppam. The concentration of Ferrous Iron & Total Iron was found 1.38 mg/L and 1.47 mg/L respectively in confluence point of Canal and Sea water at Kuruchikuppam. The samples taken from Canal was reported very less Ferrous Iron as well as total Iron. Interestingly, the concentration of Ferrous Iron in Soil Sample taken from canal was reported as high as 6466 mg/kg.

4.2 Samples collected and analyzed by Chennai Mattex Lab Private Limited Chennai

PPCC has taken samples of Sea as well as Drain which is confluence at Kuruchikuppam

beach on 19.10.2023 i.e after two days of incident. Samples were got analyzed from M/s Mettex Lab Pvt., Ltd.,, Chennai, the analysis reports are tabulated in Table 5;

Table 5: Analysis report of Sea Water and Canal water taken on 19.10.2023

SI NO	Characteristic Test	Results	
		Sea Water	**Canal Sewage Water**
1	Dye Content	Absent	Absent
2	pH	7.27	7.04
3	Iron as Fe	11.44 mg/L	15.53 mg/L
4	Nickel as Ni	BDL (DL: 0.01mg/L)	BDL (DL: 0.01mg/L)
Note: BDL- Below Detection Limit, DL- Detection Limit			

Based on the result of analysis, following observation have been made

a. As per the analysis results, iron concentrations was found 11.44 mg/L 15.53 mg/L in Sea water and Canal water respectively.
b. No Dye content and Nickel concentration was report in both samples.

4.3 Assessment Report on the Cause of Red Coloration by Annamalai University:

Annamalai University made survey on 02.11.2023 i.e one day after the incident and collected the necessary water and plankton samples by adopting the standard methods and analysed in their laboratory, the detailed report is enclosed as **Annexure -1**. Based on the analysis report, made following findings;

- In the analysis, it was observed that the domination of *Noctiluca scintillans* in numbers when compared with other phytoplankton. The *Noctiluca scintillans* is a single cell phytoplankton that might have caused the bloom on the Puducherry coast. It was also observed that the majority of *Noctiluca scintillans* cells were found ruptured (plankton crash). This process led to the release of pigment into the coastal waters that might be responsible for red coloration. The examination of water samples in the affected region revealed that the dominant contributor to the bloom was Noctiluca scintillans with a concentration of 641 x 10^3 organisms per liter and it dominates in the coastal environments. In general, the bloom takes place when the coastal water is sourced with

rich nutrients, occasionally leading to the development of algal bloom, referred to as "red tide." The reported species of Noctiluca scintillans in this assessment is not harmful due to their dense aggregations.

- The environmental parameters such as sea surface temperature (31°C), salinity (41psu), pH (6.5), and dissolved oxygen (5.8ppm) were assessed and related to the phytoplankton proliferation. The parameters were found to be conducive to the development of this species. Noctiluca scintillans is known for its distinctive reddish coloration when it aggregates in high numbers and undergoes plankton crash. The crash leads to the release of pigments present in their cells, which are colored pigments When *Noctiluca scintillans* cells lyse, or rupture, they release their pigments into the surrounding water. This pigment was found to have adhered to the nearby rock surfaces, and even the seafloor, creating a red biofilm-like coating . This phenomenon is a result of the breakdown of the cells and the dispersion of their pigments (lipid based) in the water, which subsequently settles on various substrates.

4.4 Assessment report on frequent discoloration of coastal waters at promenade Beach by National Center for Coastal Research (NCCR):

The team from National Centre for Coastal Research visited the site on 08.11.2024 i.e. after one day of the incident and collected the phytoplankton species from decolorized region, the analysis reports is given in Table 6 and detailed report is enclosed at **Annexure -2**.

Table 6: Phytoplankton species identified in the Red Patch region of Pondicherry Coast (Cells L^{-1})

Sl.No.	Species	South	Centre	North	Bloom Sample
Bacillariphyceae					
1	Coscinodiscus centralis	300	0	0	0
2	Coscinodiscus wailesil	0	0	150	0
3	Nizschia sp.	0	416	0	0
4	Thalassiosira	0	833	150	0
Dinophyceae					
5	Noctiluca scintillans	4200	416	150	7400
6	Prorocentrum micans	300	1250	450	0
7	Prorocentrum sp.	0	0	450	0

8	Procentrium sp.	600	0	0	0
9	Properidinium sp.	0	416	0	0
10	Pyrophacus sp.	600	0	0	0
11	Tripos furca	900	1250	900	0
12	Tripos fusus	0	0	150	0
13	Tripos sp.	0	0	150	0
Charophyceae					
14	Pediatrum sp.	300	2083	0	0
15	Scenedesmus sp.	0	416	150	0
Cyanophyceae					
16	Ulothrix sp	0	416	0	0
Protozoan					
17	Ciliate sp.	0	1250	0	0
Total		7200	8333	3000	7400

In total, 16 Phytoplankton species belonging to Bacillariophyceae (4), Dinophyceae (9), Charophyceae (2) were and Cyanophyceae (1) were identifies from the samples collected. Among the four classes identified, dinoflagellates were found to be dominant at all the locations. Total phytoplankton population density at the discolored region was observed to be 8333 cells L^{-1} with the presence of green algae and suspended matter which implies fresh water influx. The bloom sample contain only green *Noctiluca scintillans* which accounted for 7400 cells L^{-1}. There was no other Phytoplankton Species found with green Noctiluca scintillans. The NDCI values in the red patch region showed zero and negative values both indicating no bloom occurrences. From FTIR analysis of the settled suspended matter collected from the discoloured region it is indicated that the suspended matter was fabric and the color is Hanna Red and Natural Dye.

Metal concentrations were analysed in the sediments, tissue samples of oysters (Crassostrea cucullate), dye settled on oyster shells and microalgae from Puducherry coast after the incident of red discoloration in seawater (Table 3). The metal concentrations in sediment were found within the range.

Table 7: Metal Concentration (µg/g) in the samples collected from Pondicherry coast

Sl.No	Sample ID	Ag	As	Cd	Co	Cr	Cu	Mn	Ni	Pb
1	PDY sedimen North	0.03	0.34	0.09	0.68	7.41	0.47	15.27	0.93	0.26

2	PDY sedimen Central	0.02	0.11	0.07	0.72	21.73	0.44	16.16	0.71	0.35
3	PDY sedimen South	0.14	0.41	0.03	0.72	21.73	0.44	16.16	0.71	0.35
4	Oyster tissue	8.33	7.40	3.66	1.07	18.03	213.3	32.92	1.17	4.93
5	Algae	0.06	2.63	0.28	0.09	61.28	1.33	39.59	1.19	15.92
6	Dye extracte d fron oyster shell	0.34	BDL	0.34	BDL	0.90	1.86	3.71	12.60	13.27

Based on the above, it is concluded that the discoloration happened due to release of water containing dye or synthetic colours and not due to algal blooms.

4.7 Signature Analysis of Sample taken from Sea and Canal Water:

Puducherry Pollution Control Committee taken a sample from Sea and Canal one day after the last incident i.e 17.11.2023 and carried out the signature analysis from M/s Chennai Mettex Lab Private Ltd, the report is enclosed as **Annexure -3**. It was observed that IR spectra of the seawater sample and the canal water sample are identical to each other and both are very similar to IR spectra of pure water. Hence IR data of samples doesn't provide any conclusion**. The GC spectra of the seawater sample contain one extra peak as compared to the spectra of the canal water sample. It signifies that there is an extra organic compound is present in the seawater which is absent in the canal water. For the identification of that unknown compound further investigation and analysis are required.**

5.0 Findings and Conclusions :

The Committee reviewed the reports of sample analysed by Puducherry Pollution Control Committee, M/s Mattex Lab Pvt. Ltd, Assessment reports of Annamalai University and National Centre for Coastal Research and arrived the following findings and conclusions;

i) As per the information provided by the PPCC “sea in Puducherry turns red coulour” incident happened in 5 occasions i.e. October 16th , October 24th November 1st November 7th and November 16th 2023. The incidence happened subsequently after 6-

7 days continuously for 5 times and last occurred was November 16th 2023, no incidence happened then onwards .

ii) No samples were taken on incidence days i.e October 16th , October 24th and November 1st . The samples were taken on October 17th and November 6th i.e after one day of incidence in one occasion, after 5days of incidence in another occasion. In both cases, the analysis reports **(Table no. 1)** not indicating any variation in the sea water quality and quality was almost similar with normal condition. Samples from Sea as well as Canal was taken after post incidence i.e October 19th and analyzed to verify the concentration of Dye content, Nickle and Iron, the analysis report **(Table no. 5)** indicates the high Iron concertation in both Sea Water as Well as Canal sewage.

iii) Puducherry Pollution Control Committee taken samples from Sea and Canal on incidence days of November 7th and November 16th, and also taken samples one day after the incidence i.e on November 17th 2023. All physio- Chemical parameters **(Table no. 2)** were found normal in samples collected on incidence as well as post incidence. Ferrous Iron and Toal Iron concentration was observed very high in post incidence samples collected from Sea water as well as in Canal Water.

iv) Analysis report **(Table no. 3)** of samples taken during Committee visit (i.e 20.12.2024) indicates the no substantial difference in value of physio chemical parameters for the sea water sample collected at kuruchikuppam and reference location which is having no inception of any canal/drain. As per the **Table no. 4**, no abnormal heavy metal concentration was reported.

v) As per the survey on 02.11.2023 and study report of Annamalai University" the domination of Noctiluca scintillans in numbers when compared with other phytoplankton. The Noctiluca scintillans is a single cell phytoplankton that might have caused the bloom on the Puducherry coast. It was also observed that the majority of Noctiluca scintillans cells were found ruptured (plankton crash). This process led to the release of pigment into the coastal waters that might be responsible for red coloration. The bloom takes place when the coastal water is sourced with rich nutrients, occasionally leading to the development of algal bloom, referred to as "red tide." The reported species of Noctiluca scintillans in this assessment is not harmful due to their dense aggregations.

The environmental parameters such as sea surface temperature (31°C), salinity(41psu), pH (6.5), and dissolved oxygen (5.8ppm) were assessed and related to the phytoplankton proliferation. The parameters were found to be conducive to the development of this species. Noctiluca scintillans is known for its distinctive reddish coloration when it aggregates in high numbers and undergoes plankton crash. The crash leads to the release of pigments present in their cells, which are colored pigments. The observed pH in the water was found to be acidic (6.5) and this showed the continuous release of acid-based pigments concentrated in the water. The dissolved oxygen levels in the area affected by the bloom were found normal.

vi) As per the Survey and Study conducted by National Centre for Coastal Research, "The bloom sample contain only green *Noctiluca scintillans* which accounted for 7400 cells L^{-1}. There was no other Phytoplankton Species found with green Noctiluca scintillans. The NDCI values in the red patch region showed zero and negative values both indicating no bloom occurrences. From FTIR analysis of the settled suspended matter collected from the discoloured region it is indicated that the suspended matter was fabric and the colour is Hanna Red and Natural Dye and concluded that the discoloration happened due to release of water containing dye or synthetic colours and not due to algal blooms".

vi) As per the Signature analysis conducted for water samples ID no. 2051(Sea water) and 2052(Canal Water). The IR spectra of the seawater sample and the canal water sample are identical to each other and both are very similar to IR spectra of pure water. Hence IR data of samples doesn't provide any conclusion. The GC spectra of the seawater sample contain one extra peak as compared to the spectra of the canal water sample. It signifies that there is an extra organic compound is present in the seawater which is absent in the canal water. For the identification of that unknown compound further investigation and analysis are required.

Conclusions:

(i) From the above findings, Committee felt that analysis of physio chemical parameters carried out for sea water and canal water on different occasion not indicating any manmade sources for causing red colour in sea water. However in two incidences Ferrous Iron and Total Iron was reported very high but these parameters were not conducted in all the incidence to confirm the cause.

(ii) The high amount of iron in the sampled water might have favoured for plankton bloom in the absence of enriched nutrients and that can be indicated in the report.

(iii) As per the Annamalia report, at the time of Plankton crash significance of coloured pigments release to water.

(iv) The conclusion of NCCR i.e release of water containing dye or synthetic colour could not be established by the analysis results of samples taken from Sea water and Canal water since physio chemical parameters found normal.

(v) As per the signature analysis of samples taken from sea and Canal, it is inferred that presence of extra organic compound in sea water sample but the exact compound could not be established.

(vi) Committee concluding that to identify the cause for red colour in Sea during incidence samples to be collected in impact area as well as reference area and has to be analyzed for physiochemical as well as heavy metal and detailed signature analysis to be conducted.

6.0 Recommendations/Suggestions:

Based on above findings, the committee recommends the following suggestions to Puducherry Pollution Control Committee;

(i) To keep stringent vigilance on quality of sewage carrying in the Canal which confluence at Kuruchikuppam to avoid red colour in sea

(ii) Periodical monitoring of canal and adjacent coastal water for physical, chemical, biological parameters as well as heavy metal. To compare these results with parameters of reference location where no colour occurred in past.

(iii) The sediments of the Canal before confluence and after confluence to be monitored for physical, chemical, biological parameters including heavy metals.

(iv) To collect samples in the sea and canal in different points in different interval in case of reoccurrence of red colour in the sea and to analyze for physical, chemical, biological parameters including heavy metals.

(v) As a long term measure, the untreated sewage which is presently letting into sea shall be taken to nearby STP for treatment.

(vi) To stop discharge of treated effluent into canal permanently from M/s Sri Aurobindo Handmade paper unit and to direct the unit to recycle the treated effluent for process or other utility. Consequently, the action taken by the unit with regard to recycling the waste water after treatment for their daily use in the unit itself can be obtained as a self – report.

(vii) The regular survey on bathymetry and current pattern in the particular location need to be carry out.

Signature of Committee Members

Dr. R. Mohanraju Professor & Head Department of Ocean Studies and Marine Biology Pondicherry Central University	**Dr. S. Kumaresan** Assistant Professor Centre for Advance Study in Marine Biol Faculty of Marine Biology, Annamalai University
Smt. H.D. Varalaxmi Regional Director, Chennai Central Pollution Control Board	**Dr. N. Ramesh** Member Secretary Puducherry Pollution Control Committe Puducherry

ANNEXURE-I

ASSESSMENT REPORT ON THE CAUSE OF RED COLOURATION IN THE COASTAL WATERS OF PUDUCHERRY, SOUTHEAST COAST OF INDIA

Dr.S.Kumaresan and Dr.S.Bragadeeswaran (CAS in Marine Biology)
and
Dr. N.ramesh (Pondicherry Pollution Control Committee)

SURVEY CONDUCTED:

A survey on the Puducherry coast (Southeast coast of India) was made on 02.11.2023 based on the advice of The Member Secretary of PPCC since regular news on red coloration of the coastal waters, near Vaithikuppam village of Puducherry is being flashed by the Pondicherry Pollution Control Committee. The sampling was accomplished by a team of researchers from CAS in Marine Biology, Faculty of Marine Sciences, Annamalai University, Parangipettai, and the staff members from the Department of Science, Technology and Environment, Pondicherry Pollution Control Committee. This assessment was made with the following objectives

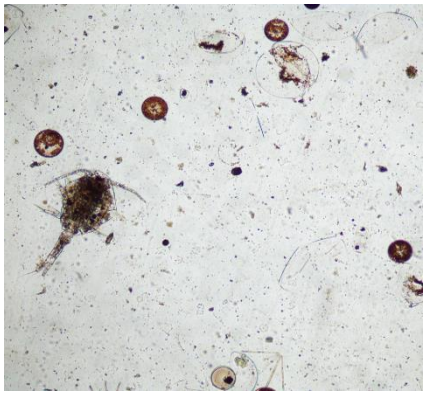
- To find out the reason for the unusual red coloration in the coastal waters of Puducherry
- To find out the responsible phytoplankton if any for the discoloration along with other environmental parameters

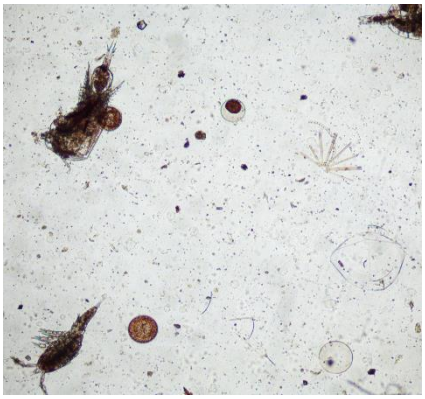
SAMPLING:

In the survey, the necessary water and plankton samples were collected by adopting the standard methods and preserved immediately. The samples were brought to the laboratory for meticulous analysis by following the standard procedures.

FINDINGS:

In the analysis, it was observed that the domination of *Noctiluca scintillans* in numbers when compared with other phytoplankton. The *Noctiluca scintillans* is a single cell phytoplankton that might have caused the bloom on the Puducherry coast. It was also observed that the majority of *Noctiluca scintillans* cells were found ruptured (plankton crash). This process led to the release of pigment into the coastal waters that might be responsible for red coloration.





BACKGROUND DETAILS OF THIS SPECIES:

Noctiluca scintillans is a unicellular, siliceous photosynthetic organism favoured by nutrient-enriched waters from land drainage mixing. These blooms were found to have occurred in the tropical region, often by green dinoflagellate (*Noctiluca scintillans*). Due to the discoloration in the coastal waters, seawater and phytoplankton samples were collected in the coastal waters of Puducherry with the coordinating points of Lat:11°56'23.25"N; Lon: 79°50'18.02"E by the team.

The examination of water samples in the affected region revealed that the dominant contributor to the bloom was *Noctiluca scintillans* (Fig. 1), with a concentration of 641 x 10^3 organisms per liter and it dominates in the coastal environments. In general, the bloom takes place when the coastal water is sourced with

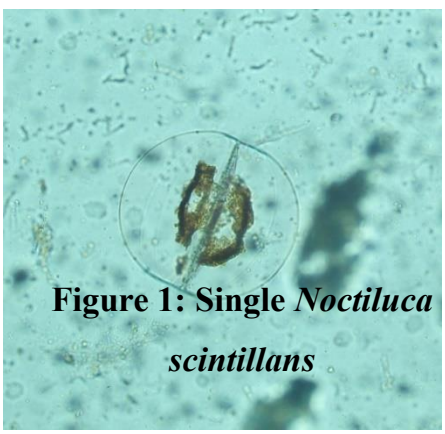


Figure 1: Single *Noctiluca scintillans*

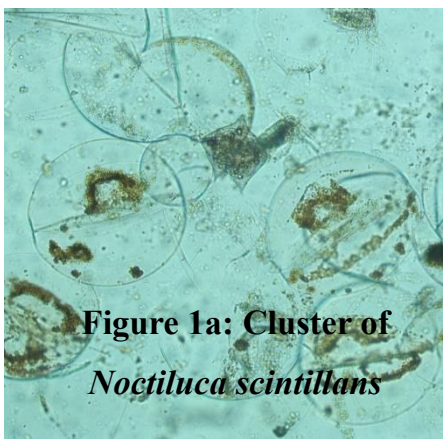


Figure 1a: Cluster of *Noctiluca scintillans*

Microscopic observation of sample from the Bloom Site

rich nutrients, occasionally leading to the development of algal bloom, referred to as "red tide." The reported species of *Noctiluca scintillans* in this assessment is not harmful due to their dense aggregations.

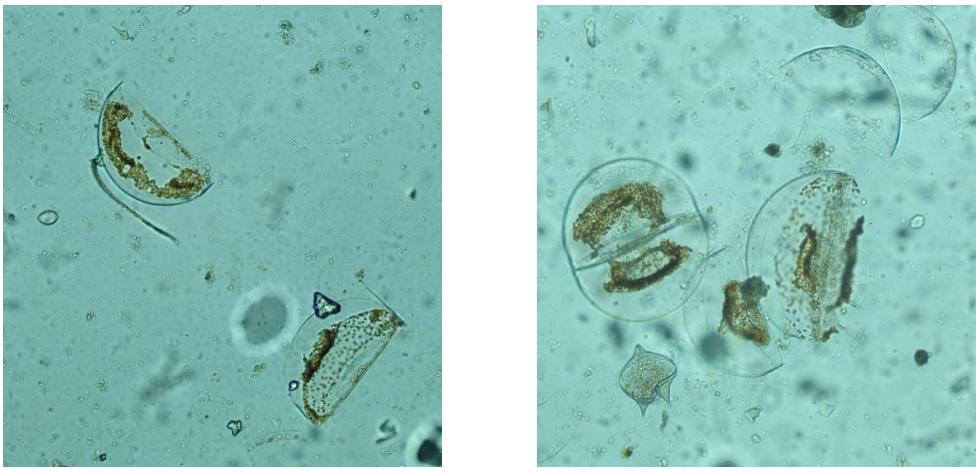


Figure 1b: Crash of *Noctiluca scintillans*

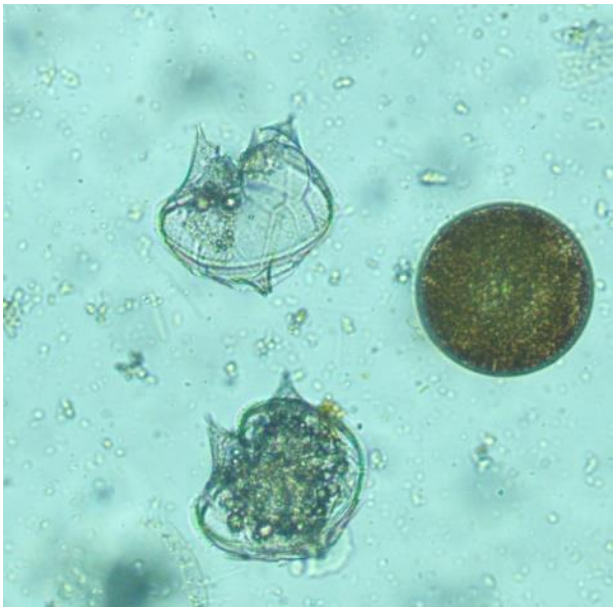
The environmental parameters such as sea surface temperature (31°C), salinity (41psu), pH (6.5), and dissolved oxygen (5.8ppm) were assessed and related to the phytoplankton proliferation. The parameters were found to be conducive to the development of this species. *Noctiluca scintillans* is known for its distinctive reddish coloration when it aggregates in high numbers and undergoes plankton crash. The crash leads to the release of pigments present in their cells, which are colored pigments.

When *Noctiluca scintillans* cells lyse, or rupture, they release their pigments into the surrounding water. This pigment was found to have adhered to the nearby rocks,

surfaces, and even the seafloor, creating a red biofilm-like coating (Fig 2). This phenomenon is a result of the breakdown of the cells and the dispersion of their pigments (lipid based) in the water, which subsequently settles on various substrates.

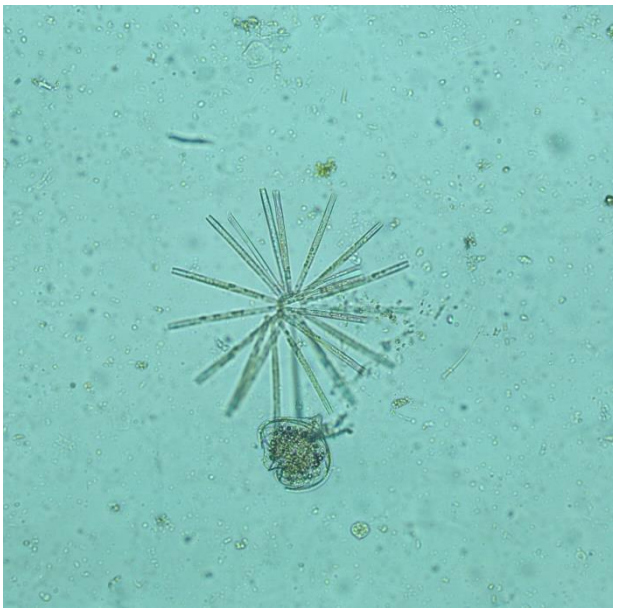
Figure 2: Red biofilm-like coating found in the bloom area

The observed pH in the water was found to be acidic (6.5) and this showed the continuous release of acid-based pigments concentrated in the water. The dissolved oxygen levels in the area affected by the bloom were found normal. During the sampling

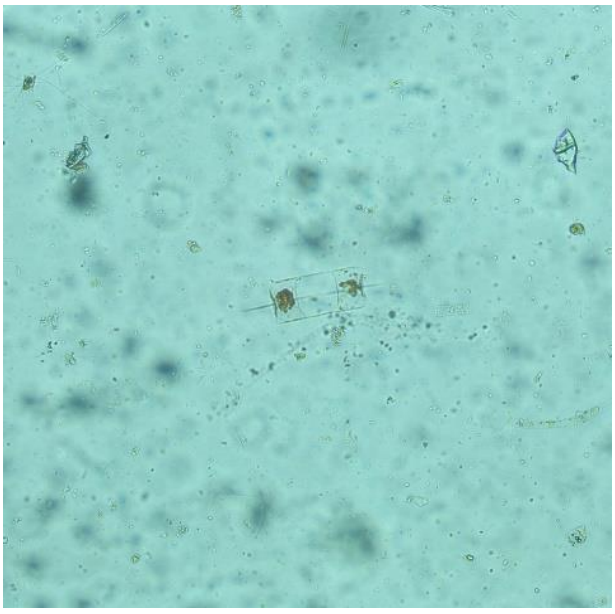


Protopperidinium brochii

Chaetoceros curvisetus* and *Cosinodiscus centralis



Thalassiothrix frauenfeldii



Ditylum brightwelli

process, several other species were also identified, including *Cosinodiscus centralis, Protopperidinium brochii, Thalassiothrix frauenfeldii, Ditylum brightwelli* and *Chaetoceros curvisetus.*

Figure 3: Other Species found during the sampling

During the bloom, two zooplankton species, *Acartia* sp. and *Euterpina acutifrons*, dominated the ecosystem (Fig 4). Notably, the observation revealed that the digestive systems of the zooplankton were found to have contained a red pigment, this might be acquired from consumption of this species, the organism responsible for the bloom (Fig 5).

***Acartia* sp.**

Euterpina acutifrons

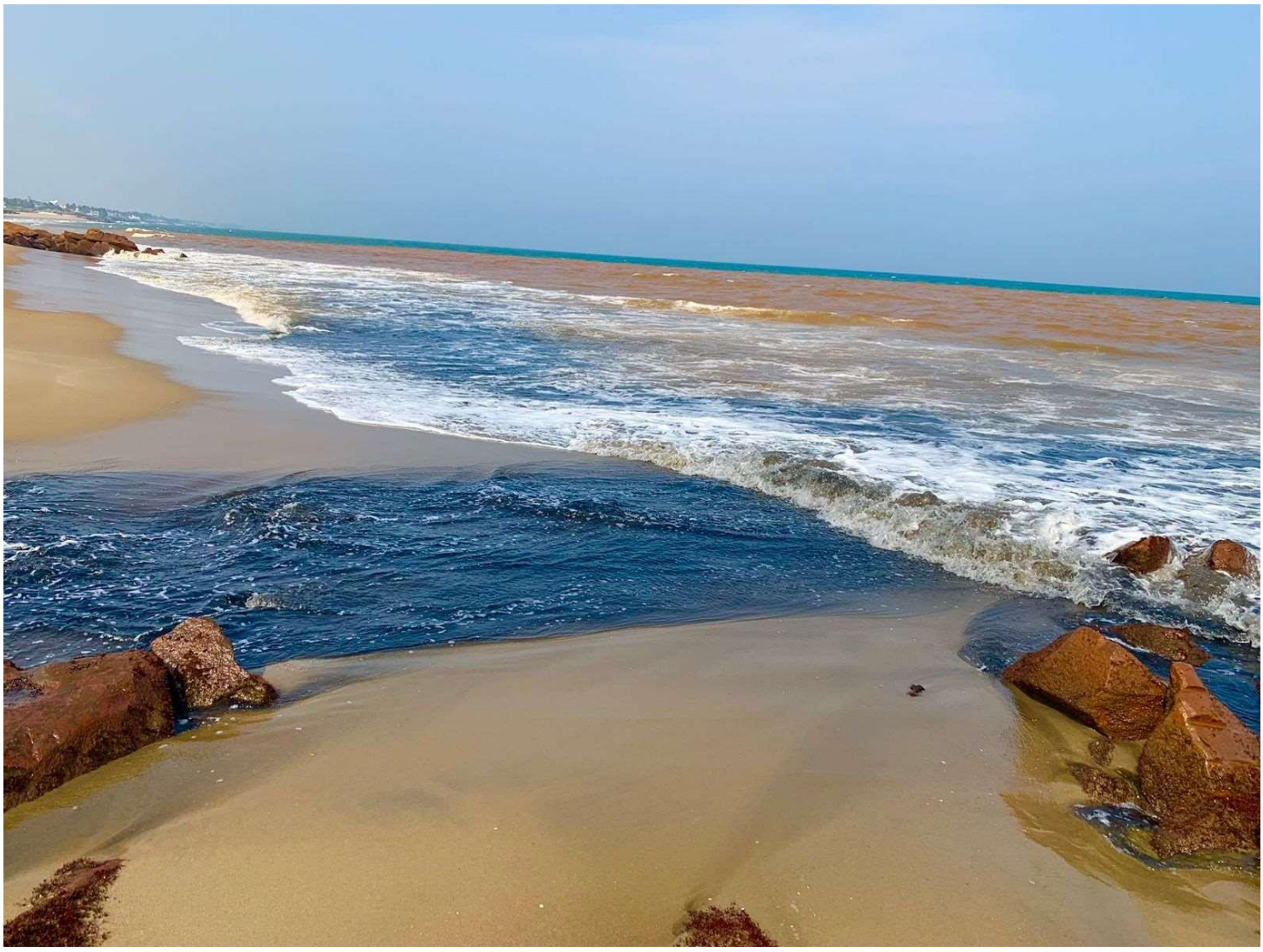
Figure 4: Dominant Zooplankton during the bloom

Figure 5: Red pigmentation in the stomach of zooplankton as a result of consumption of bloom-forming organisms

ANNEXURE-II

Report on the Assessment of Frequent Discoloration of Coastal Waters at Promenade Beach, Puducherry

(Based on observation dated 08/11/2023)



Prepared by
National Centre for Coastal Research
Ministry of Earth Sciences

Submitted to
Puducherry Pollution Control Committee
Puducherry

NCCR Team

Dr. Sisir Kumar Dash, Scientist F

Dr. K. Ramu, Scientist F

Dr. S. R. Marigoudar, Scientist E

Dr. P. Karthikeyan, Project Scientist II

Mr. C. Muthukumar, Project Scientist II

Mr. N. Logesh, Project Scientist I

Dr. V. Manigandan, Project Scientist I

Dr. R. Sankar Ganesh, Project Scientist I

Dr. G. Arun, Project Scientist I

Description of the report

Discoloration of coastal waters into reddish brown is frequently being observed at the Promenade beach, Puducherry. The discoloration patch extends about 100 - 200 meters north and south of the sewage draining channel located at the beach (Fig.1). As this discoloration phenomenon happened in the prominent location of Puducherry, it gained huge media attention. The Puducherry Pollution Control Committee (PPCC) made the initial inspection of the recent event that happened on 07/11/2023 and sought the support of National Centre for Coastal Research (NCCR) to delineate the source and cause for the discoloration. NCCR deputed a team of experts to carry out the field investigations on 08/11/2023 (Fig.2).

In general, the discoloration of coastal waters might happen due to formation of algal blooms or release of industrial effluents. As this region receives untreated sewage, it was initially suspected that the formation of algal bloom might have caused the discoloration. Some coastal villages like Bommayarpalayam in Puducherry are known to have red soil. During the rainy season its quite common that, lot of seepage of such red soil mixtures drains into the sea in these regions. NCCR team visited Boomayarpalyam coast and found that such phenomenon had not happened in the recent days.

The neighboring fishermen community near Promenade beach informed that they observed a dark color oily substance floating through the sewage channel and which upon interacting with the seawater turned reddish brown. The reddish discoloration remained for 3-6 hours and slowly disappeared. However, the reddish-brown color deposited on the boulder rocks and walls of the sewage channel (100m upstream) were persistent as a thick layer for days (Fig. 3). The sessile organisms attached on the boulders were observed to be coated with reddish-brown color. Samples were collected from random locations as suggested by PPCC based on the expansion of discoloration to measure the physicochemical and biological

parameters. We performed the traditional qualitative assessment of phytoplankton community and the remote sensing technologies to check the existence or phenology of algal bloom.

Fig 1: Map of the coastal water discoloration area with field-collected sampling sites along the Promenade beach, Puducherry.

Fig 2: NCCR team along with PPCC officials inspecting the site.

Fig 3: Persistent coloration on the walls of the sewage channel.

Fig 4: Absorption of color on the sessile organisms

The microscopic examination of the sample collected from the discoloured region revealed the reddish-brown particles as suspended matter (Fig.1) not the remains of algal bloom crash.

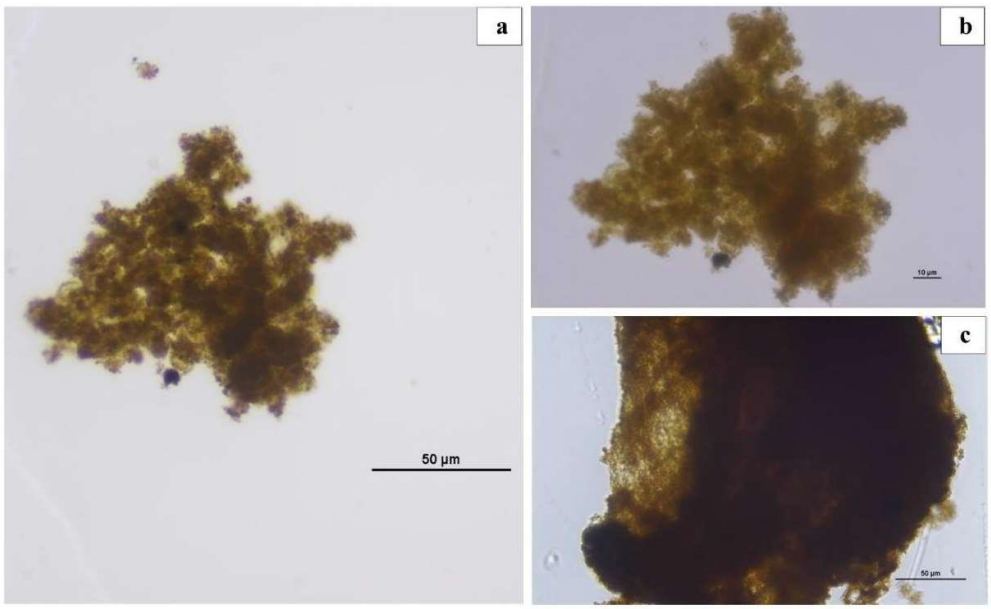


Fig 5 : Microscopic images (a-c) observed under different magnification show suspended matter in the sample collected in the red patch region of Puducherry coast.

In the water samples collected, there was no drastic changes in the physicochemical properties of the seawater (Table.1). All the physicochemical parameters measured were

comparable with the region receiving untreated sewages and available past datasets from Puducherry coast.

Table 1: Physiochemical parameters measured in the water samples collected from discolorized region

Code	Date	Time	Ammonia (µM)	Nitrite (µM)	Nitrate (µM)	Phosphate (µM)	Silicate (µM)	TN (µM)	TP (µM)	Chl (µg/l)
1	07.11.2023	9.00 am	9.01	0.58	1.19	0.61	37.72	58.12	2.22	25.95
PDY 2	07.11.2023	9.00 am	8.51	0.70	1.49	0.54	43.44	52.90	2.24	19.25
PDY 3	07.11.2023	9.00 am	8.39	0.89	1.30	0.48	41.18	48.20	1.72	0.18
1	07.11.2023	4.00 pm	8.48	1.93	20.29	1.28	53.33	52.09	3.36	19.16
2	07.11.2023	4.00 pm	4.81	0.55	1.32	0.80	29.72	36.30	1.97	12.46
3	07.11.2023	4.00 pm	9.32	0.89	0.51	0.81	48.50	38.92	2.42	27.48
4	07.11.2023	4.00 pm	13.25	0.95	3.97	0.67	60.08	59.48	2.33	27.27
South	08.11.2023	8.00 am	10.94	0.42	0.71	0.94	23.40	46.37	3.35	7.34
North	08.11.2023	8.00 am	28.21	2.76	0.84	7.39	133.57	114.92	6.65	1.38
Centre	08.11.2023	8.00 am	44.36	1.97	1.06	18.55	387.87	220.40	12.05	7.87

In total, 16 phytoplankton species belonging to Bacillariophyceae (4), Dinophyceae (9), Charophyceae (2) and Cyanophyceae (1) were identified from the samples collected (Table 2). Among the 4 classes identified, dinoflagellates were found to be dominant at all the locations (Fig.6). Total phytoplankton population density at the discolured region was observed to be 8333 cells L^{-1} with the presence of green algae and suspended matter which implies freshwater influx (Fig. 6). The bloom sample contained only green *Noctiluca scintillans* which accounted for 7400 cells L^{-1} (Fig. 6). There was no other phytoplankton species found with green *Noctiluca scintillans*.

Table 2 : List of phytoplankton species identified in the Red Patch region of Pondicherry coast (Cells L^{-1}).

S. No.	Species	South	Centre	North	Bloom Sample
Bacillariophyceae					
1	Coscinodiscus centralis	300	0	0	0
2	Coscinodiscus wailesii	0	0	150	0
3	Nitzschia sp.	0	416	0	0
4	Thalassiosira sp.	0	833	150	0
Dinophyceae					
5	Noctiluca scintillans	4200	416	150	7400
6	Prorocentrum gracile	300	1250	450	0
7	Prorocentrum micans	0	0	450	0
8	Prorocentrum sp.	600	0	0	0
9	Protoperidinium sp.	0	416	0	0
10	Pyrophacus sp.	600	0	300	0
11	Tripos furca	900	1250	900	0
12	Tripos fusus	0	0	150	0
13	Tripos sp.	0	0	150	0
Charophyceae					
14	Pediastrum sp.	300	2083	0	0
15	Scenedesmus sp.	0	416	150	0
Cyanophyceae					
16	Ulothrix sp.	0	416	0	0
Protozoan					
17	Ciliate sp.	0	1250	0	0
Total		7200	8333	3000	7400

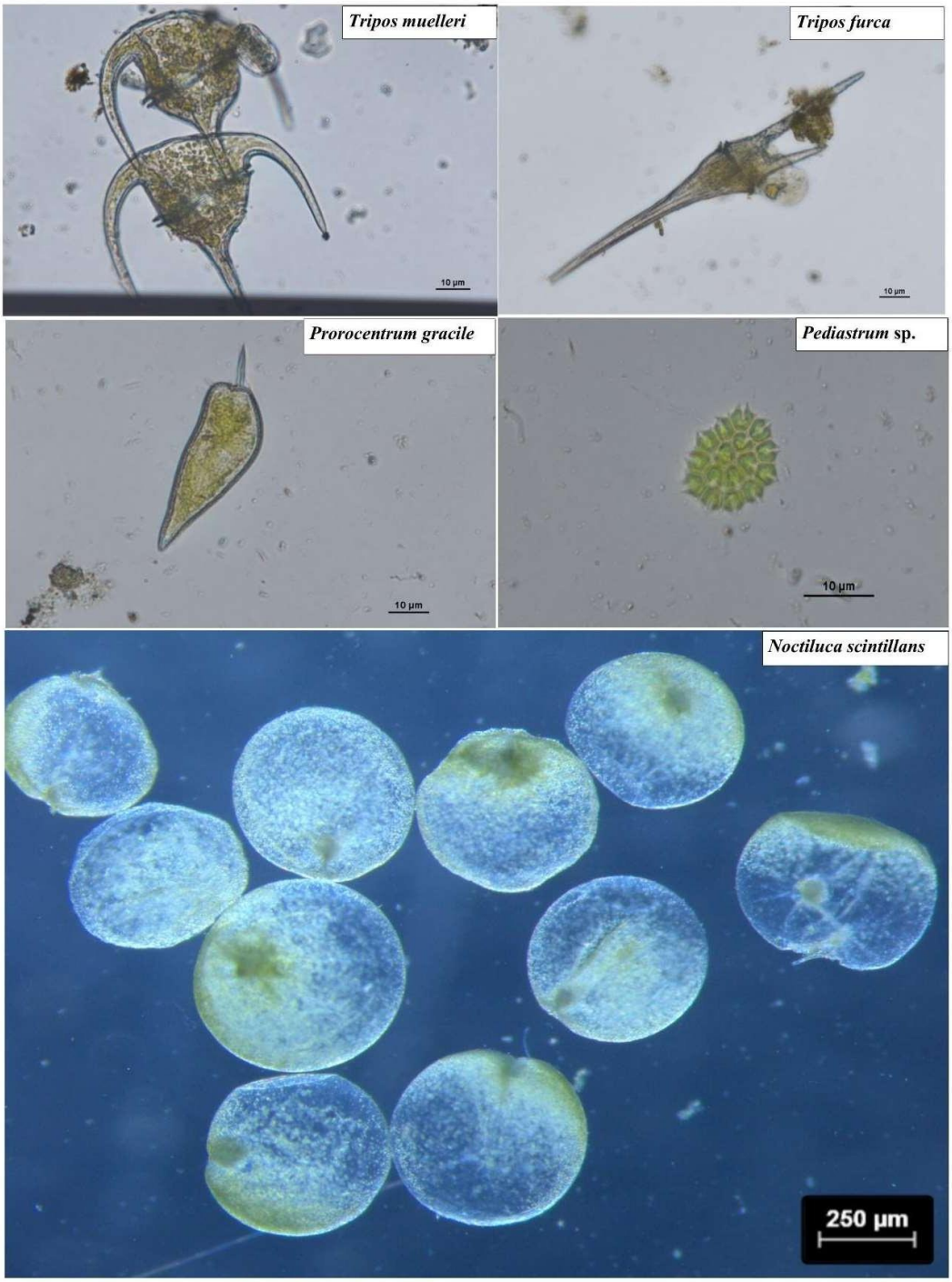


Fig 6: Dominant phytoplankton species identified in the discoloration region

The discoloration of coastal waters observed on 17/10/2023 and 01/11/2023 were assessed using multispectral satellite images. Based on the availability of the data and cloud cover the Sentinel 2 Level 1 satellite image were taken for Puducherry costal region. The observed red patch covered an area of 0.6 sq.km and 1.45 sq.km on 17th October and 1st November of 2023 respectively. The analysis of previously available image (12/10/2023) showed no evidence of red patch in the study region. The Fig. 7 shows red patch that occurred in Pondicherry coastal area on 17/10/2023.

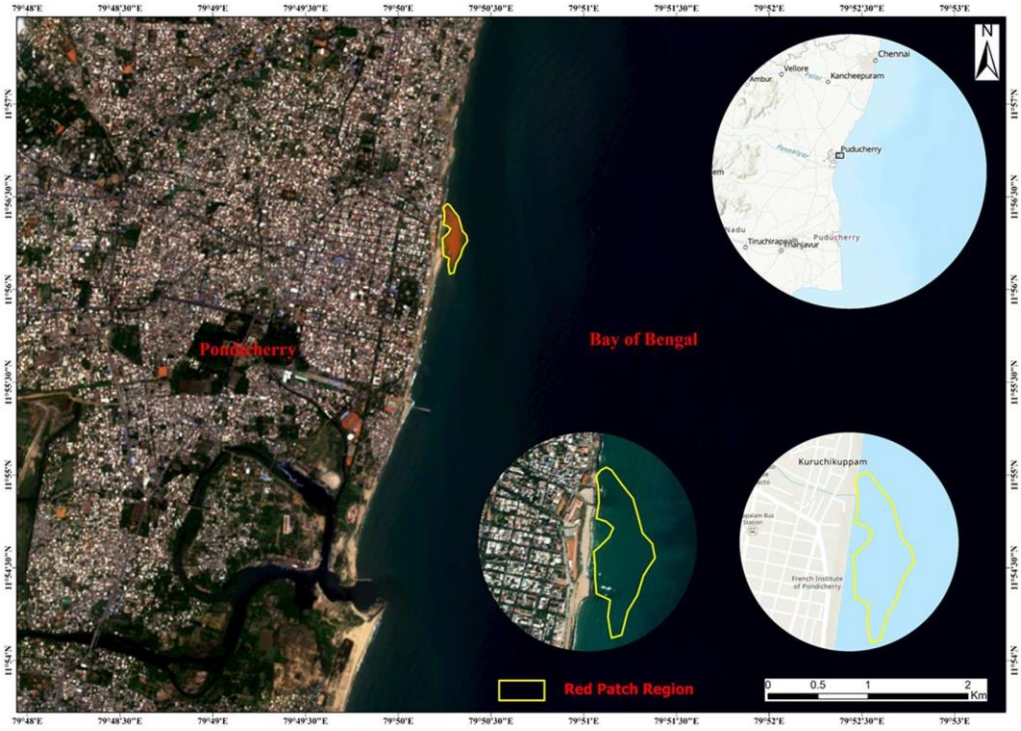


Fig 7. Red Patch area in Pondicherry coastal waters.

The False Color composite (FCC) images for the dates of 17th October and 1st November, 2023 clearly showed the red patch region in green color and there is no evidence of patches in previously available date (Fig. 8). The Chl-a, Total suspended Matter (TSM) and NDCI were calculated after the pre-processing of Sentinel 2 Level 1 satellite image using Case 2 Regional Coast Colour (C2RCC) to confirm the presence of bloom. The chlorophyll - a ranged from 4 to 6 mg/m^3 and the TSM ranged from 25 to 50 g/m^3 on 17th October 2023. On

1st November 2023 the observed chlorophyll - a ranged from 0 to 2.66 mg/m^3 and TSM ranged from 0 to 3.25 g/m^3 (Figure 9).

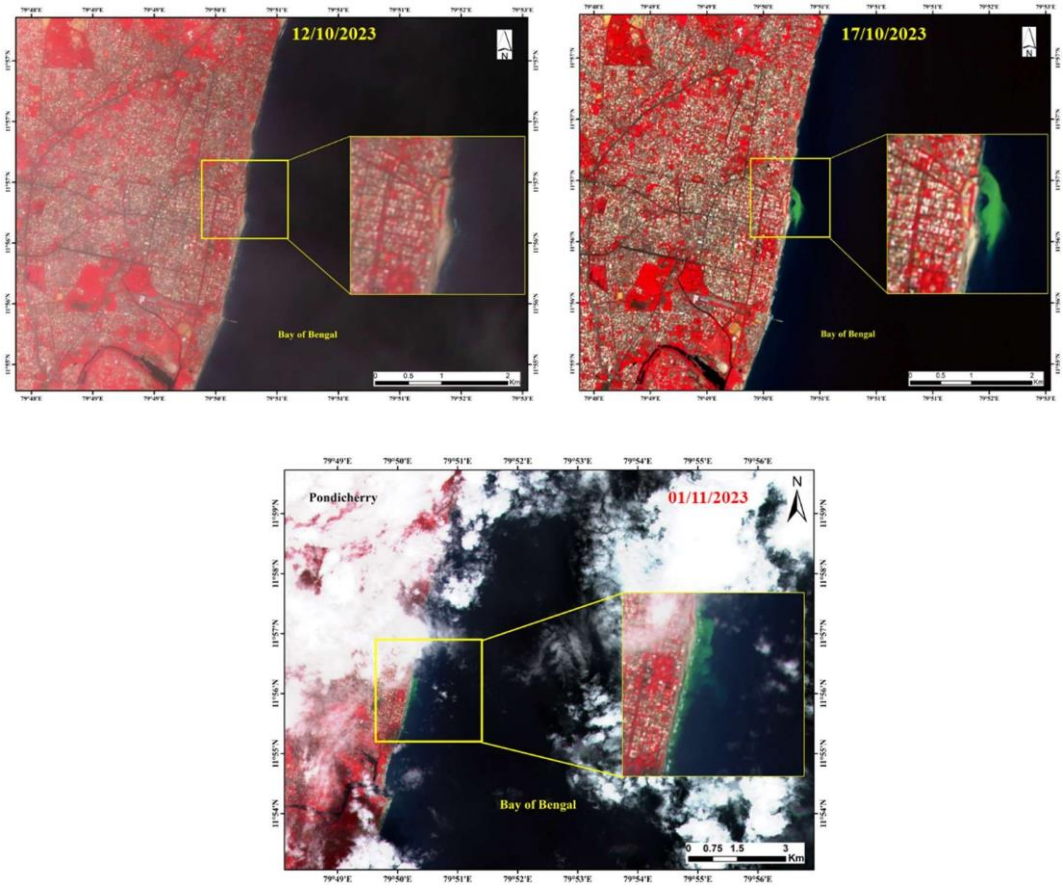


Fig 8. False color composite of the red patch region

The normalized difference chlorophyll index (NDCI) is useful to accurately map the presence of bloom area. The Red patch area was analyzed using NDCI band difference algorithm (red and red-edge band) (Eq.1). To determine the NDCI from S2 the band 4 and 5 were used. The NDCI less than zero suggests that the water body likely has lower chlorophyll-a. Higher NDCI values indicates presence of algae or phytoplankton. The NDCI values in the red patch region showed zero and negative values on both the dates implying no bloom occurrence (Fig. 10).

$$NDCI = \frac{\text{Rrs708}-\text{Rrs665}}{\text{Rrs708}+\text{Rrs665}}\,(dll) \qquad (1)$$

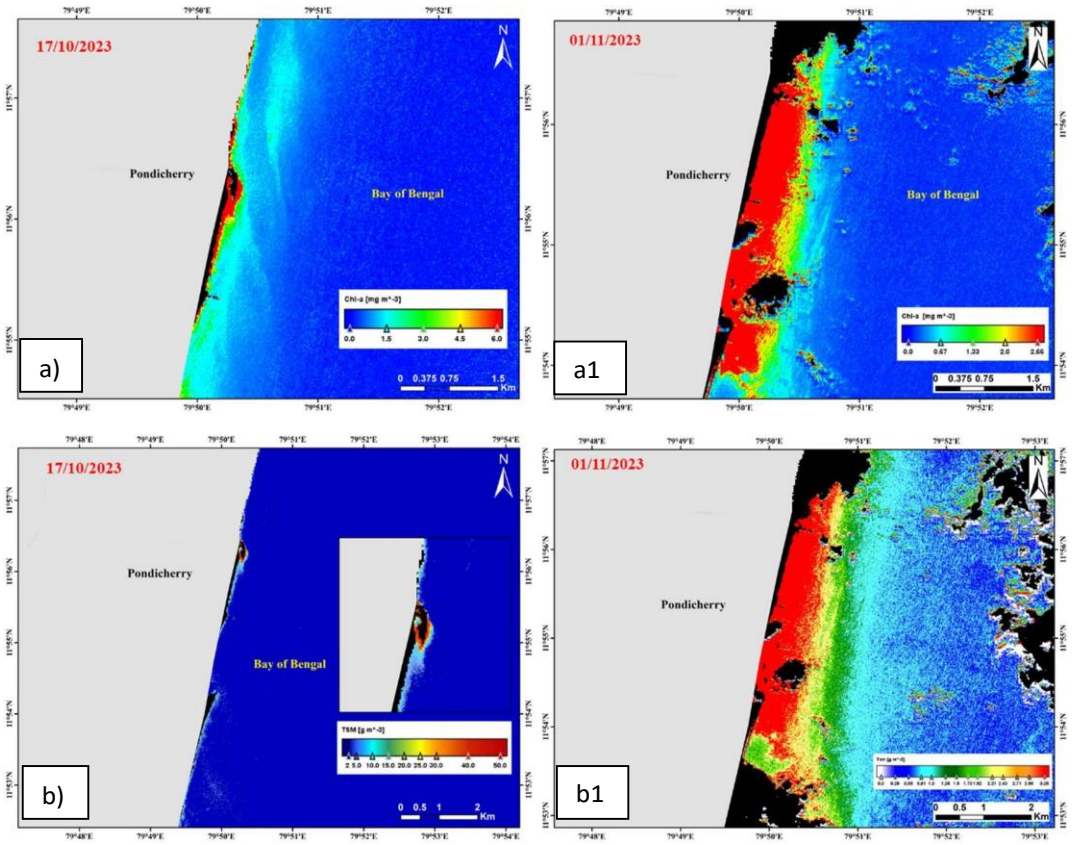


Figure 9. a & a1) Chl-a concentration; b & b1) TSM concentration for the red patch region

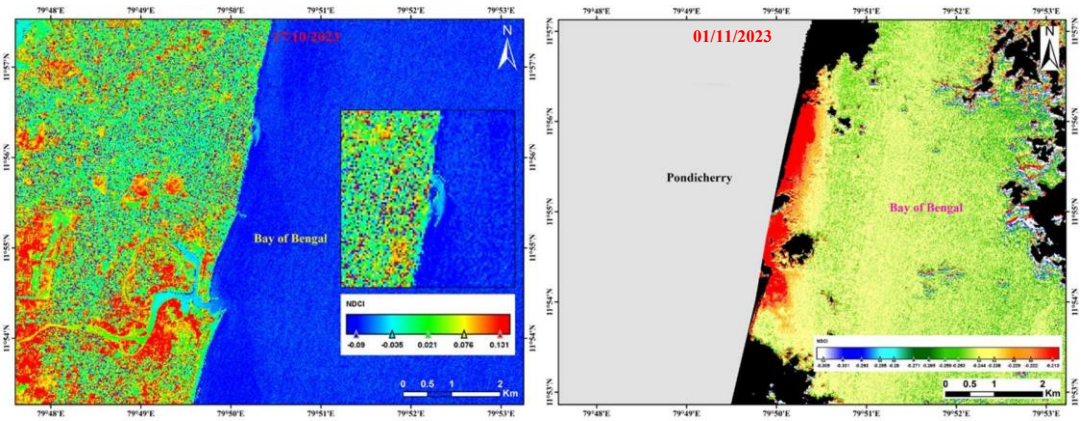


Figure 10. Normalized difference chlorophyll index for the red patch region

The Spectrum profile in the red patch region was created using SNAP application. The high peak was observed between 650 and 710 nm (Fig. 11). As per the previous publications the high peak values in the spectrum between 650 and 710 nm are high concentration of

suspended particulate matter. Therefore, based on the NDCI values and spectrum profile the red patch region is not a bloom.

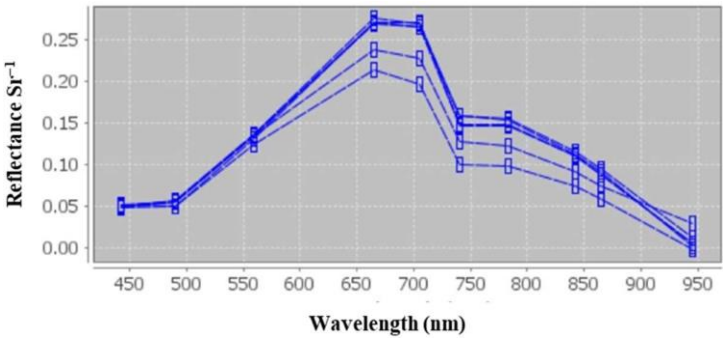
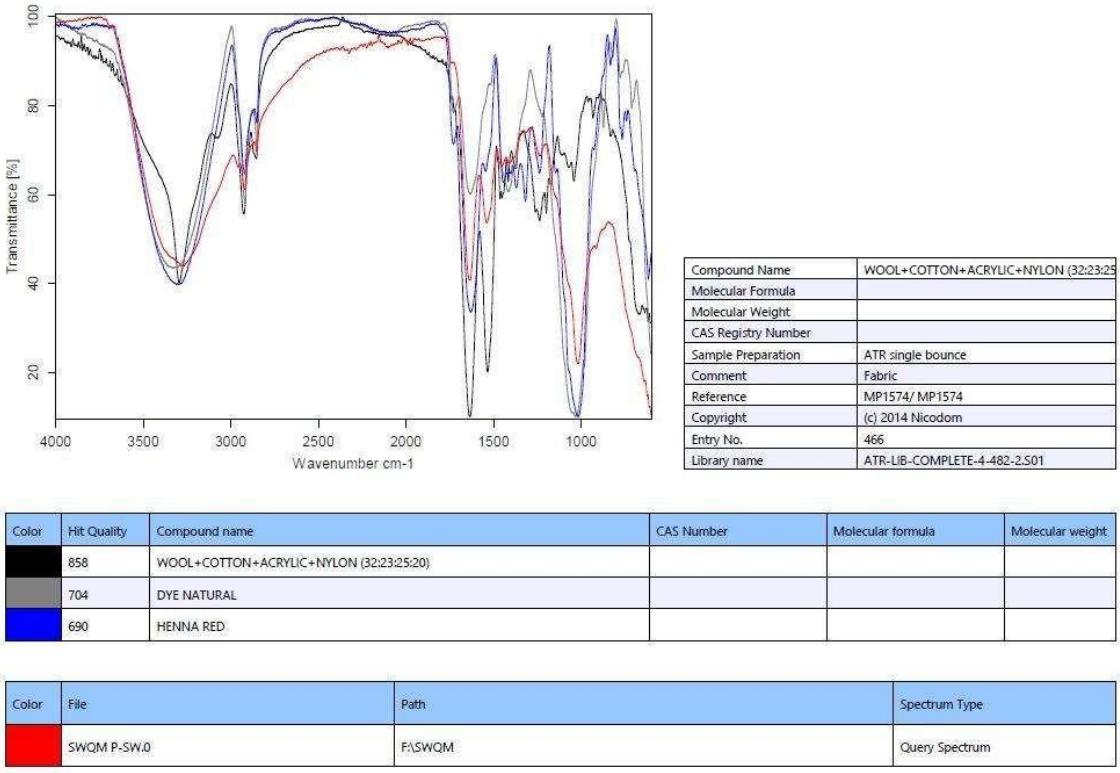


Figure 11. Spectrum profile for the red patch region

Further, Fourier Transform Infrared Spectroscopy (FTIR) analysis was performed for the settled suspended matter collected from the discoloration region to find the nature of the particles. From the results (Fig. 12), it is observed that the suspended particles are fabric (wool, cotton & nylon) in nature and the color of Hanna Red and Dye Natural.



Compound Name	WOOL+COTTON+ACRYLIC+NYLON (32:23:25
Molecular Formula	
Molecular Weight	
CAS Registry Number	
Sample Preparation	ATR single bounce
Comment	Fabric
Reference	MP1574/ MP1574
Copyright	(c) 2014 Nicodom
Entry No.	466
Library name	ATR-LIB-COMPLETE-4-482-2.S01

Color	Hit Quality	Compound name	CAS Number	Molecular formula	Molecular weight
	858	WOOL+COTTON+ACRYLIC+NYLON (32:23:25:20)			
	704	DYE NATURAL			
	690	HENNA RED			

Color	File	Path	Spectrum Type
	SWQM P-SW.0	F:\SWQM	Query Spectrum

Fig 12. FTIR spectrum of suspended particulate matter

The outer layer of the oyster shells (both live & dead), plastics, styrofoam were pigmented in orange to red colour at the decolorized site (Fig 13 &14). Sample of oyster bed on the intertidal rocks was examined and found to be healthy live organisms of oyster *Crassostrea cucullata*, barnacle, anemone and juveniles of mussels etc (Fig13 a-d). The dye had not penetrated into the tissues of oyster and did not adversely affect the live organisms (Fig.13 e).

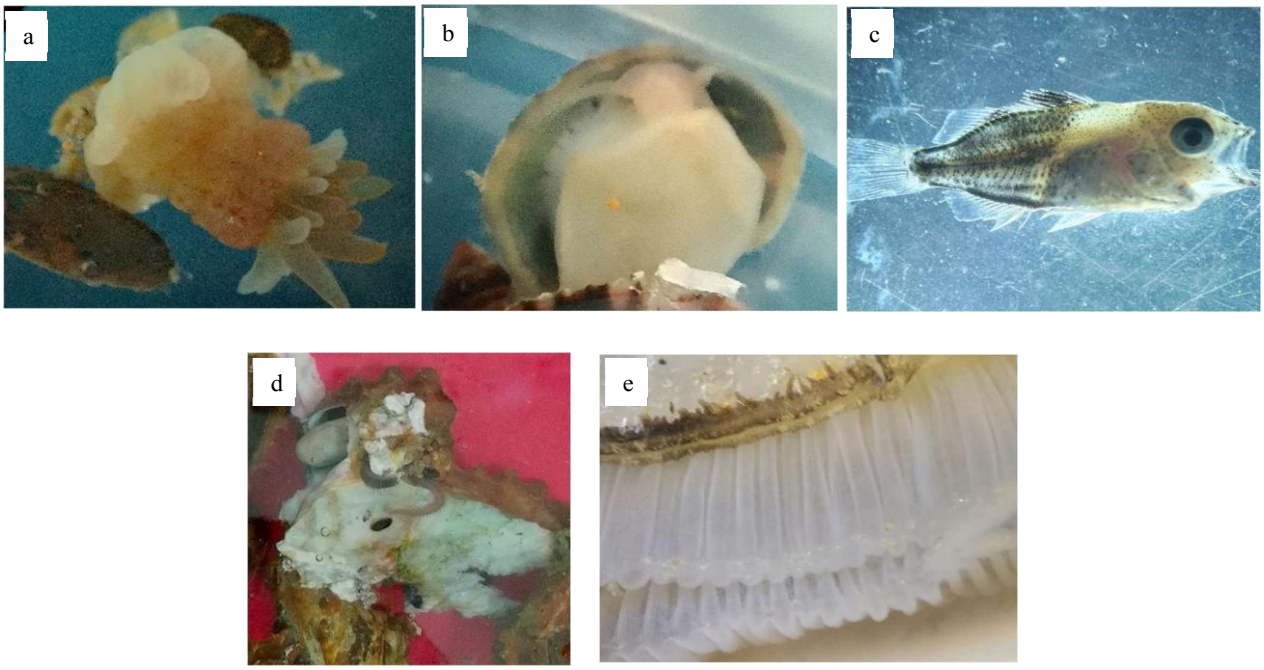


Fig.13. Marine organisms observed on the rocks and seawater in intertidal region at Pondicherry beach. a) Sea anemone (<1cm), b) Limpet, c) Fish fry (1-1.5 cm), d) Oyster and polychaete worm and e) microscopic image of oyster gill.

Fig.14. Outer surface of the oyster shells and Styrofoam on the rocks and seawater in intertidal region at Pondicherry beach pigmented in red colour after the incident of effluent discharges.

Metal concentrations in the samples collected from Pondicherry coast

Metal concentrations were analyzed in the sediment, tissue sample of oyster (*Crassostrea cucullate*), dye settled on oyster shells and macroalgae collected from the Pondicherry coast after the incident of red discoloration in seawater (Table 3). The metal concentrations in the sediment samples were found within the range of recently reported concentrations.

Table 3. Metal concentrations (µg/g) in the samples collected from Pondicherry coast.

S.No.	Sample ID	Ag	As	Cd	Co	Cr	Cu	Mn	Ni	Pb
1	PDY sediment North	0.30	0.34	0.09	0.68	7.41	0.47	15.27	0.93	0.26
2	PDY sediment Central	0.02	0.11	0.07	0.72	21.73	0.44	16.16	0.71	0.35
3	PDY sediment South	0.14	0.41	0.03	0.72	24.64	0.38	27.99	1.41	BDL
4	Oyster tissue	8.33	7.40	3.66	1.07	18.03	213.3	32.92	1.17	4.93
5	Algae	0.06	2.63	0.28	0.09	61.28	1.33	39.59	1.19	15.92
6	Dye extracted from oyster shell	0.34	BDL	0.43	BDL	0.90	1.86	3.71	12.60	13.27

Concluding remarks on observation made on 08/11/2023

From our observations, we conclude that the discoloration happened because of the release of waste water containing dye or synthetic colors and not due to algal blooms. Its recommended that PPCC inspect the industries located near the vicinity and plug the release of any untreated effluent discharges to avoid such events in the future. Moreover, PPCC have to restrict the release of untreated sewage directly into the coast, else it may fuel the formation of toxic algal blooms and can make the ecosystem vulnerable.

-End of the report-

CHENNAI METTEX LAB PRIVATE LIMITED®

Jothi Complex, 83, M.K.N. Road, Guindy, Chennai - 600 032, Tamil Nadu, INDIA
Phone : +91 44 22323163, 22311034, 42179490, 42179491 | CIN : U74999TN2008PTC069459
Email : test@mettexlab.com | Web : www.mettexlab.com

TEST REPORT

ISSUED TO : M/s.The Member Secretary,
Puducherry Pollution Control Committee,
3rd Floor, PHB Building,
Anna Nagar, Puducherry.

T.C Date : 22.11.2023

T.C No : CML/23-24/78071

Date Of Receipt : 17.11.2023

Cust. Ref : SRF Dated : 17.11.2023

Analysis Commenced On : 17.11.2023

Lab No : 24083964

Analysis Completed On : 22.11.2023

Sample Description : **Water- Sample- ID No: 2052**
(as stated by customer)

Characteristics Test	Test Method	Results
Functional Group Analysis	FTIR	Annexture Attached
Finger Print Analysis	GCMS MS	Annexture Attached
Ferrous Iron	IS: 3025 Part 53:2003 (Reaff: 2019)	27.55 mg/l
Total Iron	IS: 3025 Part 2:2004 (Reaff: 2014)	28.13 mg/l

End of Report

For Chennai Mettex Lab Private Limited

Reviewed & Authorized By
P. KAVITHA
Technical Manager
Authorised Signatory

CHENNAI METTEX LAB PRIVATE LIMITED

Jothi Complex, No.83, M K N Road, Guindy, Chennai - 600 032

Work Sheet

SRF Number 17,053 LabNo 24083964 Date 17-Nov-2023

Sample Name

Sample Description Water Sample ID No : 2052.

Responsibilities Vairavel

Analysis Commencess On 21.11.23

Due Date 24-Nov-2023

Analysis Completed On 22.11.23

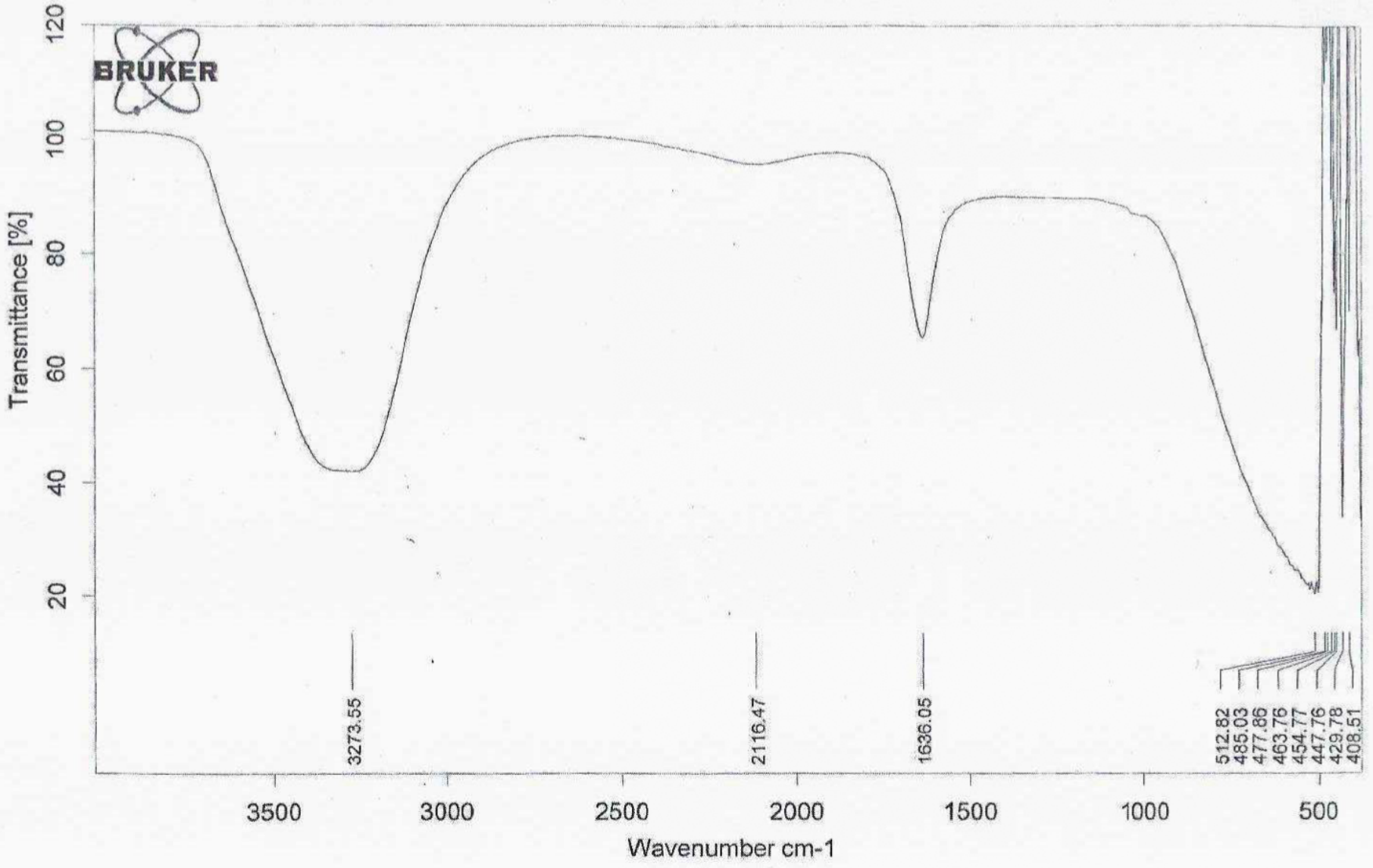
S No	Test Name & Method	Result	Requirements/Limits
			Max val
1	Chemical Finger Print	-	-

Annexture attached

Note Functional Group Analysis

Analysed by

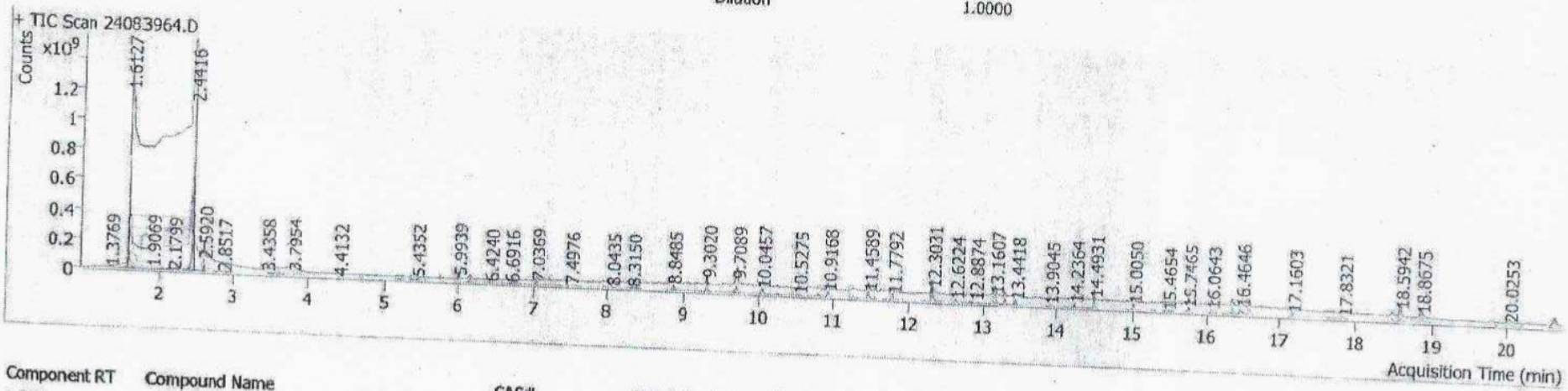
Verified by



C:\Program Files\OPUS_65\MEAS\24083964-WATER SAMPLE-2052.0	24083964-WATER SAMPLE-2052	Instrument type and / or acce	22/11/2023

Unknown Analysis Report - Best Hits Summary with Retention Indices

Batch Path	D:\MSDATA\2023\NOVEMBER\MULTI PESTICIDES\21112023
Analysis File Name	Batch_Scan.uaf
Analyst Name	admin
Data File Name	24083964.D
Sample Name	24083964_2052_
Acq Method File	Multipesticides_Scan_2023
Acq Time	11/22/2023 1:54:50 PM
Instrument Name	TQ
Data Path Name	D:\MSDATA\2023\NOVEMBER\MULTI PESTICIDES\21112023
Sample Type	Sample
Acq Method Path	D:\MassHunter\GCMS\1\methods\
Operator	
Dilution	1.0000



Component RT	Compound Name	CAS#	Match Factor	Formula	Library File	Hit RI	Library RI	Delta RI	Component Area
1.377	(2-Aziridinylethyl)amine	4025-37-0	77	C4H10N2	NIST17.L				19776521
1.590	Methylene chloride	75-09-2	52	CH2Cl2	NIST17.L				31919707
1.602	1-Propanol, 3-chloro-	627-30-5	50	C3H7ClO	NIST17.L				7153076
1.603	Valeric anhydride	2082-59-9	65	C10H18O3	NIST17.L				15117632
1.611	1,2-Dimethoxy-ethene	1000194-22-7	82	C4H8O2	NIST17.L				227734186
1.613	Ethyl Acetate	141-78-6	90	C4H8O2	NIST17.L				2511755872
1.621	Cyanogen chloride	506-77-4	70	CClN	NIST17.L				421376517
1.627	Propyl pyruvate	1000431-41-8	68	C6H10O3	NIST17.L				2756851989
1.627	Acetohydroxamic acid	546-88-3	72	C2H5NO2	NIST17.L				2785717889
1.638	Glycine, N-methyl-N-ethoxycarbonyl-, heptyl ester	1000320-67-7	69	C13H25NO4	NIST17.L				34657439
1.665	2,2'-Bithiazolidine	77771-20-1	62	C6H12N2S2	NIST17.L				13881479254
1.907	Trithiocyanuric acid	638-16-4	54	C3H3N3S3	NIST17.L				645750275
2.059	Octyl (E)-2-methylbut-2-enoate	1000373-71-2	55	C13H24O2	NIST17.L				8477457
2.080	Aminomaleimide	37770-94-8	56	C4H4N2O2	NIST17.L				1942349
2.107	1-Butene, 1,1,2,3,3,4,4,4-octafluoro-	357-26-6	50	C4F8	NIST17.L				20664588
2.164	Aminothiazole	96-50-4	55	C3H4N2S	NIST17.L				596821
2.180	N-(Tert-butyldimethylsilyl)-N-ethylaniline	1000423-69-6	55	C14H25NSi	NIST17.L				6803078?
2.198	5-[4-(1-Aminomethyladamantyl-3)-3-methoxyphenyl]-10,15,20-tri(4-methoxyphenyl)-21H,23H-porphine	1000216-43-9	59	C59H55N5O4	NIST17.L				5407868
2.222	N-Methyl-L-proline, pentyl ester	1000452-77-3	50	C11H21NO2	NIST17.L				2179575

Component RT	Compound Name	CAS#	Match Factor	Formula	Library File	Hit RI	Library RI	Delta RI	Component Area
2.359	5-[4-(1-Aminomethyladamantyl-3)-3-methoxyphenyl]-10,15,20-tri(4-methoxyphenyl)-21H,23H-porphine	1000216-43-9	56	C59H55N5O4	NIST17.L				1339723
2.357	5-[4-(1-Aminomethyladamantyl-3)-3-methoxyphenyl]-10,15,20-tri(4-methoxyphenyl)-21H,23H-porphine	1000216-43-9	80	C59H55N5O4	NIST17.L				544003
2.393	Alanylalanine, N,N'-dimethyl-N'-methoxycarbonyl-, methyl ester	1000328-55-9	54	C11H20N2O5	NIST17.L				77119536
2.399	Benzene, 3-butenyl-	768-56-9	61	C10H12	NIST17.L				292562782
2.409	1,3,5,7-Tetroxane	293-30-1	57	C4H8O4	NIST17.L				11629463218
2.419	Propanoic acid, dimethyl(isopropyl)silyl ester	1000279-45-8	56	C8H18O2Si	NIST17.L				297099451
2.421	1H-Tetrazole	288-94-8	69	CH2N4	NIST17.L				377312700
2.430	Peroxide, dimethyl	690-02-8	62	C2H6O2	NIST17.L				262446410
2.433	2-Propenoic acid, ethenyl ester	2177-18-6	84	C5H6O2	NIST17.L				43644913
2.433	Propargyl alcohol	107-19-7	62	C3H4O	NIST17.L				4769175
2.439	L-Prolinamide	7531-52-4	57	C5H10N2O	NIST17.L				488925805
2.440	.alpha.-Ethyl aspartate	1000132-78-1	62	C6H11NO4	NIST17.L				18205285564
2.442	1,3,5-Trioxane	110-88-3	74	C3H6O3	NIST17.L				12691031675
2.443	Propane, 2-ethoxy-	625-54-7	73	C5H12O	NIST17.L				432941469
2.444	p-Dioxane-2,3-diol	4845-50-5	62	C4H8O4	NIST17.L				896766774
2.452	Methylazoxymethanol acetate	592-62-1	72	C4H8N2O3	NIST17.L				6366643529
2.592	Propanoic acid, ethyl ester	105-37-3	90	C5H10O2	NIST17.L				75109842
2.600	Thioacetic acid	507-09-5	78	C2H4OS	NIST17.L				268490216
2.600	Acetic acid, methyl ester	79-20-9	76	C3H6O2	NIST17.L				22125667
2.787	Toluene	108-88-3	71	C7H8	NIST17.L				5578024
2.851	Cyclotrisiloxane, hexamethyl-	541-05-9	88	C6H18O3Si3	NIST17.L				4531162
2.852	l-Leucine, N-(2-chloroethoxycarbonyl)-N-methyl-, dodecyl ester	1000328-52-3	63	C22H42ClNO4	NIST17.L				4985920
2.917	Tetrachloroethylene	127-18-4	52	C2Cl4	NIST17.L				3264411
2.918	2-Pyrimidinamine, 4,6-dichloro-	56-05-3	63	C4H3Cl2N3	NIST17.L				4111783
3.436	1-Butanamine, N-butyl-	111-92-2	84	C8H19N	NIST17.L				20818755
3.444	2-Oxo-4-phenyl-6-(4-chlorophenyl)-1,2-dihydropyrimidine	24030-13-5	69	C16H11ClN2O	NIST17.L				1792411
3.444	3,4-Dihydroisoquinoline, 1-[3-methoxybenzyl]-6-methoxy-	1000126-16-1	61	C18H19NO2	NIST17.L				2219526
3.518	Glycine, N-ethyl-N-methoxycarbonyl-, heptyl ester	1000322-75-8	50	C13H25NO4	NIST17.L				14233822
3.518	Formic acid, TMS derivative	18243-21-5	50	C4H10O2Si	NIST17.L				6121902
3.584	Methane, isocyanato-	624-83-9	51	C2H3NO	NIST17.L				3771537
3.584	Butane, 2,2,3,3-tetramethyl-	594-82-1	56	C8H18	NIST17.L				2792721
3.713	Propyl pyruvate	1000431-41-8	78	C6H10O3	NIST17.L				67604218
3.795	Methyl nitrite	624-91-9	78	CH3NO2	NIST17.L				393120927
4.413	n-Heptyl acrylate	2499-58-3	53	C10H18O2	NIST17.L				3379121
4.413	3-Undecene, 5-methyl-	1000061-84-1	59	C12H24	NIST17.L				5157862
4.666	2-Hydroxyethyl methacrylate	868-77-9	53	C6H10O3	NIST17.L				4502454
5.164	2-Ethyl-8-quinolinol	71104-53-5	57	C11H11NO	NIST17.L				4492677
5.209	2-Butylamine, N-hexyl-	1000463-86-4	54	C10H23N	NIST17.L				3670003
5.263	4-Chlorobutanoic anhydride	1000333-91-1	56	C8H12Cl2O3	NIST17.L				659608

Unknown Analysis Report - Best Hits Summary with Retention Indices

Component RT	Compound Name	CAS#	Match Factor	Formula	Library File	Hit RI	Library RI	Delta RI	Component Area
5.361	Cinnoline, 4-methyl-, 1-oxide	5580-86-9	57	C9H8N2O	NIST17.L				17405826
5.361	Ethanone, 1-(2,3-dihydro-1H-inden-5-yl)-	4228-10-8	75	C11H12O	NIST17.L				15952093
5.415	1-Hepten-3-one	2918-13-0	61	C7H12O	NIST17.L				11104955
5.415	Cyclohexanone, 3-methyl-2-(1-methylethyl)-, cis-trans	28357-23-5	62	C10H18O	NIST17.L				5567884
5.435	Chloroxylenol	88-04-0	84	C8H9ClO	NIST17.L				27388968
5.436	Benzene, 1-(chloromethyl)-3-methoxy-	824-98-6	66	C8H9ClO	NIST17.L				10035108
5.552	Benzaldehyde, 2,4-dihydroxy-6-methyl-	487-69-4	64	C8H8O3	NIST17.L				2703154
5.749	1(3H)-Isobenzofuranone, 3,3-dimethyl-	1689-09-4	78	C10H10O2	NIST17.L				19801604
5.749	3-Methylidene-2-benzofuran-1-one	3453-63-2	53	C9H6O2	NIST17.L				23362141
5.994	1-Azahexane-2,3-dione, 1-(2'-acetylphenyl)-	1000164-05-1	58	C13H15NO3	NIST17.L				49658891
5.994	Ethanone, 1-[4-(1-hydroxy-1-methylethyl)phenyl]-	54549-72-3	83	C11H14O2	NIST17.L				46466520
6.132	6-Fluoro-2-trifluoromethylbenzoic acid, 2-formyl-4,6-dichlorophenyl ester	1000343-74-4	79	C15H6Cl2F4O3	NIST17.L				8459068
6.132	1-Aminocyclopentanecarboxylic acid, N-(2-chloroethoxycarbonyl)-, nonyl ester	1000329-17-0	53	C18H32ClNO4	NIST17.L				9170656
6.154	Butylated Hydroxytoluene	128-37-0	88	C15H24O	NIST17.L				37639702
6.154	1-[(2-Bromo-phenyl)-(2,2-dimethyl-propionyloxy)-methyl]-3,4-dihydro-1H-isoquinoline-2-carboxylic acid, ethyl ester	1000188-83-4	60	C24H28BrNO4	NIST17.L				31798457
6.420	4-Hydroxy-2-hexenoic acid, ethyl ester	61454-95-3	56	C8H14O3	NIST17.L				7730077
6.422	Dodecanoic acid	143-07-7	67	C12H24O2	NIST17.L				11515278
6.424	1-Butoxypropan-2-yl 2-methylbutanoate	1000367-09-4	53	C12H24O3	NIST17.L				13676263
6.691	2-Hexene, 2,4-dimethyl-	14255-23-3	63	C8H16	NIST17.L				5845533
6.692	Cyclohexane, (1,1-dimethylpropyl)-	31797-64-5	54	C11H22	NIST17.L				13890838
6.718	Phthalic acid, pentyl tridec-2-yn-1-yl ester	1000315-43-8	53	C26H38O4	NIST17.L				4182207
6.737	2,2-Dimethylpropanoic anhydride	1538-75-6	54	C10H18O3	NIST17.L				5458212
6.764	Benzenaminium, 4-carboxy-N,N,N-trimethyl-, hydroxide, inner salt	33046-28-5	64	C10H13NO2	NIST17.L				1278173
6.839	Cyclooctasiloxane, hexadecamethyl-	556-68-3	60	C16H48O8Si8	NIST17.L				16360400
6.888	1,2-Benzenediol, O-(4-butylbenzoyl)-O'-(isobutoxycarbonyl)-	1000329-73-6	50	C22H26O5	NIST17.L				2913712
6.965	2,6-Bis(1,1-dimethylethyl)-4-(1-oxopropyl)phenol	14035-34-8	61	C17H26O2	NIST17.L				2079214
7.020	1H-Imidazole-4,5-dicarbonitrile	1122-28-7	50	C5H2N4	NIST17.L				1887806
7.037	2-(Methylmercapto)benzothiazole	615-22-5	85	C8H7NS2	NIST17.L				42898359
7.037	9H-Purine, 9-methyl-6-(methylthio)-	1127-75-9	67	C7H8N4S	NIST17.L				35764110
7.075	5H-Tetrazol-5-amine	1000273-02-0	55	CH3N5	NIST17.L				4053335
7.164	Benzophenone	119-61-9	54	C13H10O	NIST17.L				9130396
7.174	2-Trifluoromethylbenzoic acid, tridec-2-ynyl ester	1000299-40-9	50	C21H27F3O2	NIST17.L				3028628
7.212	1,3,5-Triazine-2,4,6(1H,3H,5H)-trione, 1,3,5-tri-2-propenyl-	1025-15-6	80	C12H15N3O3	NIST17.L				26947663
7.323	aR-Turmerone	532-65-0	61	C15H20O	NIST17.L				6437184
7.498	Borane, diethyl(decyloxy)-	1000152-34-3	67	C14H31BO	NIST17.L				28709027
7.498	Heptane, 2,2,3,3,5,6,6-heptamethyl-	7225-67-4	72	C14H30	NIST17.L				28114544
7.787	Uracil, 1-benzyl-5-fluoro-	4871-13-0	50	C11H9FN2O2	NIST17.L				1016135

Component RT	Compound Name	CAS #	Match Factor	Formula	Library File	Hit RT	Library RT	Delta RT	Component Area
7.888	alpha.-Oxo-furan-2-acetonitrile	6047-91-2	57	C6H3NO2	NIST17.L				1705451
7.952	Tetradecanoic acid	544-63-8	58	C14H28O2	NIST17.L				10473757
8.044	Cyclononasiloxane, octadecamethyl-	556-71-8	71	C18H54O9Si9	NIST17.L				21087429
8.086	3,5-Di-tert-butyl-2-hydroxybenzaldehyde	37942-07-7	57	C15H22O2	NIST17.L				1774552
8.216	Phosphoric acid, 4-methoxyphenyl dimethyl ester	7357-14-4	55	C9H13O5P	NIST17.L				4162974
8.315	Nonane, 5-methyl-5-propyl-	17312-75-3	59	C13H28	NIST17.L				19218903
8.318	Sulfurous acid, 2-ethylhexyl hexyl ester	1000309-20-2	62	C14H30O3S	NIST17.L				16663500
8.370	Sulfurous acid, 2-ethylhexyl hexyl ester	1000309-20-2	53	C14H30O3S	NIST17.L				11655602
8.403	Ethane, 1,2-dibromo-	106-93-4	52	C2H4Br2	NIST17.L				3422900
8.804	4-Chlorodiphenylamine	1000308-70-0	66	C12H10ClN	NIST17.L				8544988
8.839	1-[4-(Chlorodifluoromethoxy)phenyl]-3-(6-chlorohexyl)urea	1000303-36-2	56	C14H18Cl2F2N2O2	NIST17.L				3393166
8.849	Caffeine	58-08-2	80	C8H10N4O2	NIST17.L				69011049
8.860	propanedinitrile, 2-(4-oxo-1,3-dithietan-2-ylidene)-	1000404-55-2	50	C5N2OS2	NIST17.L				7555732
8.875	Phthalic acid, hept-4-yl isobutyl ester	1000356-78-3	86	C19H28O4	NIST17.L				42120762
8.881	Benzene, 2-(2-isothiocyanatoethyl)-1,4-dimethoxy-	56771-74-5	54	C11H13NO2S	NIST17.L				2076961
8.895	Amantadine	768-94-5	52	C10H17N	NIST17.L				3871925
9.006	Osalmid	526-18-1	55	C13H11NO3	NIST17.L				8624311
9.172	2-Furancarboxylic acid, 2-tetrahydrofurylmethyl ester	4623-04-5	53	C10H12O4	NIST17.L				16862846
9.173	Octane, 2,7-dimethyl-	1072-16-8	63	C10H22	NIST17.L				16478038
9.284	Cyclodecasiloxane, eicosamethyl-	18772-36-6	57	C20H60O10Si10	NIST17.L				23708576
9.302	7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione	82304-66-3	83	C17H24O3	NIST17.L				93989072
9.302	Isoquinoline, 1,2,3,4-tetrahydro-1-allyl-6,7-dimethoxy-3,3-dimethyl-	180461-39-6	53	C16H23NO2	NIST17.L				131596494
9.352	Benzyloxydimethyloctylsilane	1000282-19-3	50	C17H30OSi	NIST17.L				4943887
9.386	1-Allyloxy-4-methoxy-benzene	13391-35-0	51	C10H12O2	NIST17.L				1931442
9.490	5-(3-Methylbutyl)-2-pyridinecarboxylic acid	49751-50-0	56	C11H15NO2	NIST17.L				5830941
9.599	2-Furoic acid, 4-cyanophenyl ester	1000307-99-6	56	C12H7NO3	NIST17.L				3929068
9.698	7(1H)-Pteridinone	2432-27-1	56	C6H4N4O	NIST17.L				57325789
9.698	Dibutyl phthalate	84-74-2	88	C16H22O4	NIST17.L				66944272
9.700	1,4-Benzenedicarboxylic acid, bis(2-methylpropyl) ester	18699-48-4	55	C16H22O4	NIST17.L				6275165
9.709	n-Hexadecanoic acid	57-10-3	89	C16H32O2	NIST17.L				218753987
9.725	Benzenaminium, 4-carboxy-N,N,N-trimethyl-, hydroxide, inner salt	33046-28-5	67	C10H13NO2	NIST17.L				2669812
10.045	Tetradecane	629-59-4	89	C14H30	NIST17.L				57271262
10.046	Eicosane	112-95-8	73	C20H42	NIST17.L				69898808
10.250	Acetamide, 2-phenyl-N-(2-phenylethyl)-N-heptyl-	1000451-29-2	53	C23H31NO	NIST17.L				15924511
10.258	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-, methylcarbamate	1918-11-2	63	C17H25NO2	NIST17.L				15691772
10.341	Selenourea	1000306-46-4	51	CH4N2Se	NIST17.L				3980488.
10.528	Cydodecasiloxane, eicosamethyl-	18772-36-6	68	C20H60O10Si10	NIST17.L				18915461

Unknown Analysis Report - Best Hits Summary with Retention Indices

Component RT	Compound Name	CAS#	Match Factor	Formula	Library File	Hit RI	Library RI	Delta RI	Component Area
10.672	2,2-Dimethylpropanoic anhydride	1538-75-6	54	C10H18O3	NIST17.L				4289792
10.790	Cyclohexane, 1-ethyl-2,3-dimethyl-	7058-05-1	58	C10H20	NIST17.L				39459025
10.791	Cyclohexane, 1,2-dimethyl-, cis-	2207-01-4	71	C8H16	NIST17.L				18936597
10.917	Sulfurous acid, 2-ethylhexyl hexyl ester	1000309-20-2	79	C14H30O3S	NIST17.L				42658510
10.917	Pentadecane, 2,6,10-trimethyl-	3892-00-0	84	C18H38	NIST17.L				58877195
11.251	Formic acid, undecyl ester	1000368-25-0	60	C12H24O2	NIST17.L				31865666
11.268	Trifluoromethyldifluorophosphine	1112-04-5	50	CF5P	NIST17.L				8305504
11.288	4-(3-Fluorophenyl)pyrimidine	68049-18-3	51	C10H7FN2	NIST17.L				1732745
11.458	2,4(1H,3H)-Pyrimidinedione, 5-hydroxy-	20636-41-3	58	C4H4N2O3	NIST17.L				50095665
11.459	Octadecanoic acid	57-11-4	88	C18H36O2	NIST17.L				104389396
11.655	Dimethylphosphinic fluoride	753-70-8	50	C2H6FOP	NIST17.L				4218655
11.710	Cyclononasiloxane, octadecamethyl-	556-71-8	72	C18H54O9Si9	NIST17.L				19056389
11.779	Heptacosane	593-49-7	74	C27H56	NIST17.L				71915253
11.779	Hexadecane	544-76-3	87	C16H34	NIST17.L				54584439
12.249	(1H-Pyrrol-3-yl)acetic acid	86688-96-2	51	C6H7NO2	NIST17.L				3817080
12.303	1-Naphthalenamine, N-phenyl-	90-30-2	90	C16H13N	NIST17.L				178972303
12.303	2,2-Dichloro-1-oxa-2-sila-1,2-dihydronaphthalene	64749-19-5	55	C8H6Cl2OSi	NIST17.L				146693508
12.437	Thiophene-2-carboxamide, N-(2-pyridinyl)-N-(2-thenoyl)-	1000273-99-6	51	C15H10N2O2S2	NIST17.L				10506108
12.622	Dodecane, 2,6,10-trimethyl-	3891-98-3	76	C15H32	NIST17.L				29268786
12.622	Undecane, 3,8-dimethyl-	17301-30-3	70	C13H28	NIST17.L				35674592
12.720	1-(Phenylthio)isoquinoline	19653-18-0	53	C15H11NS	NIST17.L				933261
12.834	Cyclodecasiloxane, eicosamethyl-	18772-36-6	73	C20H60O10Si10	NIST17.L				25091471
12.887	Ricinoleic acid	141-22-0	55	C18H34O3	NIST17.L				65867519
12.908	Nonane, 2,2,4,4,6,8,8-heptamethyl-	4390-04-9	52	C16H34	NIST17.L				7660909
13.030	1,4-Bis-furan-2-ylmethyl-piperazine	1000295-95-2	54	C14H18N2O2	NIST17.L				7218138
13.079	Phthalic acid, di(3-methylphenyl) ester	1000315-37-3	56	C22H18O4	NIST17.L				1860615
13.156	Ethanone, 1,2-di-2-furanyl-2-hydroxy-	552-86-3	64	C10H8O4	NIST17.L				36622893
13.161	9-Octadecenamide, (Z)-	301-02-0	85	C18H35NO	NIST17.L				154356798
13.239	1H-Indole, 1-(3-nitropropyl)-	131322-48-0	57	C11H12N2O2	NIST17.L				1861075
13.292	6-Chloro-2-methyl-4-phenyl-quinoline	22609-12-7	76	C16H12ClN	NIST17.L				57583412
13.295	1-Chloro-11H-indolo[3,2-c]quinoline	155249-51-7	61	C15H9ClN2	NIST17.L				58944921
13.427	Benzeneacetic acid, 2-fluoro-	451-82-1	53	C8H7FO2	NIST17.L				4990459
13.442	Heptacosane	593-49-7	71	C27H56	NIST17.L				61782896
13.444	Undecane, 3,7-dimethyl-	17301-29-0	84	C13H28	NIST17.L				36082334
13.868	Ethyl bromide	74-96-4	53	C2H5Br	NIST17.L				3771083
13.904	Tetracosamethyl-cyclododecasiloxane	18919-94-3	65	C24H72O12Si12	NIST17.L				24500582
14.188	2-Thiophenepropanenitrile	5722-13-4	58	C7H7NS	NIST17.L				24109960
14.220	S-Tetrazine, 3-methyl-6-(2-thienyl)-	57537-54-9	50	C7H6N4S	NIST17.L				4270233
14.235	Cyclopentane, 1,1,3,4-tetramethyl-, trans-	20309-77-7	68	C9H18	NIST17.L				30408623
14.236	Nonane, 1-iodo-	4282-42-2	76	C9H19I	NIST17.L				47359374
14.236	Heneicosane	629-94-7	81	C21H44	NIST17.L				63452447
14.339	Ethyl bromide	74-96-4	50	C2H5Br	NIST17.L				2340964
14.423	1,4-Phenylene bis(2-furoate)	35741-00-0	50	C16H10O6	NIST17.L				8841555

Generated at 3:02 PM on 11/27/2023

Component RT	Compound Name	CAS#	Match Factor	Formula	Library File	Fit RI	Library RI	Delta RI	Component Area
14.493	Phthalic acid, di(2-propylpentyl) ester	1000377-93-5	91	C24H38O4	NIST17.L				114247176
14.924	Cyclononasiloxane, octadecamethyl-	556-71-8	66	C18H54O9Si9	NIST17.L				21065272
14.982	Furfural	98-01-1	51	C5H4O2	NIST17.L				4041832
15.005	Tetracosane	646-31-1	87	C24H50	NIST17.L				69024609
15.005	Heneicosane	629-94-7	74	C21H44	NIST17.L				82637297
15.265	2(1H)-Pyridinone, 1,6-dimethyl-	15031-43-3	59	C7H9NO	NIST17.L				4587773
15.308	6H-Dibenzo[b,d]pyran-6-one, 7,9-dihydroxy-3-methoxy-1-methyl-	56771-85-8	55	C15H12O5	NIST17.L				5679510
15.452	N-Methoxy-14-azadispiro(5,1,5,2)pentadec-9-ene-7,11,15-trione	95854-81-2	60	C15H19NO4	NIST17.L				4270513
15.465	benzenamine, 4-(1,1-dimethylethyl)-N,N-diphenyl-	1000402-15-7	63	C22H23N	NIST17.L				14437236
15.507	Benzo[b]thiophene-2-ol	496-31-1	53	C8H6OS	NIST17.L				3647689
15.747	Pentacosane	629-99-2	80	C25H52	NIST17.L				57329443
15.748	Sulfurous acid, 2-ethylhexyl hexyl ester	1000309-20-2	79	C14H30O3S	NIST17.L				41350469
16.064	1,3-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester	137-89-3	87	C24H38O4	NIST17.L				47397242
16.068	2-(Heptanoylamino)-benzothiazole	121189-74-0	53	C14H18N2OS	NIST17.L				4641649
16.339	13-Docosenamide, (Z)-	112-84-5	79	C22H43NO	NIST17.L				82596334
16.464	Heptacosane	593-49-7	79	C27H56	NIST17.L				54198669
16.465	Heptacosane, 1-chloro-	62016-79-9	62	C27H55Cl	NIST17.L				132939923
16.575	Squalene	111-02-4	82	C30H50	NIST17.L				63442075
17.160	Hentriacontane	630-04-6	74	C31H64	NIST17.L				59308072
17.160	Docosane, 1-iodo-	1000406-31-9	66	C22H45I	NIST17.L				46149972
17.611	2-Thiophenecarboxylic acid, 3-fluorophenyl ester	1000330-99-2	51	C11H7FO2S	NIST17.L				5259628
17.832	Undecane, 3,9-dimethyl-	17301-31-4	67	C13H28	NIST17.L				24016016
17.832	Octadecane	593-45-3	61	C18H38	NIST17.L				42860944
18.486	Cholesta-4,6-dien-3-ol, (3.beta.)-	14214-69-8	60	C27H44O	NIST17.L				41141011
18.589	2-Methylhept-6-en-3-one	1000424-30-2	71	C8H14O	NIST17.L				23866788
18.594	Cholestan-3-ol, (3.beta.,5.beta.)-	360-68-9	85	C27H48O	NIST17.L				184734105
18.868	Cholesterol	57-88-5	82	C27H46O	NIST17.L				148184263
19.781	Campesterol	474-62-4	56	C28H48O	NIST17.L				45471398
20.025	Stigmasterol	83-48-7	79	C29H48O	NIST17.L				80095649
20.121	Silane, dimethyl(2-naphthoxy)tetradecyloxy-	1000347-22-0	51	C26H42O2Si	NIST17.L				799156
20.627	.gamma.-Sitosterol	83-47-6	90	C29H50O	NIST17.L				155238540