Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

ISSN NO. 2320-5407

DOI:10.21474/IJAR01/21753
DOI URL: http://dx.doi.org/10.21474/IJAR01/21753

RESEARCH ARTICLE

HELMINTH DYNAMICS IN URBAN WASTEWATER FROM THE "BORIBANA" COLLECTOR (ATTECOUBE, ABIDJAN)

F. N'guessan[1], M. Cisse[2] , K. Tigoli[2] and A. Ouattara[2]

1. Jean Lorougnon Guede University, Ufr-Environment, Laboratory of Biodiversity and Tropical Ecology, Bop 150 Daloa, Côte d'Ivoire.
2. Nangui Abrogoua University,Ufr-Environmental Sciences and Management, Laboratory of Environment and Aquatic Biology, 02 Bop 801 Abidjan 02, Côte D'ivoire.

Manuscript Info

Manuscript History
Received: 11 July 2025
Final Accepted: 13 August 2025
Published: September 2025

Key words:-
helminth eggs, Abidjan, parasitological characterization, wastewater.

Abstract

A parasitological study was conducted on wastewater passing through the "Boribana" collector, located in the commune of Attécoubé (District of Abidjan, Côted'Ivoire), to assess its helminth egg load. Samples were collected from November 2015 to May 2016 at four sites distributed along the collector. The analysis identified fourteen (14) helminth taxa belonging to three classes: Nematodes (7 taxa), Trematodes (4 taxa) and Cestodes (3 taxa). Nematodes were found to be the most diverse. The most frequently detected species were Ascaris lumbricoides, Trichuris trichiura and Taenia sp., with Ascaris lumbricoides also being the most abundant species. The average helminth egg concentration ranged from 9.53 eggs/L (station D) to 146.15 eggs/L (site A). A peak in parasite load was observed during the local rainy season, suggesting a significant seasonal influence on parasitic contamination of wastewater.

Introduction:-

Rapid urbanization and population growth in developing countries are accompanied by a significant increase in the production of domestic and industrial wastewater (Konaté,1996). In the absence of adequate sanitation infrastructure, this effluent is frequently discharged into the environment without prior treatment, directly affecting receiving environments such as rivers, lakes, lagoons, and coastal areas. This poor management poses a major threat to water resources, aquatic biodiversity, and public health.

The use of contaminated water for drinking or domestic purposes is a recognized vector for the transmission of waterborne diseases, particularly in densely populated areas where sanitation infrastructure is inadequate (Morel, 1996). Furthermore, stagnant or slow-flowing water promotes the proliferation of vectors of diseases such as malaria and schistosomiasis. The World Health Organization (WHO, 1987) emphasizes that the uncontrolled growth of urban areas, fueled by a massive rural exodus, has led to the emergence of informal settlements lacking basic services, exacerbating environmental contamination and parasite prevalence.

Corresponding Author:-F. Nguessan
Address:-Jean Lorougnon Guede University, Ufr-Environment, Laboratory Of Biodiversity and Tropical Ecology, Bop 150 Daloa, Cote dIvoire.

Pathologies linked to poor wastewater management include intestinal parasitic infections, mainly due to helminths, which particularly affect school-aged children (Pierson, 1998). The persistence of these infections reflects a degraded environmental context, marked by poor fecal hygiene, inadequate sanitation facilities, and inaccessibility to quality drinking water (Nozais, 1998).

The situation is particularly worrying in the district of Abidjan, where the commune of Attécoubé illustrates the critical failings of the urban sanitation system. The "Boribana" collector, the main outlet of this municipality, discharges a large volume of wastewater into the Ébrié lagoon without treatment, compromising the ecological balance of the environment and exposing human and animal populations to serious health risks.

Despite the health implications of these discharges, data on the parasitological quality of wastewater in the Abidjan district remain scarce. This work aims to fill this knowledge gap, following studies conducted on the "Gouro" collector (Cissé et al., 2011). The objective of this research is to assess the parasite load of wastewater from the "Boribana" collector through a qualitative and quantitative analysis conducted at four stations representative of contrasting socioeconomic and hygienic environments. In parallel, the study examines the seasonal variation in helminth egg abundance according to rainy and dry periods, in order to better understand the dynamics of parasitic contamination in tropical urban environments.

Materials and Method:

Presentation of the study area:

The city of Abidjan is located in the southeast of Côte d'Ivoire, between latitudes 4°10' and 5°30' North and longitudes 3°50' and 4°10' West. It constitutes the country's main economic, administrative, and demographic center. The Ébrié Lagoon, a vast body of water, borders the city to the south and covers approximately 16% of its total area, estimated at 60,000 hectares (Dongo, 2001). This geographical configuration favors the direct transfer of urban wastewater to aquatic environments. Consequently, the risks of pollution and health impacts are significant.

The commune of Attécoubé, located in west of Abidjan, forms the setting for this study. It covers 68.2 km². Approximately 40 km² are covered by the Banco National Park and 5 km² by the Ébrié Lagoon. Thus, the actual habitable area is reduced to 23.2 km² (Champentieret al., 2000). This territory is characterized by a high population density, often haphazard urbanization, and insufficient sanitation service coverage.

The "Boribana" collector represents the municipality's main wastewater drainage axis. 10.5 km long, it connects the "Cité Fairmont" and "Sébroko" neighborhoods. It is located on the left bank of the Ébrié Lagoon. This collector drains a variety of water sources. It receives domestic effluent (latrines, public toilets), artisanal wastewater (garages, livestock markets), and rainwater. Its wide varies from 1 to 10 meters depending on the sections crossed.

Description of the sampling sites:

Four sites were selected along the collector. Their selection was based on criteria of accessibility, hydrological representativeness, and diversity of surrounding uses. The first site, designated site A (05°21’26.1’’N; 04°01’51.3’’W), is located at the entrance to Attécoubé, near the KLENZI gas station. It receives wastewater from the Gbébouto and Saint-Joseph neighborhoods. The second, site B (05°20’28.4’’N; 04°01’56.9’’W), is located approximately five kilometers downstream. It collects effluent from site A and from the Adjamé-Bromakoté livestock market. Site C (05°20’36.1’’N; 04°02’06.9’’W), located three kilometers further, drains water from the Ebrié and Adjamé Santé neighborhoods. Finally, site D (05°20’38.1’’N; 04°02’15.7’’W) is two kilometers from the previous site, less than 500 meters from the lagoon. It receives water from the “Boribana” neighborhood and water accumulated upstream.

These four sites cover a wide variety of urban contexts. They thus allow for a rigorous spatial and temporal analysis of parasitic contamination in the collector. The locations of the sites are shown in Figure 2.

Domestic Wastewater Sampling:-

Two sampling campaigns were conducted at each site of the "Boribana" collector between November 2015 and May 2016. Samples were taken in high-flow areas, where water circulation is most intense (Bontoux, 1983). Sampling took place between 6:00 am. and 9:00 am., a period corresponding to peak domestic wastewater discharges related to household activities (Lahlou 1992; Nsom-Zamo et al., 2003).

The volume of each sample was 2.5 liters. This volume, validated as optimal for parasite analyses along with the 5-liter volumes, ensures reliable and representative results (Schwartzbrod& Strauss 1989). Each sample was stabilized by adding 2 ml of formalin (10%), then labeled and transported to the laboratory for parasitological analyse.The two monthly series of samples made it possible to calculate the monthly average concentration of the parasite load.

Parasitological Analyses:

Analytical Method:-

Parasitological analysis relies on enrichment techniques, necessary due to the low density of parasitic elements, which makes direct examination unreliable (Thévenotetal,. 1985). Among the available methods, Bailenger's was chosen. Recommended by the WHO (1997), it is rapid, simple, reproducible, and economical. Additionally, the reagents used are consistent, non-toxic, and inexpensive.

This method is based on parasite concentration by separating debris, under the effect of differential forces exerted by immiscible phases (acetoacetic acid and ether) on hydrophilic and lipophilic particles. It allows efficient recovery of eggs from several helminth species (Bouhoum&Schwartzbrod 1989).

Helminth Egg Concentration

The method used is Bailenger's, modified according to WHO recommendations (1997). It relies on passive decantation of the sample, performed in the laboratory overnight. The resulting sediment is transferred to tubes and then centrifuged at 1000 rpm for 15 minutes.

The pellet is then mixed with an equivalent volume of acetoacetic acid buffer at pH 4.5, prepared with 15 g of sodium acetate, 3.5 ml of acetic acid, and 1 liter of distilled water. A volume of ether, twice that of the buffer, is added. The mixture is vigorously vortexed and then centrifuged again at 1000 rpm for 6 minutes.

This step produces four distinct layers (Figure 3). The top three layers are removed, including the layer of debris attached to the walls. The final pellet is resuspended in a 33% $ZnSO_4$ solution, with a specific gravity of 1.18, with a volume five times that of the pellet.This concentration allows helminth eggs to rise to the surface under the coverslip, facilitating their detection and counting under a microscope.

Observation, Identification, and Counting of Helminth Eggs:-

Observation is performed using a MacMaster slide and a binocular microscope. A magnification of ×100 is used for egg identification, while ×400 is used for morphological identification. This is based on specific criteria: size, shape, contour, color, thickness, and content (Bouhoum 1987). Measurements are taken with a micrometer. Identification is based on the keys of Bailenger (1982) and WHO (1997).

Counting is performed using a MacMaster slide (capacity: 0.3 ml). The total number of eggs per liter of wastewater (N) is calculated using the following formula:

Where N: Number of eggs per liter of wastewater;
A: Number of eggs counted on the MacMaster slide;
X: Volume of the final product (ml);
P: Capacity of the MacMaster slide (0.3 ml);
V: Volume of the initial wastewater sample to be analyzed (2.5 liters).

Expression of Results:-

Species richness corresponds to the total number of species recorded in a given environment. It is a key indicator of the ecological quality of a plant (Aliaume et al., 1990). Occurrence (F) is used to assess the constancy of a species. It expresses the percentage presence of a species in all the samples analyzed. It is calculated using the following

formula :

Based on the value of F, Dajoz (2000) adopts the following classification: -

- constant species: present in more than 50% of samples;
- incidental species: present in 25 to 50% of samples;
- accidental species: present in less than 25% of samples.

Statistical Analysis:
The Kruskal-Wallis rank-order test was used to compare abiotic parameter values between stations and between different sampling months. The Mann-Whitney U test was used to compare variations in environmental parameters from one month to the next and from one station to another (StatSoft France 2005). STATISTICA 7.1 software was used for the various tests, maintaining the probability threshold at 0.05.

Results and Discussion:-

Results:

Qualitative Analysis:

Taxonomic Composition:

Analysis of wastewater from the "Boribana" collector identified 14 helminth taxa. These taxa are divided into three main classes: Nematodes, Trematodes, and Cestodes. Nematodes are the most represented with seven taxa, including Ascaris lumbricoides and Trichuris trichiura (Table I). Trematodes comprise four taxa, while Cestodes comprise three taxa. The characteristic eggs of each group are illustrated in Figure 4.

Occurrence:-
The majority of taxa were detected in all four stations. However, some, such as Trichostrongylus sp., were absent from site D. Analysis of the 48 samples revealed an occurrence ranging from 6.25% for Dicrocoeliumlanceatum to 100% for Ascaris lumbricoides. Consistent taxa (present in more than 50% of samples) include Taenia sp. (85.41%) and Capillaria sp. (68.75%). Enterobius vermicularis was considered incidental (50%). The other species, present in less than 25% of samples, were classified as incidental (Figure 5).

Spatial and Monthly Dynamics of Taxon Richness:-
Spatially, site D displays the lowest richness (RT = 1), while station A records the highest (RT = 12). Taxa range from 2 to 12 at site A, from 3 to 10 at B, from 2 to 11 at C, and from 1 to 9 at D. However, the Kruskal-Wallis test (p = 0.68) reveals no significant difference between site (Figure 6). Temporally, taxon richness remains low overall, with limited fluctuations. At site A, it ranges from 3 taxa in March to 13 in January. Similar patterns are observed at the other sites (Figure 7).

Quantitative Analysis:-
The quantitative analysis focused on spatial and monthly variations in helminth egg concentrations. Figures 8, 9, and 10 illustrate the overall variation by site, the distribution by class, and the distribution by taxon, respectively
Marked variability was observed between sites. At site A, concentrations ranged from 45 to 192.5 eggs per liter. At site B, they ranged from 42.5 to 117.5 eggs per liter. Site C had values between 15 and 115 eggs per liter. At site D, concentrations fluctuated from 7.5 to 100 eggs per liter.

The highest concentrations were recorded at site A. They gradually decreased toward site D. This variation was statistically significant according to the Kruskal-Wallis test, with a p-value of 0.007. Comparaisons using the Mann-Whitney test indicate significant differences between sites A and D, A and C, and B and D, with p-values less than 0.05.

All three helminth classes are present at all sites. Nematodes dominate, followed by trematodes, as shown in Figure 9. Ascaris lumbricoides is the predominant taxon at all sites, as shown in Figure 10.Monthly variation in egg concentration is generally moderate, as shown in Figure 11. At site A, values range from 45.16 eggs per liter in April to 146.15 in March. At site B, they vary between 45.55 in February and 108.35 in April. At site C, concentrations fluctuate between 37.22 and 79.20. Finally, at site D, they range from 9.53 eggs per liter in December to 82.13 in May.

Discussion:-

Parasitological analyses of wastewater from the "Boribana" collector reveal high taxonomic diversity, with fourteen taxa identified, as well as significant quantitative heterogeneity. This species richness exceeds that observed by Sylla &Belghyti (2008) in the raw wastewater of Sidi Yahia du Gharb in Morocco, which contained ten. However, parasite composition appears to depend on local conditions, such as the presence of livestock markets, slaughterhouses, or the level of infestation of the population served. The results obtained are comparable to those reported in several European countries and the United States by Stien &Schwartzbrod (1988). They confirm significant fecal pollution carried by the effluent. Qualitative analysis highlights three groups of helminths: Nematodes, Cestodes, and Trematodes. Nematodes are largely dominant.

According to Schwartzbrodet al., (1983), Guessabet al., (1993), and Alouniet al., (1995), intestinal nematode eggs exhibit greater resistance in wastewater compared to cestode and trematode eggs. Their prevalence may also be explained by their direct transmission cycle, as indicated by M'rabet (1991), Bouhoumetal.,(1997), and Schwartzbrod& Capizzi (2003). These findings are corroborated by work conducted in Morocco (Belghyti et al., 1994; Nsom-Zamo et al., 2003) and elsewhere in the world (Stien &Schwartzbrod 1987). Embryoned nematode eggs are transmitted directly from an infested host to a healthy individual, without intermediate maturation. This mode of transmission favors massive and rapid production. Conversely, cestodes and trematodes require an intermediate host, making their life cycle longer and more complex.

The diversity and number of eggs also vary among groups. Identified nematodes include Ascaris lumbricoides, Capillaria sp., Enterobius vermicularis, Necator americanus, Strongyloides sp., Trichuris trichiura, and Trichostrongylus sp. Recorded trematodes include Dicrocoeliumlanceatum, Fasciola hepatica, Schistosoma japonicum, and Schistosoma mansoni. Cestodes are represented by Diphyllobotrium latum, Hymenolepisdiminuta, and Taenia sp. Ascaris lumbricoides eggs are the most common. This dominance could be explained by their high resistance and protective shell, which ensures their survival in hostile conditions, as highlighted by the WHO (1987). Helminth egg concentrations varied among the sampled stations. Site A had the highest load, while Site D recorded the lowest values. Bouhoum (1996) demonstrated that parasite density is strongly influenced by demographics. The high number of residents connected to site A would explain its high concentration.

In contrast, at site D, the slow flow velocity would promote egg settling and reduce the parasite load. Monthly analysis shows that peak concentrations are reached in March, April, and May. This trend is consistent with the observations of Bouhoumet al., (2002), Dssouli (2002), El Gamri&Belghyti (2007), and Cissé et al., (2011). These authors also observed an increase in parasite load during the rainy season. WHO (1987) attributes this increase to climatic conditions favorable to egg maturation, including temperature, humidity, oxygen, and sunshine. Population behavior, such as the opening of septic tanks during the rainy season, also aggravates this situation due to a lack of health and environmental education.

List Of Tables :-

Table 1: List of taxa encountered in urbanwastewaterfrom the “Boribana” collector at the different sites (+: Presence; -: Absence).

		Sampling sites			
Classes	**Taxa**	**Site A**	**Site B**	**Site C**	**Site D**
Cestodes	Diphylobotrium latum	+	+	+	+
	Hymenolepisdiminuta	+	+	+	+
	Taenia sp.	+	+	+	+
Nematodes	Ascaris lumbricoïdes	+	+	+	+

	Capillariasp.	+	+	+	+
	Enterobius vermicularis	+	+	+	+
	Necator americanus	+	+	+	+
	Strongyloïdessp.	+	+	+	+
	Trichostrongylus sp.	+	+	+	-
	Trichuris trichiura	+	+	+	+
Trematodes	Dicrocoeliumlanceatum	+	+	+	-
	Fasciola hepatica	+	+	+	+
	Schistosoma japonicum	+	+	+	-
	Schistosoma mansoni	+	+	+	+
Total	**14 taxa**	**14**	**14**	**14**	**11**

List Of Figures:-

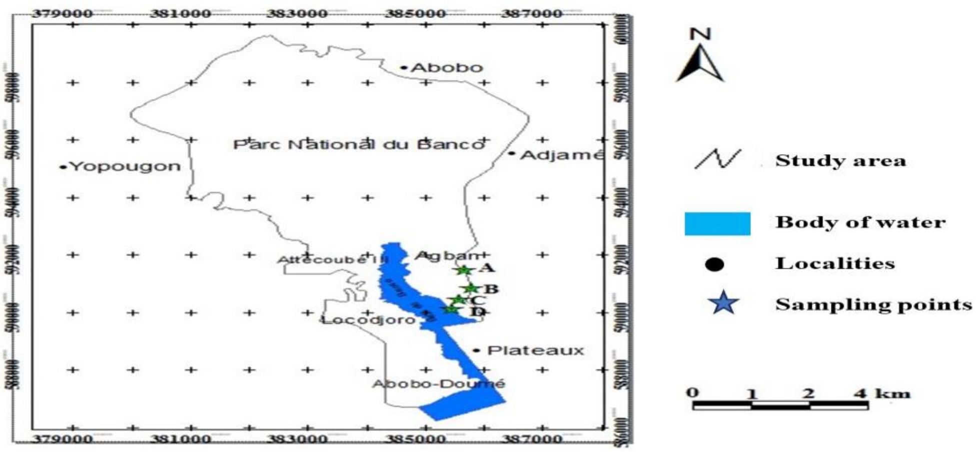


Figure 1: Geographical location of the different sampling points

Figure 2: Partial view of the sampling sites (A = Site A; B = Site B; C = Site C; D = Site D).

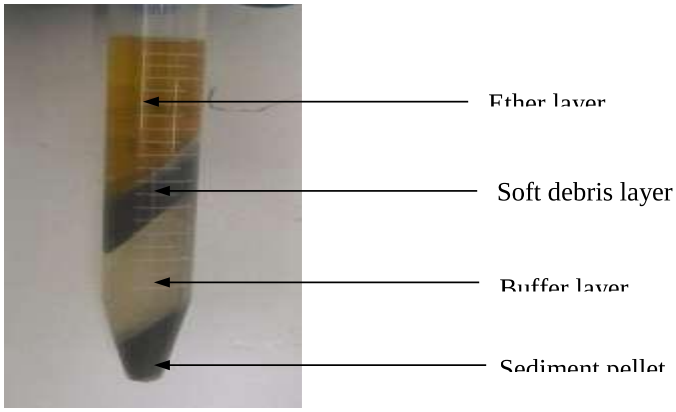
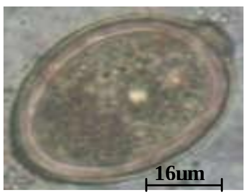
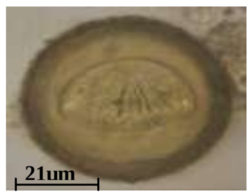


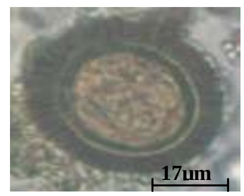
Figure 3: Presentation of the layers obtained after centrifugation of wastewater samples



*Diphylobotriumlatum*egg

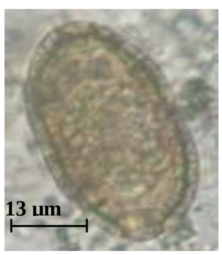


*Hymenolepisdiminuta*egg

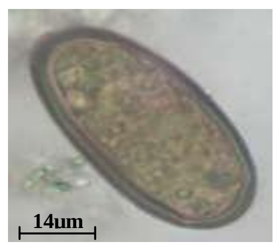


Taenia sp. egg

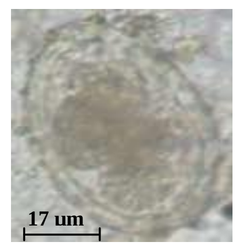
*Ascaris lumbricoïdes*egg



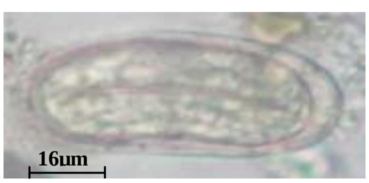
*Capillaria*sp. egg



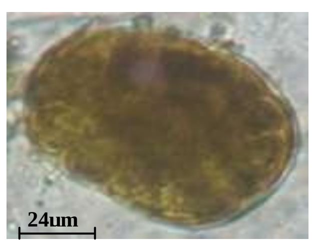
Enterobius vermicularis egg



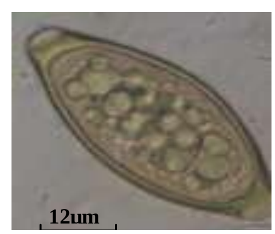
*Necatoramericanus*egg



*Strongyloïdes*sp. egg



Trichostrongylus sp. egg

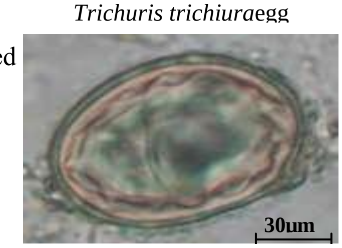


*Trichuris trichiura*egg

Figure 4: Illustration of helminth ... drained

Dicrocoeliumlanceatum egg

Fasciola hepatica egg



*Schistosoma japonicum*egg

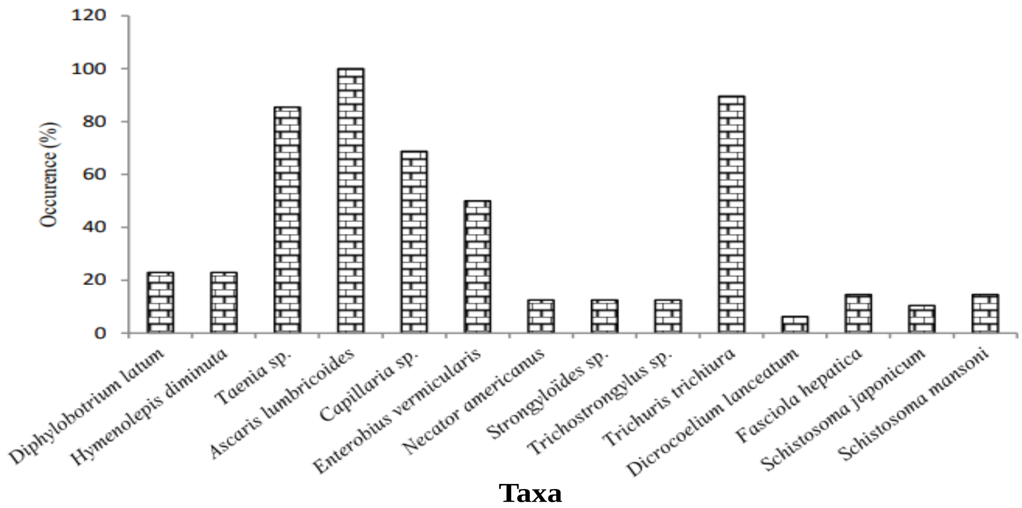


Figure 5: Percentage of occurrence of helminth taxa found in urban wastewater from the "Boribana" collector.

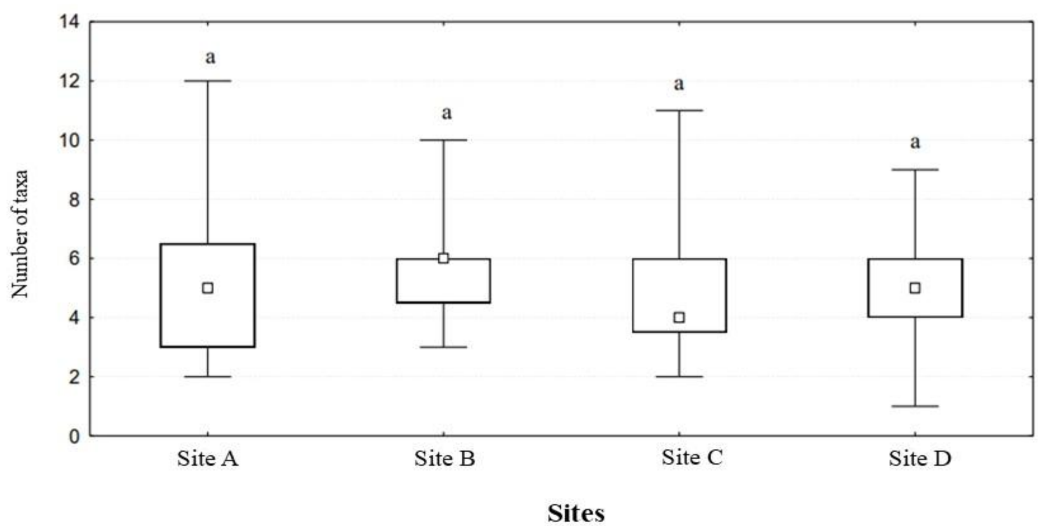


Figure 6: Spatial variation in the taxonomic richness of helminth eggs in urban wastewater from the "Boribana" collector.

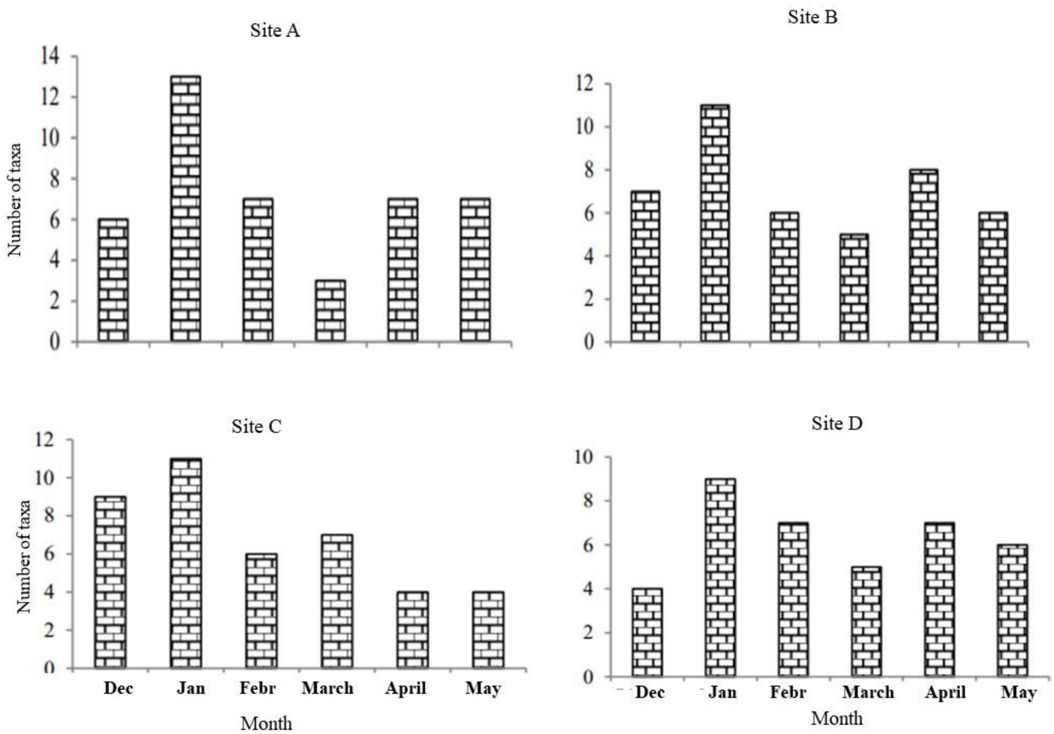


Figure 7: Monthly variation in the taxonomic richness of helminth eggs in urban wastewater from the "Boribana" collector.

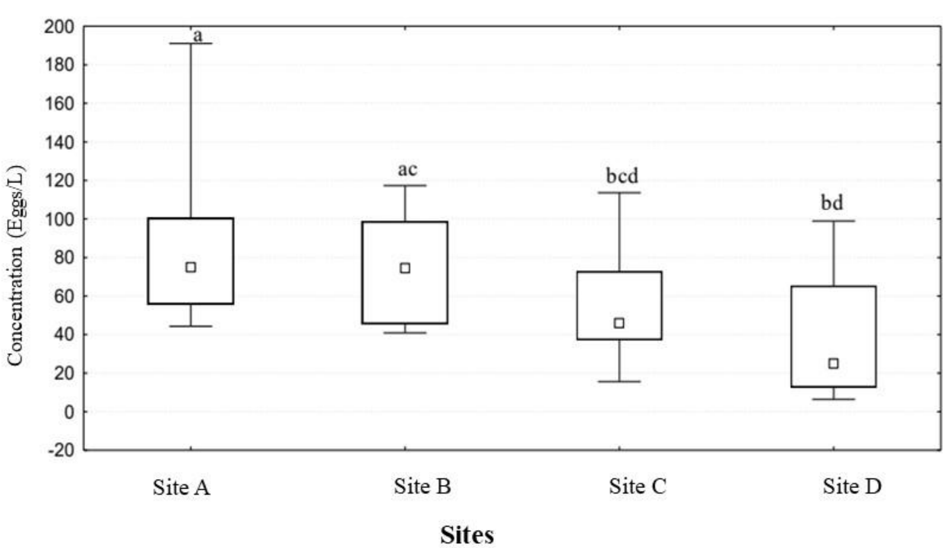


Figure 8: Variation in the concentration of helminth eggs at the different stations surveyed

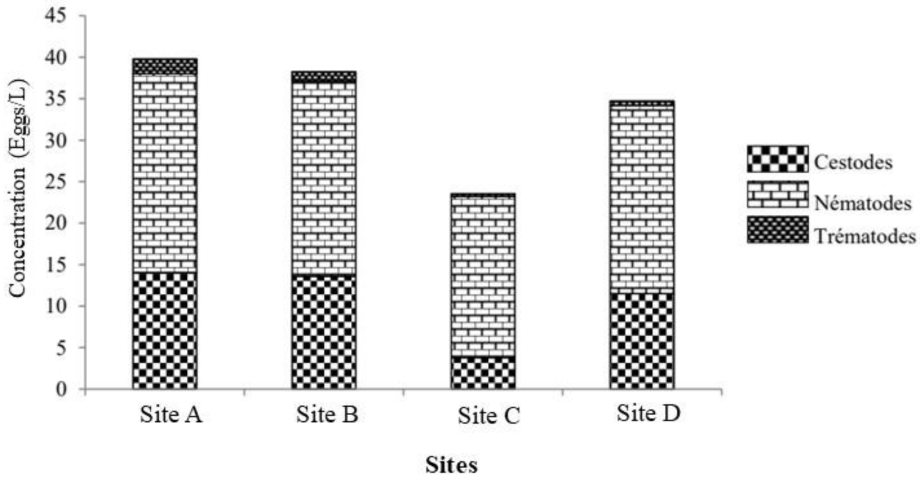


Figure 9: Egg concentration of helminth classes collected at the different sampling sites.

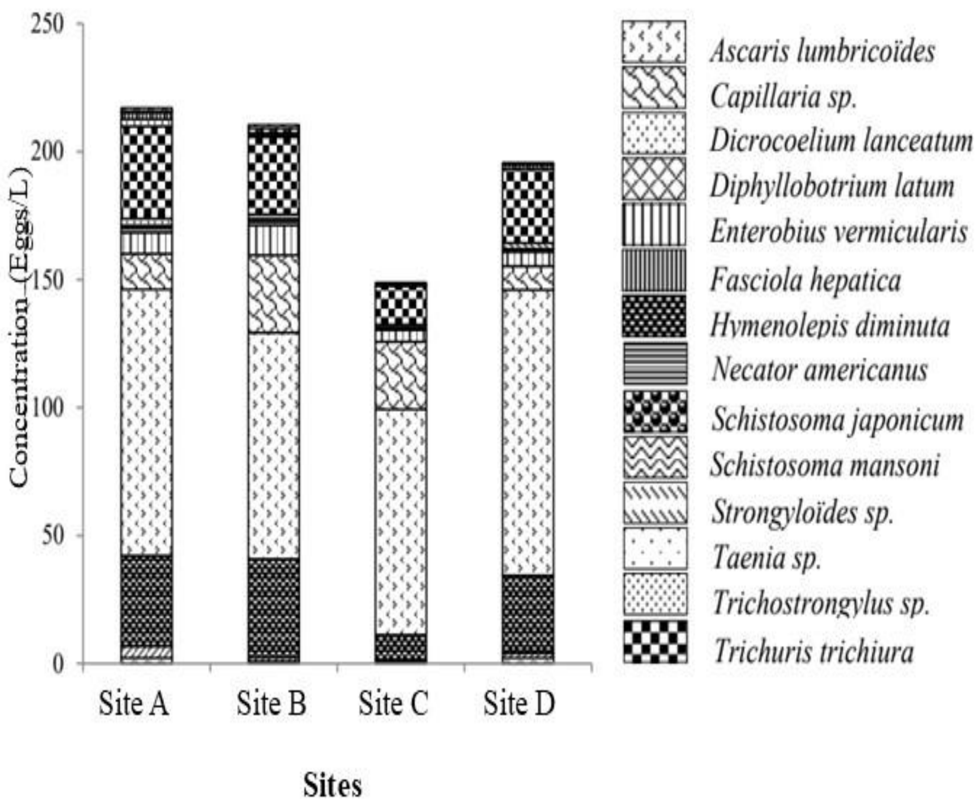


Figure 10: Egg concentration of helminth taxa in urban wastewater from the different stations surveyed.

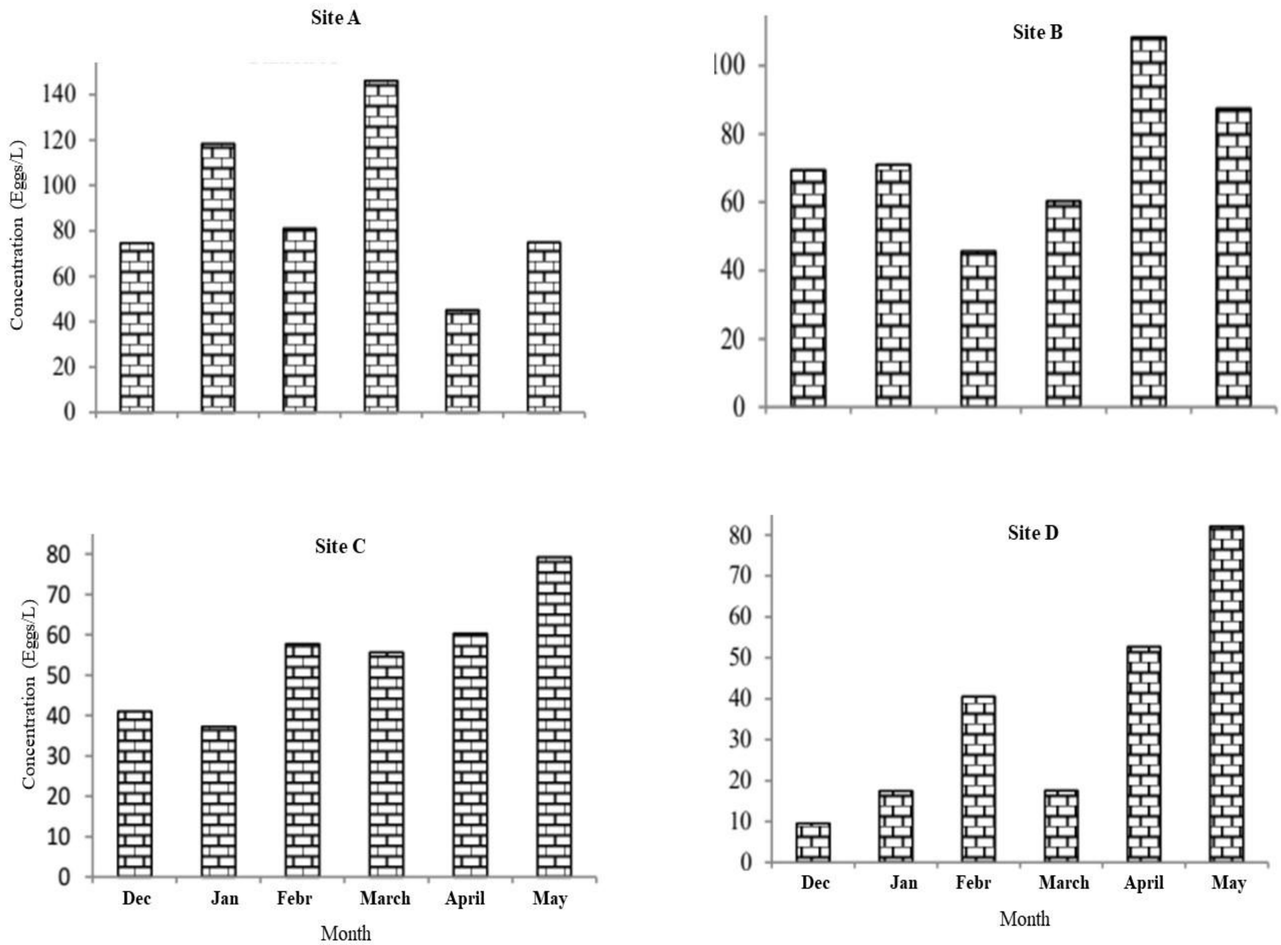


Figure 11: Monthly variation in the concentration of helminth eggs in urban wastewater from the “Boribana” collector.

Conclusion:-

The characterization of helminth eggs in the wastewater from the "Boribana" collector allowed us to assess the quality of the raw discharge before treatment. This study revealed a high parasite load, with fourteen taxa divided into three classes: Nematodes, Cestodes, and Trematodes. Nematodes, represented by seven taxa including Ascaris lumbricoides and Necator americanus, are the most diverse.

Trematodes comprise four taxa and Cestodes three. Ascaris lumbricoides largely dominates the samples, particularly during the rainy season, a period conducive to parasite spread. The concentrations observed far exceed the thresholds recommended by the WHO for irrigation, highlighting a significant health risk in the event of reuse without treatment. To prevent these ecological and health risks, particularly the contamination of the Ébrié lagoon, the installation of a wastewater treatment plant is essential.

Acknowledgments:-

Our sincere thanks go to the Head of the Aquaculture Health Research Team, the Director, and Members of the Laboratory of Environment and Aquatic Biology (LEBA) for conducting the analyses, writing, and publishing this article.

References:-

1. Aliaume C., Lasserre G. & Louis M. 1990. Organisationspatiale des peuplementsichtyologiques des herbiers à Thalassia du grand cul de sac marinenGuadeloupe. Revue d'HydrobiologieTropicale, 23, 231-250.
2. Alouini Z., Achour H., Alouini A. 1995. Devenir de la charge parasitaire des eaux useéstraitées dans le réseau d'irrigation « Cebala in Zekri, Laajini A., (Ed.) agriculture durabilité et environnement. Zaragoza : Centre international de hautes études agronomiquesméditerranéennes (CIHEAM), 117-124.
3. BailengerJ. 1982. Coprologieparasitaire et fonctionnelle. Edition Brouillard. Bordeaux, France, 82p.
4. Belghyti D., El Karim K., Bachikh J. et al. 1994. Caractérisationparasitologique des eaux usées du lac Fouargt (Kénitra-Maroc) et évaluation du niveauépidémiologique dans une population ruraleen contact avec ces eaux. Actes : QuatrièmeConférenceInternationale des Limnologuesd'Expression Française, Marrakech, 2, 25-28.
5. Bontoux J. 1983. Introduction à l'étude des eaux douces, eaux naturelles, eaux usées, eaux de boisson, Partie IV, La tribune de Cebedeau, Liège, Belgique, 36, 381-398.
6. Bouhoum K. 1996. "Etude épidémiologique des helminthiases intestinales chez les enfants de la zone d'épandage des eaux usées de Marrakech : Devenir des kystes de protozoaires et des œufsd'helminthes dans les différentssystèmesextensifs de traitement des eaux usées" Thèsede Doctorat de Troisième Cycle, Université de Marrakech, Maroc, 227p.
7. Bouhoum K. 1987. Devenir des œufsd'helminthes au cours d'un traitementexpérimentald'épuration par bassin de stabilisation. Thèse de 3ème cycle. Faculté des Sciences Sémlaliade Marrakech, Maroc, 161 p.
8. Bouhoum K. Amahmid O. &Asmama S. 2002. Wastewater reuse for agricultural purposes: Effects on population and irrigated crops. Proceeding of international symposium environmental pollution control and waste management. Part II. Tunis, Tunisie, 582-586.
9. Bouhoum K., Amahmid O., HabbariKh. et al. 1997. Devenir des œufsd'helminthes et des kystes de protozoaires dans un canal à cielouvertalimenté par les eaux usées de Marrakech. Revue des Sciences de l'Eau, 2, 217-232.
10. Bouhoum K. &Schwartzbrod J. 1989. Quantification of helminth eggs in wastewater. Zentralblatt für Hygiene und Umweltmedizin, 188, 322-330.
11. Champentier S., Diallo A. & Kouadio S.J.M. 2000. Independent water and sanitation providers Africa (Abidjan-Côte d'Ivoire). Water and sanitation program, World Bank Institute, 6p. http:// www.wsp.org, Version (03/2003).
12. Cissé M., N'guessan F., Karamoko Y. et al. 2011. Charge parasitaire des eaux usées du collecteur « Gouro » traversant les communes d'Abobo, Adjamé et Cocody (District d'Abidjan). Les Technologies de Laboratoire, 6 (25), 96-105. DOI : https://doi.org/10.34874/PRSM.teclab-vol6iss25.475.
13. Dajoz R. 2000. Précis d'écologie. 7ème éditionDunod, Paris, 615 p.
14. Dongo K. 2001. Etude de l'évolution du systèmed'assainissement « eaux usées » de la villed'Abidjan. Mémoire de DEA, Université de Cocody, Abidjan, 81p.
15. DssouliKh. 2002. Traitement et réutilisation des eaux uséesen agriculture au Maroc Oriental (Oujda) : Etude des helminthes parasites. Thèse de Doctorat. Faculté des Sciences d'Oujda, Maroc, 133p.
16. EL Guamri Y. &Belghyti D. 2007. Contamination des eaux usées du réseau d'assainissementliquide par les œufsd'helminthes (cas de la ville de Kénitra, Maroc). Revue Microbiologique Industrielle Sanitaire et Environnementale, 1, 44-59.
17. Guessab M., Bize J., Schwartzbrod J. et al. 1993. Wastewater treatment dry infiltration on sand: results in Ben Sergao, Morocco, Water Science Technology, 17, 91-95.
18. Konaté S. 1996. Contribution à l'étude de l'absorption de l'azote et du phosphorepar la jacinthed'eau (Eichorniacrassippes), mémoire de DEA des sciences de l'environnement, spécialité eau ; option : biologie, UAA, 63 pages.
19. Lahlou O. 1992. Etude parasitologique des eaux usées de la villed'ElJadida et de la région de Sidi Bennour. Mémoire de CESA: Traitement et Valorisation Agricole des eaux usées. Faculté des Sciences d'Oujda, Maroc, 45p.
20. Morel A.A. 1996. L'assainissement des eaux pluvialesen milieu urbain tropical subsaharien, Dossier technique. Banque Mondiale, pp. 15-26.
21. Nozais J. P. 1998. Maladies parasitaires et périlfécal : les maladies dues aux helminthes. MédecineTropicale, 41, 181-185.
22. M'rabet K. 1991. Etude de la contamination des champs d'épandage de la villed'Oujda par les œufsd'helminthes et leur transmission dans le réseau trophique. Thèse de 3ème cycle. Faculté des Sciences d'Oujda, Maroc, 120p.

23. Nsom-Zamo A.C. Belghyti D. &Lyagoubi M. 2003. Parasitological study of helminthes eggs carried by the untreated wastewater of the Maamora urban district (Kénia-Morocco). Journal Européend'Hydrologie, 34 (2), 245-250.
24. OMS. 1987. Lutte contre les parasitosesintestinales. Rapport technique, n° 749, Genève, Suisse, 47 p.
25. OMS. 1997. Analyse des eaux résiduairesenvue de leurrecyclageen agriculture. Manuel des techniques de l'laboratoireenparasitologie et bactériologie, Genève, 31 p.
26. Pierson P. 1998. Irresistible forces, immovable objects: Post-industrial welfare states con front permanent austerity. Journal of European Public Policy, 5, 539–560.
27. Schwartzbrod J., Beradel J.M., Thevenot M.T. et al. 1983. Boues des stations d'épuration et œufsd'helminthes. Journal Français d'Hydrologie, 14 (3) : 275-282.
28. Schwartzbrod J. &Cappizi-Banas S. 2003. Parasite contamination of liquid sludge from urban wastewater treatment plants. Water Sciences and Technology 47: 163-166.
29. Schwartzbrod, J. & Strauss S. 1989. Devenir des kystes de Giardia au cours d'un cycle d'épuration. Technique Science et MéthodeL'Eau, 6, 331-334.
30. Statsoft France. 2005. STATISTICA (logicield'analyse des données), version 7.1 www.Statsoft.Fr.
31. Stien J.L. &Schwartzbrod J. 1988. Flux d'œufsd'helminthes parasites dans les stations d'épurations par bouesactivées. Technique Science et Méthode, 10, 495-498.
32. Sylla I. &Belghyti D. 2008. Analyseparasitologique des eaux usées brutes de la ville de Sidi Yahia du Gharb (Maroc). Revue Mondiale de la Recherche Biologique, 1, 1-2.
33. Thevenot M.T. Larbaigt G. Collomb J. et al. 1985. Recovery of helminth eggs in compost in the course of composting in: Inactivation of microorganisms in sewage sludge by stabilization processes. Elsevier Science Publisching Co., NewYork, 158-167.