International Journal of Research in BioSciences
Vol. 2 Issue 4, pp. (47-53), Oct 2013
Available online at http://www.ijrbs.in
ISSN 2319-2844

Research Paper

Meiofauna bioindicator potentials: awareness and management options of the coastal residents of misamis oriental, northern mindanao, Philippines

Vedra Sonnie A.
Mindanao State University at Naawan, 9023 Naawan, Misamis Oriental, PHILIPPINES

(Received September 19, 2013, Accepted October 10, 2013)

Abstract

Deterioration of coastal habitats due to unregulated anthropogenic activities has led to loss of marine biodiversity and ecological integrity. The potential use of meiofauna as bioindicators of coastal environmental health, therefore, is a tool leading into the formulation of effective management strategies. Awareness and management options were based on the knowledge, perception and attitude of residents in an urban coastal area of Cagayan de Oro City and in a rural coastal area of Initao, Misamis Oriental. Survey questionnaires, key informant interviews, focused group discussions, walk through method and some secondary data collation were done. Results showed that meiofauna has the potentials of becoming bioindicators of pollution through the observed abundant occurrences of worms in the coastal sediments that might pose health hazards. The appearance and disappearance of macrofauna, feeding on meiofauna, could be the immediate indicator of the negative impacts of pollution and anthropogenic perturbations. Residents observed that both coastal areas were already experiencing degradation due to unregulated untreated effluent discharges, fecal wastes from livestock, overfishing and sediment loading from rivers and creeks. Although, the use of meiofauna for environmental monitoring is not directly considered by the residents, however, it opened an opportunity for them to be informed of new reliable scientific information that can be used to monitor the state of coastal areas. As such, the residents had recommended the serious protection of coastal resources from further degradation to gain back their socio-ecnomic benefits for the present and future generations.

Keywords: coastal areas, meiofauna, bioindicators, coastal management, Misamis Oriental

Introduction

Marine ecosystem is experiencing rapid anthropogenic disturbances which led to the loss of marine life. One of these organisms is meiofauna, considered as biological indicators of the quality of marine habitats. Meiofauna are metazoan organisms measuring 30 µm to 1 mm. Their life histories and feeding habits differed from larger macrofauna indicating them as a well-defined entity [1]. The potential use of meiofauna as bioindicators of environmental health had started based on their ecology that closely linked to their soft-bottom habitats, particularly on various anthropogenic perturbations in aquatic ecosystems [2]. Meiofauna reflect the quality of the ecosystem since they assumed key role in the food chain serving as

prey of higher trophic level organisms and in the cycling of nutrients. They are highly abundant, ubiquitous, have short generation times, absence of a planktonic phase in their life cycles and have high metabolic rates [3]. These meiofaunal characteristics suggest a shorter response time and their higher sensitivity to anthropogenic disturbances in aquatic habitats [4,5].

The presence and abundance of meiofauna could therefore be used to determine the health status of the environment. The potential of meiofauna as bioindicators of environmental health is promising and the result is still wanting in the wider scientific community. Population fluctuation of meiofauna can be a consequence of the quality of the sediments, as their habitat and feeding ground that a certain coastal area has. Urban and rural coastal sediments may differ in terms of significant amounts of pollutants from point and non-point sources. Sediment transport, stratification and organic loading can be due to tidal action, which is dependent on the lunar cycles of a month. Monitoring on the quality of aquatic ecosystems and the knowledge generated on this meiofauna response can be used for further scientific investigations [6].

Coastal areas are more susceptible to destruction than other ecosystems as a result of the interrelated complex relationship of three interacting systems: the terrestrial ecosystem, the marine ecosystem and the anthropogenic system [7]. Eroded soils containing all sorts of pollutants, pesticides and fertilizers from agricultural activities, deforested lands and other externalities from various terrestrial activities were deposited in coastal areas through catchments of river systems. Wastes from offshore undertakings can also be carried in coastal areas due to tide and current systems. Most of all, various anthropogenic activities are concentrated in the perimeters of coastal areas to increase and sustain livelihood opportunities, generate productive employment, and access to health and social services.

In some cases, management of coastal areas is less prioritized by the local government units. The objectives of their developmental plans are anchored mostly on addressing the delivery of the immediate needs of the constituents like social and health services, infrastructure developments, economic and other project management. This impaired their legal mandate on coastal resources management as stipulated in RA 7160 or the Local Government Code of 1991. The coastal waters of Initao and Cagayan de Oro City in Misamis Oriental could be of those areas that need to be assessed to have a holistic management plans for the ecological and economic benefits of the people and the natural systems.

This study aimed, therefore, to generate information on the potential use of meiofauna as bioindicators of coastal degradation from residents and to know their coastal activities that would lead them into formulation of recommended appropriate management and protection options.

Materials and Methods

Preliminaries prior to data gathering

Prior to actual survey and sampling, an entry protocol visit to the LGUs of Initao and Cagayan de Oro City was done for two reasons: to explain the objectives of the study and to obtain permission to conduct the study in the area. This entry protocol was necessary to ensure support and cooperation of the many sectors within the LGU, especially in giving information and in making data available from their units. Sampling of respondents was done in selected coastal residents of Gimangpang (S1, 8^0 25'30" N, $124^0$17'10" E) and Poblacion (S2, 8^0 25'38" N, $124^0$17'16" E) of Initao and in Puntod (S3, 8^0 29'23" N, $124^0$39'12" E) and Lapasan (S4, 8^0 29'22" N, $124^0$39'28" E) in Cagayan de Oro City in two consecutive months of April and May 2007.

Primary and secondary data gathering

Data gathering employed household surveys, key informant interviews, focused group discussions, and walk through method. Household and key informant interviews were done among coastal residents in a pre-determined number of respondents. Focused group discussions (FGDs) were also done to cross-check opinions of the others that removed certain degree of bias among the respondents. Walk through

method was done to review and validate inaccuracies or inconsistencies of the answers made by the respondents. Available secondary data were obtained from the Municipal Planning and Development Office, Barangay Profiles and from other reliable sources.

Sampling of respondents

Respondents in this context of study were selected based on their knowledge about coastal resources and their status, their various activities and their recommended management options. Population, herein referred as respondents, refers to all household heads or any member in the family of age group 20 years and older. The number of respondents was determined using the formula of Slovin (1960): [8,9]

$$n = \frac{N}{1 + Ne^2},$$

where:

n is the sample size
N is the population size
e is the margin of error – percent allowance for non-precision

In key informant interviews, a guide questionnaire was developed to address the objectives of this study. This was administered to pre-selected individuals, considered to be key informants, representing all sectors of the locality. This group of key informants was Barangay Captains, health officials, some local residents, municipal or city legislators and others. The city or municipal planning and development coordinator of Cagayan de Oro and Initao helped in choosing these individuals. A group discussion was initiated to focus on specific issues (e.g. coastal habitat degradation, expansion of coastal communities, improper solid wastes disposal, declining fishery resources) concerning the coastal areas. During the entry protocol visit, identified key informants with the help of the local executives (i.e. Barangay Captains and Purok Presidents), were scheduled for a group discussion.

Results and Discussion

Use of Meiofauna as Bioindicators in Coastal Ecosystem Quality

Most of them had responded that the predators of meiofauna like demersal fishes (e.g. mudskippers) and other macroinvertebrates (e.g. crabs, shrimps) could be used for environmental quality monitoring. Accordingly, the appearance and disappearance of these macroinvertebrates, compared to the 'unseen' meiofauna, could be monitored easily as influenced by the gleaning activities of the coastal residents or by the adverse impacts of pollution. In Gimangpang, Initao, Misamis Oriental, 40% of the respondents had cited that meiofauna could be used as indicator for environmental health monitoring (Figure 1). They are specific on naming polychaetes (locally known as *sasing*) known among the meiobenthologists as temporary meiofauna and later grow into macrofauna. They had observed that there are already several worms in the sediments, unknowingly referring to some meiofauna groups like nematodes, oligochaetes and polychaetes. This abundance of worms in the sediments, according to them, indicated coastal pollution, and eventually led into coastal degradation. Meiofauna indeed, was already known to the residents but when asked 'meiofauna' per se is unknown to them. This is new information delivery to the coastal residents, might in turn, be helpful in monitoring coastal environmental health.

Anthropogenic Interventions in Coastal Ecosystem

Most of the respondents cited that the coastal areas are the center of various socio-economic activities (Figure 2). In fact, during low tides of full moon and new moon, fishing of demersal fishes (e.g. damsel fishes, wrasses) and gleaning of edible benthic and sessile invertebrates (e.g. crabs, shrimps, octopus, gastropods, sea cucumbers, sea urchins) were prevalent. In the evening and dawn of the ebb tides of last quarter and first quarter, part-time fishers went fishing using hand-held fishnets to catch demersal fishes (e.g. damsel fishes, siganids, wrasses) with an aid of kerosene-powered lamps and flashlights. These activities were specifically done in the rural coastal areas of Gimangpang and Initao, Misamis Oriental. The residents knew that trampling of the sediments done by the gleaners could affect the

porosity of the sediments and eventually to the death of benthic and sessile organisms inhabiting the sand grains (i.e. epifauna, infauna and meiofauna). Swimming, boating and other recreational activities like strolling during sunsets were done especially on weekends by the urban residents. This might reduce the pressures on the meiofauna and their habitat due to indirect contact of the residents. However, biodegradable and nonbiodegradable wastes were generated much that would pollute the coastal environment because of the improper implementation of solid waste management. This would favor the growth and eventual abundance of worms in the sediments, thereby feeding on the organic matter generated from wastes materials. This can result to the imbalance on the close interaction between and among the meiofauna population. The abundance of worms, especially the nematodes, could be the primary agents to health hazards like parasitism among the coastal residents. Although the utilization patterns of the urban and coastal areas differed, still coastal pollution was generated and caused the imbalance on the population ecology of meiofauna.

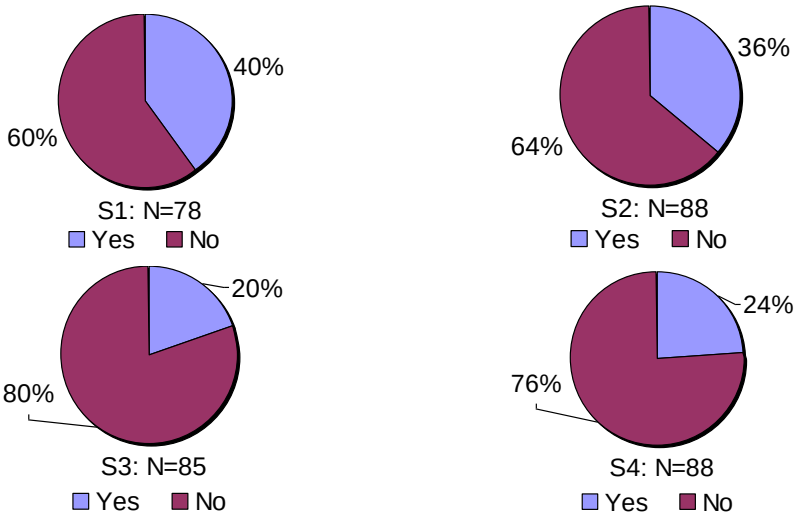

Figure 1: Response of coastal residents of Initao and Cagayan de Oro City on meiofauna as bioindicators for environmental health and monitoring

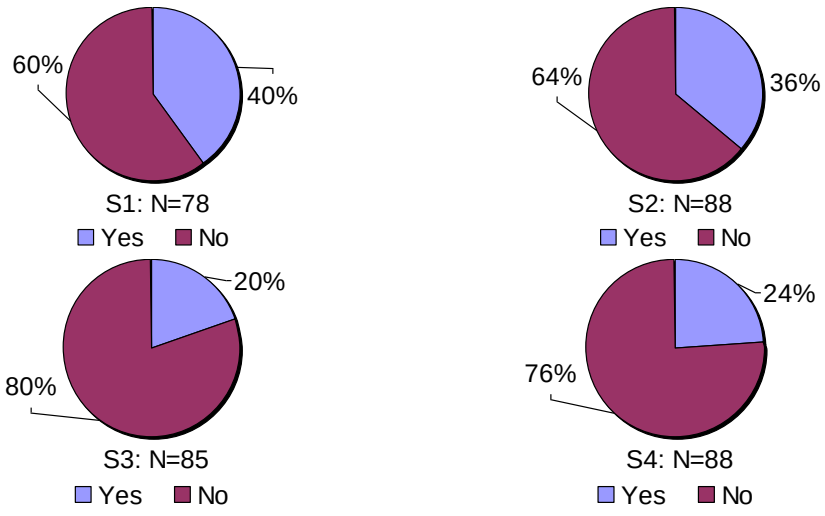

Figure 2: Response of coastal residents of Initao and Cagayan de Oro City on various coastal activities undertaken

Impacts of Anthropogenic Interventions in Coastal Areas

Both rural and urban coastal areas were experiencing coastal degradation (Figure 3). They cited that all coastal activities abovementioned were unregulated and uncontrolled besides having improperly implemented the solid waste management. This has aggravated by their direct observations on free-flowing untreated effluent discharges from toilets, sinks, laundry area and bathrooms of the households, fecal wastes from fenced domesticated livestock, public market drainage containing all sorts of liquid and semi-liquid wastes, wastes from business establishments like food courts, oils and other wastes from motorboats and ships, agricultural wastes and eroded sediments carried by the river and creeks, and from other unknown sources. They are emphatic in saying that these could cause severe water pollution and therefore, could inhibit the growth and survival of the economically-important intertidal organisms, especially the benthic and sessile organisms (e.g. sea urchins and sea cucumbers), that might use some meiofauna groups as their food source. Fishery livelihoods, recreational and aesthetic values, have in turn, declined through the uncontrolled occurrences of those coastal pollutants. Likewise, the increasing number of coastal residents (i.e. migrants from other areas), could put more pressure to the coastal habitats through the potential generation of various water pollutants (i.e. solid wastes or untreated effluents) and the continuing pressures to the coastal fishery resources as they will be forced to be engaged due to lack of livelihood opportunities.

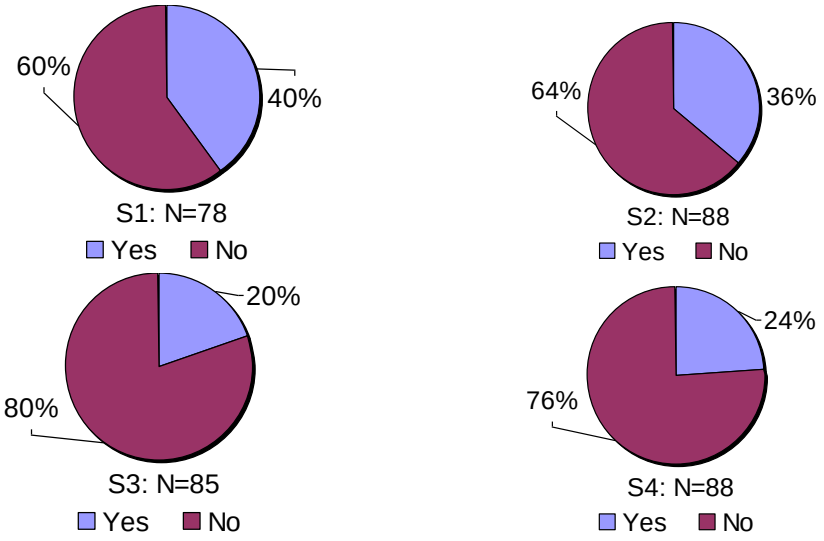

Figure 3: Response of residents of Initao and Cagayan de Oro City on various socio- economic activities leading to experiences in coastal degradation

Suggested Recommendations for Coastal Protection

The benefits derived by the rural and urban coastal residents had triggered some suggested actions to be undertaken in response to the causes of environmental degradation. These are the strict implementation of solid waste management law, prosecution of illegal fishers, regular coastal clean-up and a proposal on coastal zoning (Table 1). There were no specific local ordinances and resolutions promulgated for coastal resources management but efforts on making them were already made through co-management among all sectors of the locality. These coastal local government units rely on the protection of coastal resources based on the implementing rules and regulations of the national legislations particularly the Local Government Code of 1991 (RA 7160), Philippine Fisheries Code of 1998 (RA 8550) and the Ecological Solid Waste Management Act of 2000 (RA 9003). Relative to this, some interventions were undertaken namely: regular coastal clean-up and information campaign on coastal resources with the help of some sectors like youth, women and Barangay Council members. With this, they had observed that the

collective and collaborative efforts of all sectors within the coastal areas and the strict implementation of the national legislations with prosecution of the violators were needed urgently to address the increasing pressures on the coastal resources and the adverse impacts of coastal pollution (Table 2).

Table 1: Response of the coastal residents on the causes of coastal degradation and the suggested actions

Causes of environmental degradation	Suggested actions to be taken
Untreated effluent discharges	Strict implementation of waste management law
Improper disposal of solid wastes	Prosecution of illegal fishers caught
Fecal wastes from livestock	Regular coastal clean-up
Overfishing and overgleaning	Proposal on coastal zoning
Sediment loading from rivers and creeks	

Table 2: Response of the coastal residents in terms of legal actions to be undertaken and the suggested recommendations

National legislations to be implemented	Suggested recommendations to be done
Philippine Fisheries Code of 1998 (RA 8550)	Collaborative and collective efforts of all sectors within the coastal areas
Ecological Solid Waste Management Act of 2000 (RA 9003)	Strict implementation of the national legislations with prosecution of the violators
Local Government Code of 1991 (RA 7160)	

Conclusion

Results showed that meiofauna, known by the residents as worms, can potentially used as bioindicators of environmental health. Although macrofauna have better options for environmental monitoring, the fact that meiofauna are also living organisms and are part of marine biodiversity, and as prey species of the macrofauna, their considerations are also important in arriving and opening new information for conservation and management of coastal areas. The abundant occurrence of worms can be due to the observed untreated effluent discharges, fecal wastes from livestock, and other pollutants from rivers and creeks. This added new knowledge had provided the residents to open their collective efforts for coastal protection and management, and therefore, further research is needed for this purpose. These collective efforts among all sectors of the coastal areas, when supported by local legislations can be better options to gain back the eventual benefits of coastal resources for the present and future generations.

Acknowledgement

The author is grateful to Dr. HJ Vicente, Dr. JG Gorospe, Prof. GI Prado and Prof. RE Acuña for the all-out support of this study. Special mention to AV Tingas for the company shared throughout the research duration. To the anonymous reviewers, for the critiques and suggestions. To SESAM family for the encouragements, to MSU Naawan, MUST and Initao College, whom this paper is dedicated most.

References

1. Warwick, R. M. and J.M. Gee., Community structure of estuarine meiobenthos. Mar. Ecol. Prog. Ser. 18:97-111, **(1994)**.

2. Coull, B. C and G.T. Chandler., Pollution and meiofauna: field, laboratory and mesocosm studies. Ocean Mar. Biol. Ann. Rev. 30: 191-271, **(1992)**.

3. Coull, B. C., Estuarine meiofauna: a review, trophic relationships and microbial interactions. In Stevenson L.H. and R.R. Colwell (eds) pp 499-511 Estuarine Microbial Ecology, University of South Carolina Press, Columbia, SC., **(1973)**.

4. Heip, C., M. Vincx, and G. Vraken., The ecology of marine nematodes. Ocenogr. Mar. Biol. Ann. Rev. 23:399-489, **(1985)**.

5. Warwick, R.M., Environmental impact studies on marine communities: pragmatical considerations. Aust. J. Ecol. 18: 63-80, **(1993)**.

6. Vedra, S.A. and H.J. Vicente., Lunar cycle influences on the temporal distribution of meiofauna in selected coastal areas of Misamis Oriental, Philippines. J Nature Studies: 9(1): 135-140, **(2010)**.

7. Sherman, K. and A. M. Duda., An ecosystem approach to global assessment and management of coastal waters. Mar. Ecol. Prog. Ser. 190:271-287, **(1999)**.

8. Pagoso, C.M. and R.A. Montaño., Introductory Statistics. 391 pp. Rex Book Store, 856 N.R. Sr. St., Manila, **(1985)**.

9. Sevilla, C.G., J.A. Ochave, T.G. Punsalan, B.P. Regala, and G.G. Uriate. Research Methods. Revised Edition. Rex Printing Co., Q.C., Phil., 332, **(1997)**.