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Oceanography

Tip of Bay of Bengal

Population Dynamics Study

Highlights

Changes of Temperature

Waters in an Island Environment

Discovering Thoughts, Inventing Future

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The Complementary Indices of the Inland Freight Flows in the Nigerian Towns from Port Harcourt and Calabar Ports using Gravity Model

By Ejem A. Ejem
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Abstract- This paper is designed to examine the cargo traffic from Nigerian seaports, using the Calabar and Port Harcourt port complexes as the case study. The objective is to identify the function variables for assessing cargo flows from the seaport above to different towns in the country. A model depicting the functional relationship existing between the variables was used in the study. The regression model was used to fit a gravity model. It was discovered that population of towns is an important factor that affects cargo flows from Nigerian Sea Ports, while distance is a less predictive factor. Although the distance variable in this work was found to be insignificant as it has an inverse relationship with cargo volume, it does not connote that distance is not relevant in every flow study.

Keywords: *flows, hinterland, freight, inland, and seaport.*

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I. INTRODUCTION

Researchers have approached location problems with a variety of quantitative models. Limbourg and Jourquin (2008) use integer programming to locate facilities with the goal of minimizing total transportation costs. This method not only uses aggregated supply and demand points but also accounts for commodity flows and their geographic location to determine the optimal position of intermodal terminals on a given network. Melkote (2001) also uses integer programming but identifies changes to the network topology along with identifying potential facility locations. Arnold et al. (2004) formulates the location problem as a binary linear program but solves it using a heuristic approach. Racunica and Wynter (2005) also use heuristics in their model and allow for non-linear and concave cost functions.

Existing tools including location theory and other quantitative location decision models guide freights but do not provide qualitative information regarding livability and sustainability vital for determining community readiness. To obtain a holistic view of the location decision, rather than a purely quantitative view, Murthy (2001) suggests good performance criteria should include both quantitative and qualitative measures as applicable to the project. And, Bontekoning et al. (2004) extensively reviewed current intermodal research and recognized that a more multidisciplinary approach is used in modeling intermodal terminal location decisions. Management and policy theory were two areas they identified that required to be considered more thoroughly. Multi-criteria decision analysis (MDCA) serves as a tool for modeling freight-related movement decisions because of its flexibility to combine various types of data and different viewpoints from experts. Macharis (2005) and Vreeker (2002) have both implemented the Analytic Hierarchy Process (AHP) as a decision support tool for MDCA. Piantanakulchai (2003) uses the AHP in conjunction with a Geographical Information System (GIS) to aid in location and alignment decisions.

The AHP was used as a way to gather input from different stakeholders of potential transportation movement projects (Macharis, 2005; Dooms & Macharis, 2003). Sirikijpanichkul (2007) shows a decision model that specifically addresses the location issue and attempts to select the optimum location based on the needs of stakeholders. Dooms (2003) presents a similar model that takes into account the short and long-term objectives of multiple stakeholders, but it does not address the location decision. This model identifies the key stakeholders in the port's long-term strategy and a way to include these parties in the decision making. Henesey et al. (2003) also uses this approach and incorporates Multi Agent-Based Simulation to provide a foundation for inland port decision makers.

The needs of all the stakeholders involved in a multimodal terminal location project can be enormous. Quantitative modeling tends to maximize the benefits of the users and operators of terminals without consideration for community impacts. Community concerns often include environmental, economic, and quality of life effects of the project. Environmental and land use impacts have been identified (Litman, 1995; McCalla, Slack, & Comtois, 2001), but quantifying the effects of these impacts is difficult. The economic significance of transportation facilities are often unclear due to the complexities of these impacts. Although a more efficient freight network would be beneficial for any nation, the possible side effects of multimodal terminals, such as noise pollution, decreased land values, and stimulation of urban sprawl can outweigh these benefits (Litman, 1995). Likewise, if jobs are created as a result

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of increased multimodal transport, but traffic congestion increases, the net effect of the movement itself could be disheartening.

Finding the balance point between all of the relevant criteria can be difficult and, often, a partnering opportunity can enhance a good location's potential or even supersede a deficient location's disadvantages. Lipscomb and Long (2008) suggest that inland freight movement decisions should take advantage of the synergies created through strategic partnerships. Because of the range of factors that affect the choice to either provide new inland freight or further develop existing inland freights, Multi-Criteria Decision Analysis is an effective way to consider all of the relevant criteria as well as all of the relevant stakeholders. Recent models describe the methodology for analysing and locating inland freights, but they do not describe how to develop the important criteria and how to measure alternatives based on these criteria. The importance of quantifiable criteria for sustainable transport systems is covered in Litman (2007). This paper developed relevant variables for complementary indices for inland freight movement in Nigeria.

II. Methodology

The method of analysis utilized in this study are derived from an analysis of the concept of cargo traffic flows and traffic forecasts. The analysis is based on the concepts of gravity model, which serves as the theoretical framework. The method to be used is the multiple regression analysis, which is used to obtain the coefficients associated with population and distance. The regression line is expressed as follows; $Y = a_o + a_1X_1 + a2X_2 + u$, Where: Y = Cargo volume, X_1 = population, X_2 = distance, U = stochastic/error term; $a_{0,}$ a_1, and a_2 are respective parameters to be estimated.

For accurate analysis of the flow model from the selected ports (i.e., Port Harcourt and Calabar Port complexes). Some service towns have been chosen and arranged as follows: Aba, Benin, Enugu, Jos, Kano, Makurdi, Nnewi, Owerri, Sokoto, and Uyo. The volume of cargo bound for the respective towns the ports was obtained by combining the flows from both Port Harcourt and Calabar ports. The estimated population size of these towns and their distances from both Calabar and Port Harcourt ports were calculated for in-depth analysis and model formulation.

Table 1 shows the actual volume and direction of flow of import goods discharged at the ports within the years in view. It also shows the annual average volume of cargo distributed (combined values of Port Harcourt and Calabar port) from the port complexes to the hinterland from 2010-2015.Table 1also shows the distance from the port complexes at Port Harcourt and Calabar respectively. It also indicates the average separating distances of the towns from two Ports in Kilometers. The table for example, shows that the distance between Calabar Port to Kano is 1183km and that of Port-Harcourt to Kano is 1179kkm. These two figures now give rise to an average of 1181km from Kano to both ports. The other service towns and their distances from the ports are set out as shown.

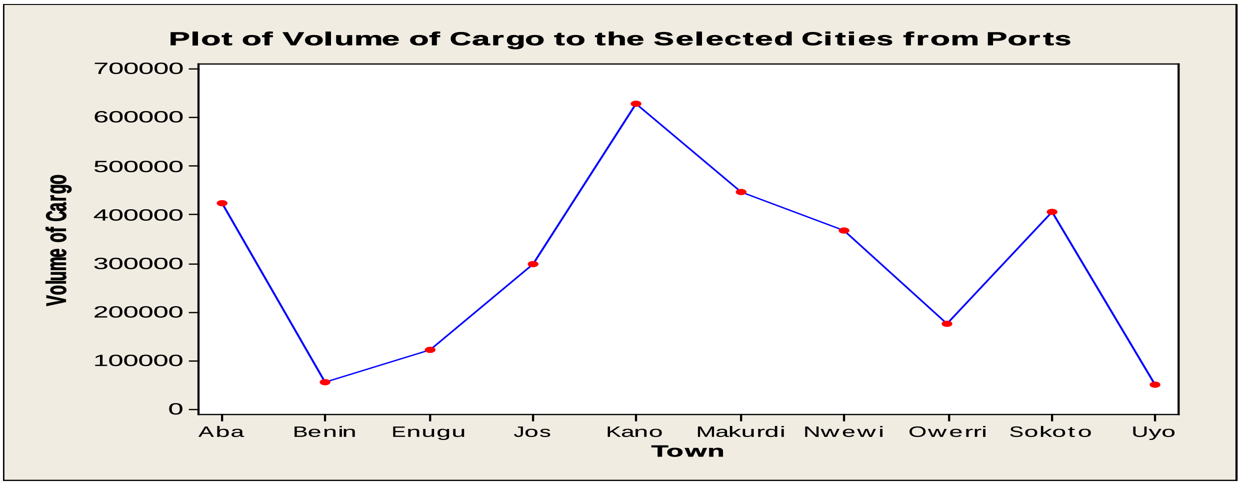
Table 1: Study Data (2010 – 2015)

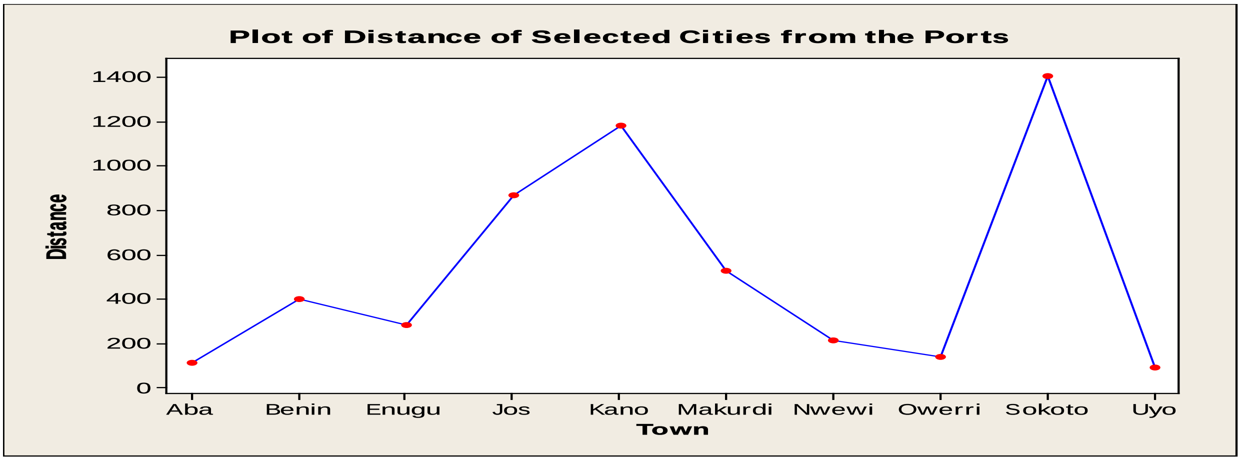
S/N	Towns	Average Annual flow of cargo from ports (in metric tonnes)	Average Population ('000)	Average Distances from Port Harcourt and Calabar (in km)
1	Aba	425640	491432	110
2	Benin	54485	2785619	400
3	Enugu	122967	21306	282
4	Jos	299824	4248204	865
5	Kano	628664	7451991	1181
6	Makurdi	447739	3530849	527
7	Nnewi	366780	159158	215
8	Owerri	176154	197743	141
9	Sokoto	407374	5733050	1406
10	Uyo	50808	124671	92

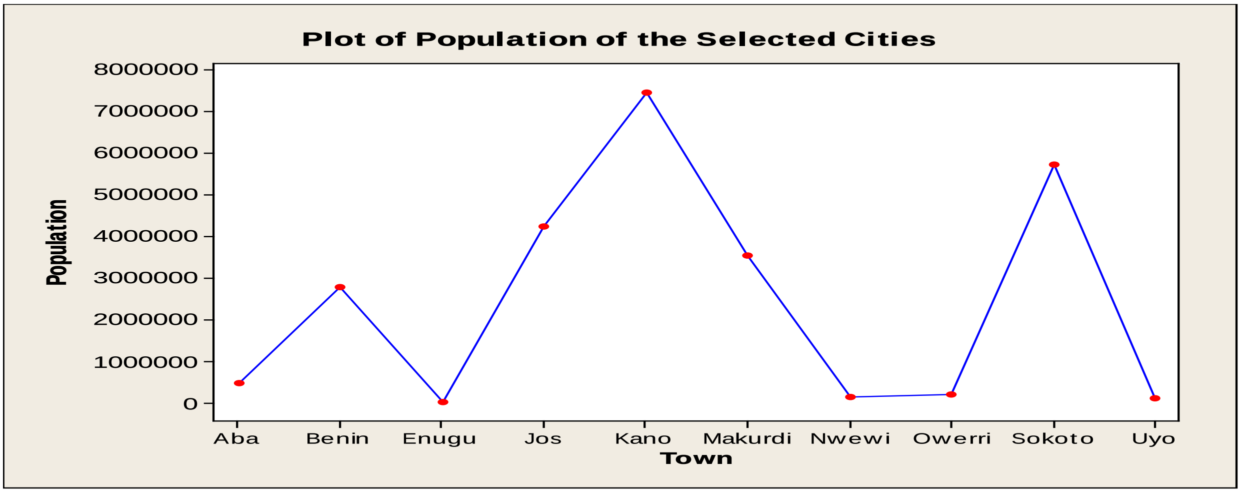
Source: National Population Commission, Lagos, Nigeria Ports Authority Abonemma, Wharf P/H and Calabar Ports and Federal Office of Statistics, Lagos.

III. Results

The figure below shows the trend of inland freight variables in the ten selected cities under study from the Port nodes- Port Harcourt and Calabar.







Categorical regression quantifies categorical data by assigning numerical values to the categories, resulting in an optimal linear regression equation for the transformed variables. Standard linear regression analysis involves minimizing the sum of squared differences between a response (dependent) variable and a weighted combination of predictor (independent) variables. Variables are typically quantitative, with (nominal) categorical data converted to binary or contrast variables. As a result, categorical variables serve to separate groups of cases, and the technique estimates separate sets of parameters for each group. The estimated coefficients reflect how changes in the predictors affect the outcome. Prediction of the response is possible for any combination of predictor values. In this case, Categorical regression was used to describe how Inland Freight Movement depends on population and distance. The resulting regression equation could be used to predict inland freight movement for any combination of the independent variables.

The following results were obtained:

Table 2: Gravity Model Result

Variable	Gravity Model
Distance	1.706*** [0.005]
Population	1.665*** [0.005]
R^2	*1.000*
Adjusted R^2	*1.000*
F	*15957.368*

1. Dependent variable = In (Volume of Cargo);
2. Standard errors in brackets are robust to heteroskedasticity and serial correlation;
3. $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$; Statistics of the first stage.

All the variables of this predictive model are statistically significant at $\alpha = 0.05$ and hence could be used for planning. Using Gravity model, the complementary indices of the inland freight flows in the Nigerian towns under study from Port Harcourt and Calabar Ports were found to be as follows:

$Q = D^{1.706}P^{1.665}$

Where Q = Volume of Cargo

D = Distance from Ports

P = Population of Town

The model was fitted with natural logarithmic values to avoid heteroscedasticity. The goodness-of-fit was excellent with the coefficient of multiple regressions at 100%. The model is ideal for forecasting inland freight flows along the ten cities in focus.

However, correlation analysis was conducted to determine the relationships among the variables of inland freight movement. The coefficient of correlation between the volume of inland freight flows and the population of inland towns from seaports of study (which is 0.635) is flagged and hence is statistically significant: Thus we reject $H_{01:}$ The population size of a service town is not a significant determinant of inland freight movement from a seaport and accept z hypothesis. We can conclusively say that, within $\alpha = 0.05$, population size is a critical determinant of cargo movement from Nigerian seaports to specific towns. Also, it is clear that the coefficient of correlation between the volume of inland freight flows and the distance of inland towns from seaports of study (which is 0.574) is not flagged and is not statistically significant. Hence, we accept H_{02}: Average distance from the seaports to service areas is not a significant determinant of freight movement. We therefore conclude that distance from seaports to service areas is not a significant determinant of cargo flow to chosen towns.

Table 3: The relationships among the variables of inland freight movement

Correlations

		Volume of Cargo	Distance	Haulage cost	Population
Volume of Cargo	Pearson Correlation	1	.574	-.199	.635*
	Sig. (2-tailed)		.083	.581	.048
	N	10	10	10	10
Distance	Pearson Correlation	.574	1	.309	.936**
	Sig. (2-tailed)	.083		.385	.000
	N	10	10	10	10
Haulage cost	Pearson Correlation	-.199	.309	1	.409
	Sig. (2-tailed)	.581	.385		.241
	N	10	10	10	10
Population	Pearson Correlation	.635*	.936**	.409	1
	Sig. (2-tailed)	.048	.000	.241	
	N	10	10	10	10

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Finally from the analysis above we can conclusively say that population size of a town is a more significant predictive variable than distance.

IV. CONCLUSION

This study is designed to examine the cargo traffic from Nigerian seaports, using the Calabar and

Port Harcourt port complexes as the case study. The objective being to identify the function for assessing cargo movement from the seaport to different towns in the country. This lead to the model depicting the functional relationship, which exists between the variables used in the study. The regression model was used to fit a gravity model, thus $Q = D^{1.706}P^{1.665}$. The model was fitted with natural logarithmic values to avoid heteroscedasticity. The regression model obtained from the study shows reasonable estimates of actual annual cargo movements from selected ports for the period 2010-2015. During the analysis, the significance of the model was shown by the relatively high value of the coefficient of multiple determinations (R^2) of 100%.Furthermore, the fact that the signs and magnitude of the population parameter are in conformity with existing theoretical axioms, while the distance parameter understandably did not meet expectations, connotes that the regression equation obtained is plausible. In the literature review, it is quite evident in the study carried out by Onakomaiya and Smith (1972), using a seven-variable multiple regression equations to explain rail shipments from Lagos and Port Harcourt to 22 towns in Nigeria. The variables used include percentage employment, population, distance, export earnings of the towns, etc. distance and export earnings accounted for 78% of the variable in import traffics.

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Changes of Temperature, pH and Salinity of Nearshore Waters in an Island Environment

By Radha Karuna Kumari & Pm. Mohan

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Abstract- The present study on temperature and pH of two Islands of Andaman during the period 2009 to 2011 suggested that the temperature increased during the year 2010 compared to the years 2009 and 2011. Moreover, a unique kind of change were noted during the years 2009, 2010, where in the bottom water (10m) exhibited comparatively higher temperature than the surface waters in both the Islands. The bottom water moved upward vertically to the surface after a 30 day period, probably due to upwelling. Earlier reports on upwelling in the Bay of Bengal and the Andaman Sea suggested that atmospheric circulation and temperature were the foremost cause for coastal upwelling. However, the above two factors did not have much significance due to the smaller surface area of these Islands. The submarine groundwater discharge could be playing a pivotal role in coastal upwelling. The groundwater discharge can lead to displacement of water mass due to the difference in physico-chemical properties, resulting in the upward movement of it towards surface over a 30 day period. This phenomena was more prominent during the nonrainy season. These inferences should be further strengthened by continuous monitoring of the nearshore waters for a larger time scale.

Keywords: temperature, ph, nearshore, upwelling, submarine groundwater discharge, Jolly Buoy, Redskin, andaman islands.

GJSFR-E Classification: FOR Code: 040305

CHANGESOFTEMPERATUREPHANDSALINITYOFNEARSHOREWATERSINANISLANDENVIRONMENT

Strictly as per the compliance and regulations of:

Changes of Temperature, pH and Salinity of Nearshore Waters in an Island Environment

Radha Karuna Kumari [α] & Pm. Mohan [σ]

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Keywords: temperature, ph, nearshore, upwelling, submarine groundwater discharge, Jolly Buoy, Redskin, andaman islands.

I. INTRODUCTION

The processes occurring under the ocean are magnificent and largely unexplored. Most of the physical and chemical processes occurring in the ocean system are unpredictable. These processes in the Island environments more complicated to comprehend than the normal nearshore environment due to the flatness of the intertidal region as well as a step like steep structure very close to the shore, in the shelf region. Further, the topographical structure of the ocean bottom along with the wind pattern, tidal oscillation, freshwater input, earthquake, etc., make this process more complicated and influences the physical and chemical parameters. Based on the literature survey, it was found that very few studies were carried out in the Island ecosystem in India, especially, in relation with temperature, pH and salinity concern. These parameters are considered as basic characteristics of any water body. So, to understand the variation of the occurrence of the above parameters in the Island environment, a study was conducted in the Protected Area, The Mahatma Gandhi Marine National Park. This location was selected because the anthropogenic interference was minimal. The study was conducted in two Islands, namely Jolly Buoy and RedSkin Islands, during the year 2009 to 2011. The Jolly Buoy Island is located in the south of Malay and the west of Rutland Island. The total area of Jolly Buoy Island is about 0.17 km^2. The coastlines are bordered by sandy beaches and rock. The Redskin Island is located between south of Chester Island and Grub Islands and west of the Hob Day Island. The total area is about 3.7 km^2 and the east coast of this island is flanked by mangrove vegetation and the west coast bordered by sand and sheet rocks. The shelf width of both the Islands varied between 50 to 500 m (Fig. 1).

II. MATERIALS AND METHODS

The present study intended to understand the physical parameters and their variability with reference to time in the nearshore coral reef environment, i.e., Surface to 10m depth. Since, the study area covers most of the coral reef within 10-15m depth, the maximum depth of the bottom waters were fixed at 10m. The parameters, temperature, pH and salinity, were studied in two depths, i.e., in surface and in 10m depth. Four transects in Jolly Buoy (J1, J2, J3 and J4), and three transects (R1, R2 and R3) in RedSkin Island, were considered for this study, during 2009 – 2011. These parameters were measured insitu using Quanta Hydrolab. Here, it also recorded that the weather pattern of these Islands is unique which has nine month monsoonal rains and three months non rainy days. The average monsoonal rain per year comes around 3395mm. No extreme winter was observed in these Islands. Based on the above factors, the weather pattern was classified under three major systems. January to April was considered as Non Rainy Season (NRS), May-August considered as the South West Monsoon period (SWM) and September-December considered as North East Monsoon (NEM) period. There were 15days plus or minus normal shift of above mentioned seasonal variations.

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III. RESULTS

Overall variation of surface temperature (Table 1, 2, 3 and 4) suggested that the year 2010 had a higher temperature than 2009 and 2011 (Fig.2A, 2B, 3A, 3B,4A, 4B,5A and 5B). The temperature in the year 2011, was lower than the previous two years. The 10m water column also had an almost similar temperature in all transects. Moreover, the monthly temperature data suggested that a shift of temperature was unambiguous during the period of 2009 and 2010. The average temperature rise observed in the year 2010 was 0.66°C in surface and 0.49°C in the bottom, comparing the years 2009 and 2010. However, the year 2011, exhibited a reduction of 0.12°C in the surface and 0.20°C in the bottom. The Redskin Island temperature (Table 5, 6, 7) for the study period was high during the year 2010 compared to the year 2009 and 2011 (Fig. 6A, 6B, 7A, 7B, 8A and 8B). The average temperature rise was of 0.53°C (Table 8), in the year 2010 in surface and 0.29°C rise in the bottom waters. However, the year 2011exhibited a reduction of 0.18°C in the surface and 0.32°C in the bottom.

The pH of the Jolly Buoy Island shows a constant increment from the year 2009 to 2011 (Fig.9A, 9B, 10A, 10B, 11A, 11B, 12A and 12B). The increment was significant towards higher pH, i.e., 7.51-7.93 on the surface and 7.53-7.94 in the bottom waters (Table 9). However, the year 2010 shows a slight increment (7.99 for surface and 8.05 for bottom waters) than the years 2009 and 2011. The Redskin also shows a similar type of variation in the range of 7.53-7.83 (Fig. 13A, 13B, 14A, 14B, 15A and 15B).

The salinity in Jolly Buoy Island (Table 10), suggested that the year 2011 (32.69PSU) had a higher salinity than 2009 (31.18-31.20PSU) and 2010 (31.42-31.35PSU). The increment was around 1.49PSU for the surface and 1.51PSU for bottom waters from the year 2009-2011 (Fig. 16A, 16B, 17A, 17B, 18A, 18B, 19A and 19B). The Redskin Island also shows an almost similar level of increment of salinity between the years 2009-2011 (Fig. 20A, 20B, 21A, 21B, 22A and 22B). The increment observed from the surface and bottom waters, respectively, were 1.47PSU and 1.32PSU.

IV. DISCUSSIONS

The study of temperature, pH and salinity of the coral reef environment of Jolly Buoy and Redskin Island for the year 2009 to 2011, for the four traverses and three traverses, represented a unique pattern. Generally, the water temperature would be comparatively higher in the surface than the bottom waters, however, in the present study, it was observed that the surface had a low temperature and bottom (10m) had a comparatively higher temperature, in certain periods. Moreover, the monthly temperature data suggested that a shift of temperature from bottom to top had taken place from the surveying month to next month, i.e., for example, in Jolly Buoy, traverse 1 at 2010, the bottom water temperature in April 31.71°C, the surface water temperature in the month of May was 31.76°C in the same station (Fig.2A, 2B). This observation was unambiguous during the period of 2009 and 2010, especially during NRS. However, this variation was not observed in the year 2011. If this process had been considered as a local upwelling as per the reports[1,2,3,4,5], who mentioned that upwelling was observed along the coasts of the Bay of Bengal and the Andaman Sea, due to river discharge and wind thrust. However, the present study revealed that no fresh water input had taken place through major river discharge, because of the smaller surface area of this Island. Moreover, the concept of submarine groundwater discharge[6,7,8] might be effective in this location which may induce the coastal upwelling. Similarly, the same phenomenon may be effective in the Redskin Island also. This factor may be supported by the pH and salinity values. Quite interesting phenomena which were observed in this study was a constant increment of pH and salinity from the year 2009-2011. This increment was also noticeable level, i.e., almost 0.41units for pH and 1.32-1.51PSU for salinity. This increment was prominent in the year 2010, which suggested that the rain water factor alone did not provide alkaline elements to this water. This inference was made due to the fact that the year 2010 had the high temperature and low rainfall. The year 2009 also had lower rainfall and comparatively higher temperature in the bottom water than the surface during NRS. The above information suggested that the elsewhere discussions on the submarine groundwater discharge has an impact on nearshore area for the different physico-chemical parameters[9-16], may have an impact on this study area also. Further the year 2010 was also reported a significant coral bleaching in this part of the Island[17], also may have caused the dissolution of alkaline elements from the bleached coral skeletons through submarine groundwater discharge, which in turn increase the pH and salinity significantly. Mohan et al.,18 had mentioned about the increase in pH in the coastal waters due to the dissolution of bleached coral skeletons. This effect was continued even during the year 2011 and in turn provided higher pH and salinity. Although, no submarine groundwater discharge studies had been carried out this region, this assumption was made solely based on the temperature, pH and salinity differences between the years.

V. CONCLUSION

The present study on the temperature, pH, and salinity, of the waters of two Islands of Andaman and Nicobar archipelago concluded that the variation in this physical parameters from surface to 10m water column was linked with atmosphere-surface interaction, local phenomena and also with the submarine groundwater discharge. This factor should be studied in detail to understand the effects of SGD (submarine groundwater discharge) on the nearshore environment of Island ecosystem. This ecosystem may have a higher tendency to be influenced by this factor due to the presence of fractured volcanic rocks along with carbonate deposits in the terrestrial environment.

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Declaration of Conflict of Interest
Authors declare no conflict of interest.

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Table 1: Variation of physical parameters in Jolly Buoy Island- Transect 1

Variation recorded in 2009						
Month	Temperature in ºC		pH		Salinity in PSU	
	surface	5m	surface	5m	surface	5m
Jan-09	26.97	26.97	7.56	7.57	31.30	31.20
Feb-09	27.43	27.91	7.54	7.51	31.20	31.30
Mar-09	27.90	29.57	7.51	7.39	31.40	31.40
Apr-09	29.53	30.12	7.39	7.27	31.30	31.30
May-09	30.27	29.21	7.26	7.49	31.20	31.20
June-09	29.53	28.68	7.40	7.79	31.10	31.10
Jul-09	28.70	30.00	7.80	6.50	32.00	32.00
Aug-09	29.50	28.39	6.50	7.74	31.40	31.30
Sep-09	28.93	28.48	7.75	7.73	31.00	31.00
Oct-09	28.52	29.33	7.74	7.93	31.00	30.90
Nov-09	29.35	28.56	7.93	7.80	30.90	30.70
Dec-09	28.59	28.68	7.82	7.77	30.90	30.70
Variation recorded in 2010						
Jan-10	28.70	29.07	7.80	7.92	30.70	30.70
Feb-10	29.10	29.60	7.91	7.82	30.80	30.90
Mar-10	29.79	30.50	7.85	7.86	30.90	31.20
Apr-10	30.55	31.71	7.86	8.10	31.20	31.30
May-10	31.76	30.52	8.10	7.91	31.40	31.70
Jun-10	30.57	28.91	7.91	8.29	31.70	31.60
Jul-10	28.91	28.53	8.27	8.30	31.60	31.60
Aug-10	28.56	28.34	8.27	8.30	31.55	31.60
Sep-10	28.21	28.14	8.29	8.31	31.50	31.60
Oct-10	29.81	29.78	7.97	7.90	31.50	31.50
Nov-10	28.39	28.38	7.95	7.92	31.10	31.10
Dec-10	28.10	28.05	7.60	7.60	32.00	32.00
Variation recorded in 2011						
Jan-11	27.90	27.90	7.80	7.78	31.90	31.80
Feb-11	27.75	27.75	7.93	7.92	31.90	31.90
Mar-11	28.98	28.47	7.87	7.84	32.97	32.97
Apr-11	28.96	28.99	7.95	7.90	32.99	32.92
May-11	30.25	30.14	8.02	8.02	33.13	33.12
Jun-11	29.74	29.67	8.03	8.02	33.21	33.17
Jul-11	29.24	29.20	8.05	8.01	33.30	33.22
Aug-11	27.94	27.93	8.37	8.25	32.97	32.87
Sep-11	27.77	27.79	8.70	8.76	32.49	32.49
Oct-11	28.00	27.79	8.46	8.38	32.51	32.65
Nov-11	29.55	29.50	7.28	7.12	31.91	31.91
Dec-11	28.09	28.09	6.89	6.90	32.87	32.87

Table 2: Variation of physical parameters in Jolly Buoy Island- Transect 2

Variation recorded in 2009						
Month	Temperature in ºC		pH		Salinity in PSU	
	Surface	5m	surface	5m	surface	5m
Jan-09	26.96	26.98	7.52	7.54	31.20	31.20
Feb-09	27.90	28.81	7.45	7.32	31.20	31.30
Mar-09	28.85	29.53	7.39	7.20	31.30	31.40
Apr-09	29.56	30.19	7.21	7.14	31.40	31.30
May-09	30.20	28.65	7.14	7.45	31.30	31.20
Jun-09	28.78	28.70	7.45	7.78	31.20	31.10
Jul-09	26.94	30.00	7.81	6.50	31.10	32.00
Aug-09	29.50	28.37	6.50	7.73	31.50	31.30
Sep-09	28.58	28.43	7.71	7.75	31.30	31.00
Oct-09	28.42	29.31	7.75	7.92	31.00	30.90
Nov-09	29.33	28.51	7.93	7.83	30.90	30.80
Dec-09	28.56	28.53	7.85	7.84	30.70	30.50
Variation recorded in 2010						
Jan-10	28.53	28.99	7.88	7.93	30.50	30.70
Feb-10	29.02	29.35	7.93	8.05	30.70	31.00
Mar-10	29.53	30.56	8.08	7.86	31.00	31.20
Apr-10	30.57	31.69	7.85	8.12	31.20	31.30
May-10	31.85	30.50	8.13	8.03	31.30	31.70
Jun-10	30.50	29.31	8.03	8.19	31.70	31.70
Jul-10	29.50	28.71	8.10	8.27	31.61	31.60
Aug-10	29.00	28.41	8.20	8.31	31.61	31.60
Sep-10	28.14	28.11	8.35	8.35	31.60	31.60
Oct-10	29.80	29.75	8.06	8.09	31.50	31.50
Nov-10	28.29	28.38	8.04	8.04	31.10	31.10
Dec-10	28.13	28.09	7.63	7.60	31.90	32.00
Variation recorded in 2011						
Jan-11	27.83	27.83	7.96	7.91	31.90	31.90
Feb-11	27.71	27.68	8.01	7.95	31.90	32.00
Mar-11	28.51	28.55	8.06	7.96	33.04	33.04
Apr-11	28.93	28.93	8.02	7.99	32.99	32.90
May-11	30.08	29.94	8.03	7.99	33.12	33.11
Jun-11	29.71	29.62	8.13	8.10	33.18	33.17
Jul-11	29.33	29.30	8.22	8.20	33.23	33.23
Aug-11	27.97	27.94	8.36	8.28	32.94	32.87
Sep-11	27.75	27.79	8.84	8.85	32.49	32.56
Oct-11	28.02	28.00	8.64	8.61	32.65	32.65
Nov-11	29.50	29.48	7.24	7.21	31.98	31.98
Dec-11	28.07	28.07	6.27	6.32	32.87	32.87

Table 3: Variation of physical parameters in Jolly Buoy Island- Transect 3

Variation recorded in 2009						
Month	Temperature in ºC		pH		Salinity in PSU	
	surface	5m	surface	5m	surface	5m
Jan-09	26.96	26.98	7.52	7.54	31.20	31.20
Feb-09	27.10	27.24	7.49	7.46	31.20	31.30
Mar-09	27.25	29.49	7.46	7.25	31.30	31.40
Apr-09	29.77	30.16	7.32	7.16	31.40	31.30
May-09	31.42	29.82	7.22	7.47	31.20	31.20
Jun-09	29.85	28.66	7.46	8.31	31.20	31.10
Jul-09	28.67	30.00	7.81	6.50	31.20	32.00
Aug-09	30.00	28.40	6.40	7.71	31.50	31.40
Sep-09	28.89	28.43	7.75	7.76	31.30	31.00
Oct-09	28.51	29.30	7.81	7.93	31.00	30.90
Nov-09	29.30	28.56	7.94	7.85	30.90	30.70
Dec-09	28.47	28.58	7.98	7.83	30.50	30.40
Variation recorded in 2010						
Jan-10	28.80	29.06	7.80	7.92	30.50	30.80
Feb-10	29.10	29.48	7.88	8.07	30.80	31.00
Mar-10	29.80	30.46	7.49	7.86	31.00	31.20
Apr-10	30.52	31.67	7.86	8.11	31.20	31.30
May-10	31.86	30.49	8.02	8.33	31.40	31.70
Jun-10	30.58	29.30	8.27	8.33	31.70	31.70
Jul-10	29.48	28.70	8.22	8.32	31.70	31.70
Aug-10	28.90	28.40	8.28	8.33	31.70	31.70
Sep-10	28.12	28.10	8.30	8.34	31.70	31.70
Oct-10	29.73	29.70	8.33	8.47	31.50	31.50
Nov-10	28.33	28.33	8.17	8.08	31.40	31.30
Dec-10	28.12	28.09	7.63	7.61	32.10	32.10
Variation recorded in 2011						
Jan-11	27.90	27.91	8.07	8.04	31.90	31.90
Feb-11	27.75	27.71	7.93	8.00	31.90	32.00
Mar-11	28.52	28.44	7.18	8.12	33.12	33.04
Apr-11	28.95	28.89	7.89	8.01	32.99	32.99
May-11	30.61	30.05	7.98	7.97	33.06	33.04
Jun-11	29.98	29.69	8.08	8.13	33.18	33.18
Jul-11	29.35	29.33	8.18	8.28	33.30	33.30
Aug-11	27.99	27.96	8.20	8.24	32.87	32.87
Sep-11	27.74	27.84	8.70	8.87	32.42	32.64
Oct-11	28.29	28.07	8.27	8.14	32.74	32.65
Nov-11	29.40	29.36	7.17	7.17	32.27	32.27
Dec-11	28.02	28.01	7.62	7.55	32.94	32.94

Table 4: Variation of physical parameters in Jolly Buoy Island- Transect 4

Variation recorded in 2009						
Month	Temperature in ºC		pH		Salinity in PSU	
	surface	5m	surface	5m	surface	5m
Jan-09	26.96	26.98	7.52	7.54	31.20	31.20
Feb-09	27.41	27.85	7.46	7.38	31.20	31.30
Mar-09	27.86	29.73	7.41	7.39	31.30	31.40
Apr-09	29.76	30.27	7.39	7.22	31.40	31.30
May-09	31.40	29.42	7.30	7.48	31.30	31.20
Jun-09	29.52	28.62	7.55	7.81	31.30	31.10
Jul-09	28.73	30.50	7.83	6.50	31.20	32.00
Aug-09	30.50	28.48	6.50	7.71	32.00	31.40
Sep-09	29.19	28.41	7.81	7.77	31.30	31.10
Oct-09	28.59	29.31	7.75	7.93	31.00	30.90
Nov-09	29.32	28.58	7.93	7.75	30.90	30.70
Dec-09	28.56	28.63	7.75	7.73	30.80	30.70
Variation recorded in 2010						
Jan-10	29.10	28.95	7.77	7.86	30.50	30.80
Feb-10	29.42	29.73	7.87	7.85	30.80	30.90
Mar-10	29.79	30.51	7.86	7.86	30.90	31.20
Apr-10	30.51	31.74	7.86	8.06	31.20	31.30
May-10	32.33	30.60	8.09	7.76	31.30	31.60
Jun-10	30.77	29.37	7.80	8.02	31.60	31.55
Jul-10	29.80	28.76	8.00	8.15	31.60	31.53
Aug-10	29.40	28.45	8.20	8.22	31.50	31.52
Sep-10	28.18	28.14	8.29	8.29	31.50	31.50
Oct-10	29.83	29.84	7.93	7.92	31.50	31.40
Nov-10	28.49	28.41	7.84	7.81	31.20	31.20
Dec-10	28.12	28.10	7.64	7.62	32.80	31.90
Variation recorded in 2011						
Jan-11	27.91	27.91	7.75	7.75	31.90	31.80
Feb-11	27.74	27.71	7.89	7.88	31.90	31.90
Mar-11	29.38	28.65	7.85	7.80	33.01	32.97
Apr-11	29.00	28.99	7.87	7.87	32.99	32.99
May-11	30.16	30.10	8.08	8.01	33.07	33.12
Jun-11	29.71	29.69	8.06	8.26	33.15	33.18
Jul-11	29.26	29.28	8.03	8.50	33.22	33.23
Aug-11	28.10	28.05	8.33	8.19	32.80	32.80
Sep-11	27.73	27.82	8.64	8.69	32.42	32.49
Oct-11	28.34	28.02	7.89	7.77	32.66	32.58
Nov-11	29.55	29.52	7.12	7.09	31.98	31.98
Dec-11	28.09	28.08	6.71	6.65	32.95	32.95

Table 5: Variation of physical parameters in Redskin Island-Transect 1

Variation recorded in 2009						
Month	Temperature in ºC		pH		Salinity in PSU	
	surface	5m	surface	5m	surface	5m
Jan-09	27.12	27.17	7.56	7.58	31.40	31.40
Feb-09	27.86	28.70	7.80	7.81	31.30	31.30
Mar-09	28.60	30.07	8.10	8.12	31.30	31.30
Apr-09	30.12	30.45	8.10	7.47	31.20	31.40
May-09	30.65	29.24	8.10	7.29	31.04	31.20
Jun-09	28.66	28.73	7.27	7.67	30.70	31.20
Jul-09	28.96	30.50	7.68	6.50	31.10	32.00
Aug-09	30.00	29.08	6.40	7.62	32.00	29.60
Sep-09	28.94	28.83	7.59	7.61	29.20	30.80
Oct-09	28.91	29.51	7.62	8.36	30.60	31.00
Nov-09	29.76	28.65	7.87	7.58	31.00	31.00
Dec-09	28.87	28.70	7.59	7.54	30.90	31.20
Variation recorded in 2010						
Jan-10	28.85	29.10	7.52	7.81	31.20	31.00
Feb-10	29.45	29.70	7.83	7.80	31.00	31.20
Mar-10	29.75	30.73	7.81	7.73	31.20	31.30
Apr-10	31.48	31.67	7.72	7.97	31.40	31.30
May-10	32.47	30.09	7.97	8.13	31.30	31.40
Jun-10	31.20	29.30	7.99	8.20	31.40	31.40
Jul-10	29.80	28.91	8.01	8.24	31.40	31.50
Aug-10	28.50	28.51	8.03	8.28	31.50	31.50
Sep-10	28.31	28.33	8.00	8.01	31.10	31.10
Oct-10	29.90	29.67	7.73	7.74	31.60	31.70
Nov-10	28.80	28.35	7.71	7.68	31.30	31.40
Dec-10	28.18	28.18	7.70	7.63	32.10	32.00
Variation recorded in 2011						
Jan-11	28.19	28.01	7.73	7.71	31.90	31.90
Feb-11	27.77	27.74	7.72	7.65	32.10	32.10
Mar-11	29.15	28.65	7.78	7.74	33.07	33.12
Apr-11	29.62	29.15	7.76	7.60	32.95	32.92
May-11	30.38	30.29	8.03	8.03	33.20	33.20
Jun-11	29.08	29.13	8.06	8.08	31.61	31.67
Jul-11	29.68	29.36	7.84	8.81	33.25	33.23
Aug-11	28.68	28.34	8.00	7.93	32.61	32.66
Sep-11	27.75	27.83	8.37	8.33	32.70	32.34
Oct-11	28.68	28.32	8.04	8.01	32.24	32.30
Nov-11	30.17	29.50	7.22	7.14	32.38	32.27
Dec-11	28.49	28.15	7.01	7.59	33.11	33.02

Table 6: Variation of physical parameters in Redskin Island- Transect 2

Variation recorded in 2009						
Month	Temperature in ºC		pH		Salinity in PSU	
	surface	5m	surface	5m	surface	5m
Jan-09	27.20	27.15	7.56	7.55	31.40	31.40
Feb-09	27.85	28.20	7.57	7.61	31.30	31.30
Mar-09	28.50	30.02	7.60	7.68	31.30	31.30
Apr-09	30.15	30.69	7.68	7.45	31.30	31.30
May-09	30.75	28.75	7.46	7.31	31.30	31.10
Jun-09	28.57	28.74	7.38	7.68	30.50	31.10
Jul-09	28.74	31.00	7.68	6.50	31.10	33.00
Aug-09	30.50	28.54	6.40	7.64	33.00	31.30
Sep-09	28.93	28.81	7.62	7.64	29.30	30.90
Oct-09	28.85	29.44	7.66	7.88	30.60	31.00
Nov-09	30.09	28.77	7.88	7.57	30.90	30.90
Dec-09	28.93	28.82	7.59	7.57	30.90	31.20
Variation recorded in 2010						
Jan-10	28.87	29.13	7.57	7.78	31.20	30.90
Feb-10	29.65	29.80	7.75	7.60	30.90	31.20
Mar-10	29.85	30.69	7.78	7.75	31.40	31.30
Apr-10	31.70	31.82	7.75	7.92	31.20	31.30
May-10	32.54	30.41	7.91	7.85	31.30	31.45
Jun-10	30.76	28.99	8.00	7.78	31.40	31.60
Jul-10	28.99	28.78	7.78	8.02	31.50	31.60
Aug-10	28.57	28.57	8.26	8.27	31.50	31.50
Sep-10	28.24	28.25	8.01	7.97	31.00	31.00
Oct-10	29.87	29.75	7.72	7.70	31.60	31.70
Nov-10	28.50	28.33	7.64	7.62	31.40	31.50
Dec-10	28.17	28.19	7.63	7.63	32.10	32.00
Variation recorded in 2011						
Jan-11	28.24	28.04	7.70	7.65	32.00	31.90
Feb-11	27.96	27.73	7.70	7.63	32.10	32.10
Mar-11	29.24	28.56	7.70	7.70	33.08	33.12
Apr-11	29.47	29.47	7.68	7.69	32.94	32.94
May-11	30.38	30.22	8.06	8.06	33.13	33.05
Jun-11	29.05	29.19	7.97	8.03	31.52	31.67
Jul-11	29.67	29.50	7.83	8.85	33.24	33.24
Aug-11	28.50	28.41	7.95	7.96	32.60	32.59
Sep-11	27.66	27.81	7.82	8.40	31.97	32.27
Oct-11	28.66	28.39	8.05	8.03	32.09	32.30
Nov-11	29.98	29.61	7.16	7.12	32.44	32.43
Dec-11	28.28	28.14	6.60	7.54	33.25	33.10

Table 7: Variation of physical parameters in Redskin Island- Transect 3

Variation recorded in 2009						
Month	Temperature in ºC		pH		Salinity in PSU	
	surface	5m	surface	5m	surface	5m
Jan-09	27.50	27.20	7.54	7.55	31.40	31.30
Feb-09	28.00	28.50	7.56	7.51	31.30	31.30
Mar-09	28.60	30.20	7.58	7.47	31.30	31.30
Apr-09	30.05	30.50	7.61	7.35	31.30	31.30
May-09	30.68	29.23	7.37	7.29	31.40	31.40
Jun-09	29.01	28.74	7.32	7.69	31.00	31.10
Jul-09	28.74	30.50	7.70	6.50	31.10	32.00
Aug-09	30.50	28.55	6.60	7.65	32.00	31.10
Sep-09	28.80	28.87	7.65	7.68	31.00	30.90
Oct-09	28.81	29.47	7.69	7.85	30.80	31.00
Nov-09	29.47	28.72	7.85	7.62	31.00	30.80
Dec-09	28.74	28.81	7.63	7.58	30.80	31.00
Variation recorded in 2010						
Jan-10	28.78	29.20	7.60	7.74	31.10	30.90
Feb-10	29.21	29.25	7.75	7.70	30.90	31.20
Mar-10	29.35	30.47	7.39	7.79	31.30	31.30
Apr-10	30.51	32.50	7.79	7.81	31.30	31.40
May-10	32.14	30.89	7.83	7.64	31.40	31.50
Jun-10	30.89	29.03	7.62	8.14	31.50	31.60
Jul-10	29.02	28.79	8.13	8.09	31.60	31.60
Aug-10	28.56	28.55	8.02	8.05	31.60	31.60
Sep-10	28.34	28.21	8.17	8.19	30.80	31.30
Oct-10	29.77	29.65	7.66	7.68	31.70	31.70
Nov-10	28.57	28.45	7.58	7.56	31.50	31.50
Dec-10	28.25	28.20	7.96	7.87	32.10	32.10
Variation recorded in 2011						
Jan-11	28.01	28.02	7.59	7.57	31.90	31.90
Feb-11	27.76	27.76	7.65	7.59	32.00	32.00
Mar-11	28.71	28.66	7.68	7.67	33.12	33.05
Apr-11	29.03	28.99	7.69	7.65	32.99	32.92
May-11	30.46	30.25	8.11	8.06	33.06	33.05
Jun-11	29.17	29.17	7.97	7.98	31.74	31.67
Jul-11	29.46	29.47	7.87	7.86	33.16	33.16
Aug-11	28.30	28.33	8.19	8.09	32.52	32.59
Sep-11	27.82	27.83	7.89	7.97	32.20	32.34
Oct-11	28.23	28.24	8.12	8.14	32.37	32.44
Nov-11	30.17	29.51	7.01	7.45	32.60	32.42
Dec-11	28.16	28.16	6.58	6.51	32.95	32.50

Table 8: Average Temperature variation in Jolly Buoy and Redskin Island during 2009-2011

Average Temperature in ºC Recorded in Jolly Buoy Island						
Transect	Surface-Average			10m-Average		
	2009	2010	2011	2009	2010	2011
T1	28.77	29.37	28.68	28.83	29.29	28.60
T2	28.63	29.41	28.62	28.83	29.32	28.59
T3	28.85	29.45	28.71	28.80	29.32	28.61
T4	28.98	29.65	28.75	28.9	29.38	28.65
Total Average	28.81	29.47	28.69	28.84	29.33	28.61
Average Temperature in ºC Recorded in Redskin Island						
	Surface-Average			10m-Average		
	2009	2010	2011	2009	2010	2011
T1	29.04	29.72	28.97	29.14	29.38	28.71
T2	29.09	29.64	28.92	29.08	29.39	28.76
T3	29.08	29.45	28.77	29.11	29.43	28.70
Total Average	29.07	29.60	28.89	29.11	29.40	28.72

Table 9: Average pH variation in Jolly Buoy and Redskin Island during 2009-2011

Average pH Recorded in Jolly Buoy Island						
	Surface-Average			10m-Average		
	2009	2010	2011	2009	2010	2011
T1	7.52	7.98	7.95	7.54	8.02	7.91
T2	7.48	8.02	7.98	7.50	8.07	7.95
T3	7.51	8.02	7.94	7.56	8.15	8.04
T4	7.52	7.93	7.85	7.52	7.95	7.87
Total Average	7.51	7.99	7.93	7.53	8.05	7.94
Average pH Recorded in Redskin Island						
	Surface-Average			10m-Average		
	2009	2010	2011	2009	2010	2011
T1	7.64	7.84	7.80	7.60	7.94	7.89
T2	7.51	7.82	7.69	7.51	7.82	7.89
T3	7.51	7.79	7.70	7.48	7.86	7.71
Total Average	7.55	7.82	7.73	7.53	7.87	7.83

Table 10: Average Salinity variation in Jolly Buoy and Redskin Island during 2009-2011

Average Salinity in PSU Recorded in Jolly Buoy Island						
	Surface-Average			10m-Average		
	2009	2010	2011	2009	2010	2011
T1	31.23	31.33	32.68	31.18	31.40	32.66
T2	31.18	31.31	32.69	31.17	31.42	32.69
T3	31.16	31.39	32.72	31.16	31.48	32.74
T4	31.24	31.37	32.67	31.19	31.37	32.67
Total Average	31.20	31.35	32.69	31.18	31.42	32.69
Average Salinity in PSU Recorded in Redskin Island						
	Surface-Average			10m-Average		
	2009	2010	2011	2009	2010	2011
T1	30.98	31.38	32.59	31.12	31.40	32.56
T2	31.08	31.38	32.53	31.32	31.42	32.56
T3	31.20	31.40	32.55	31.21	31.48	32.50
Total Average	31.09	31.39	32.56	31.22	31.43	32.54

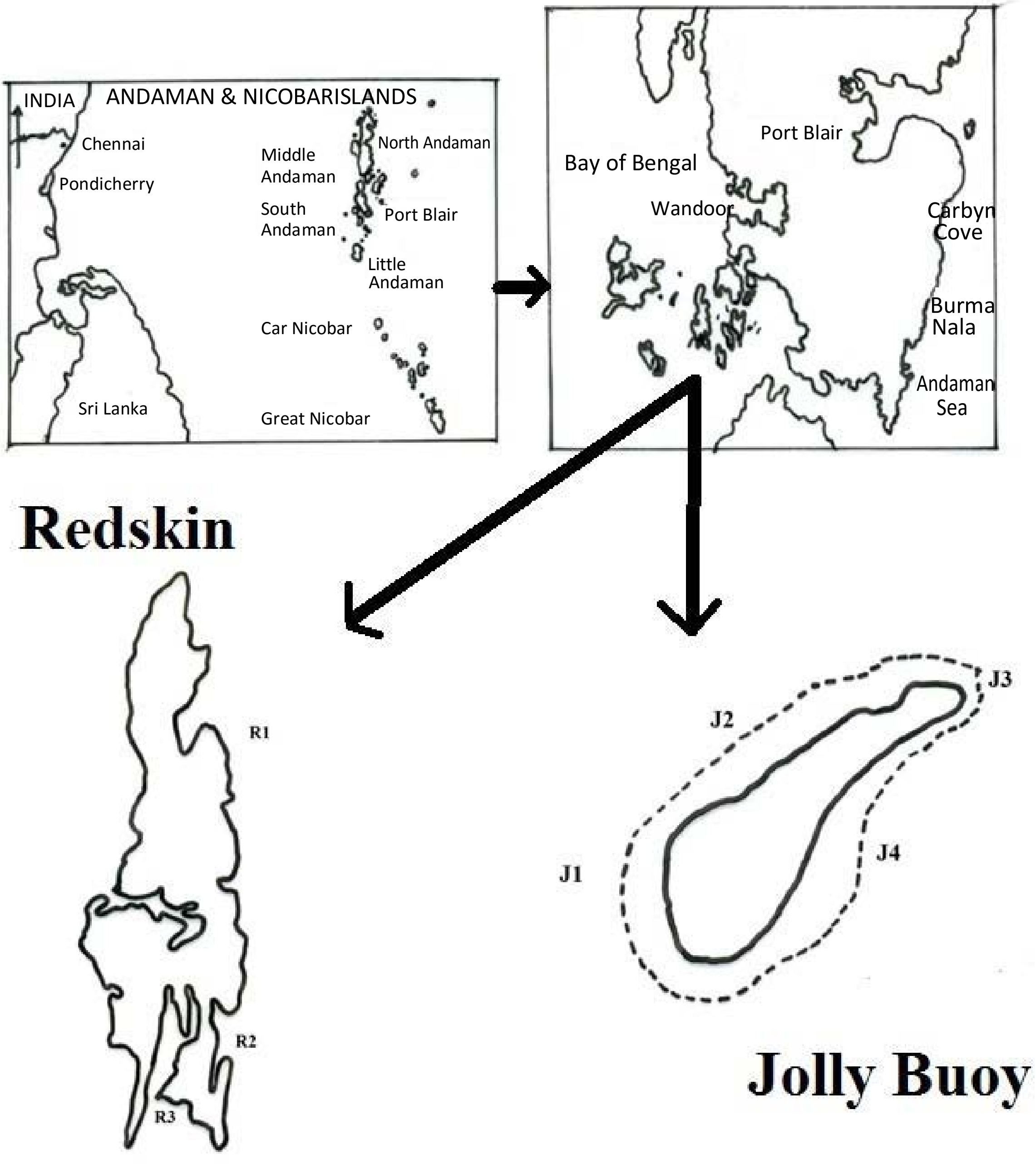

Fig. 1: Study Area

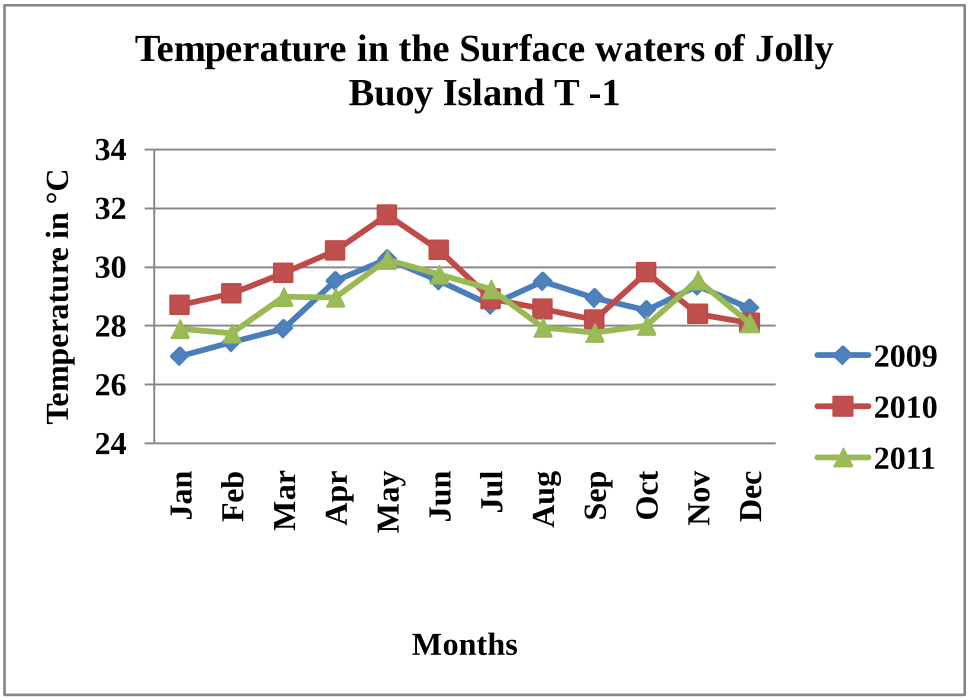

Fig. 2: A. Temperature in Transect 1 of Jolly Buoy Island-Surface Waters

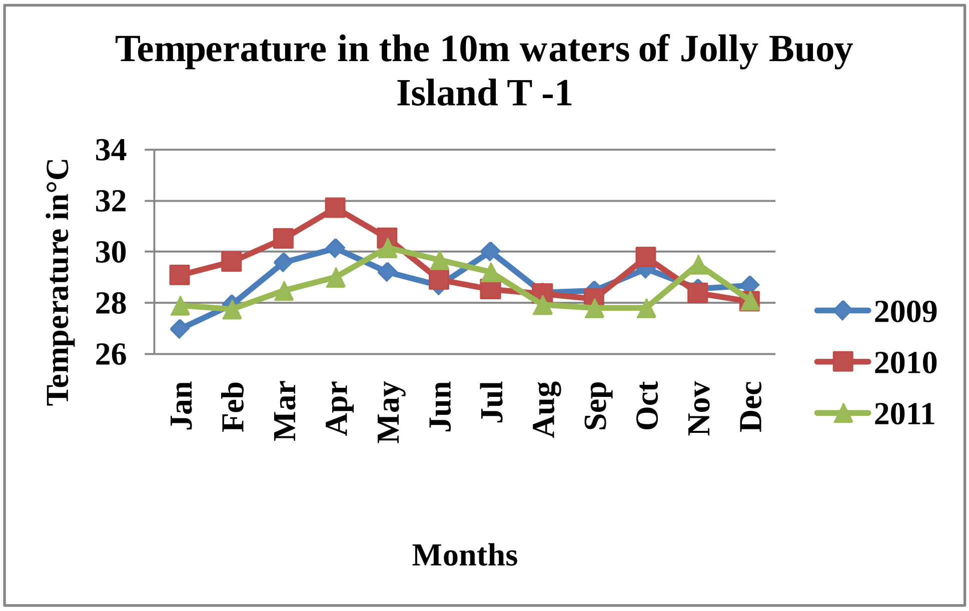

Fig. 2: B. Temperature in Transect 1 of Jolly Buoy Island-10m Waters

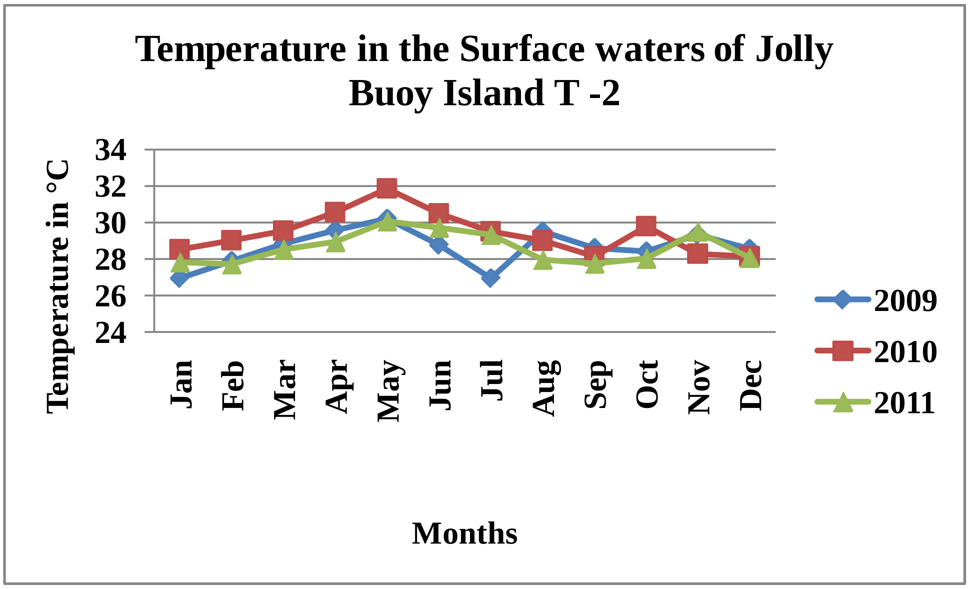

Fig. 3: A. Temperature in Transect 2 of Jolly Buoy Island-Surface Waters

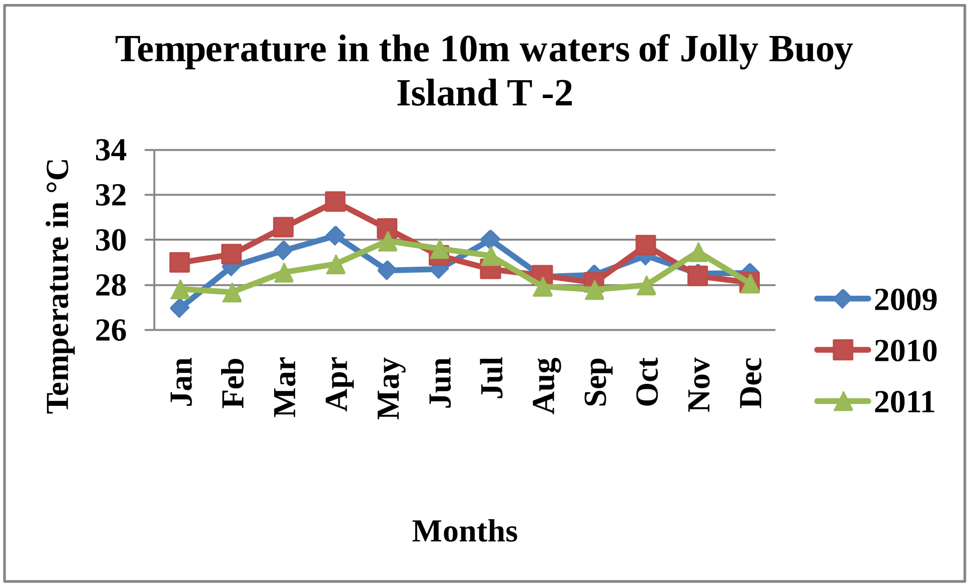

Fig. 3: B. Temperature in Transect 2 of Jolly Buoy Island-10m Waters

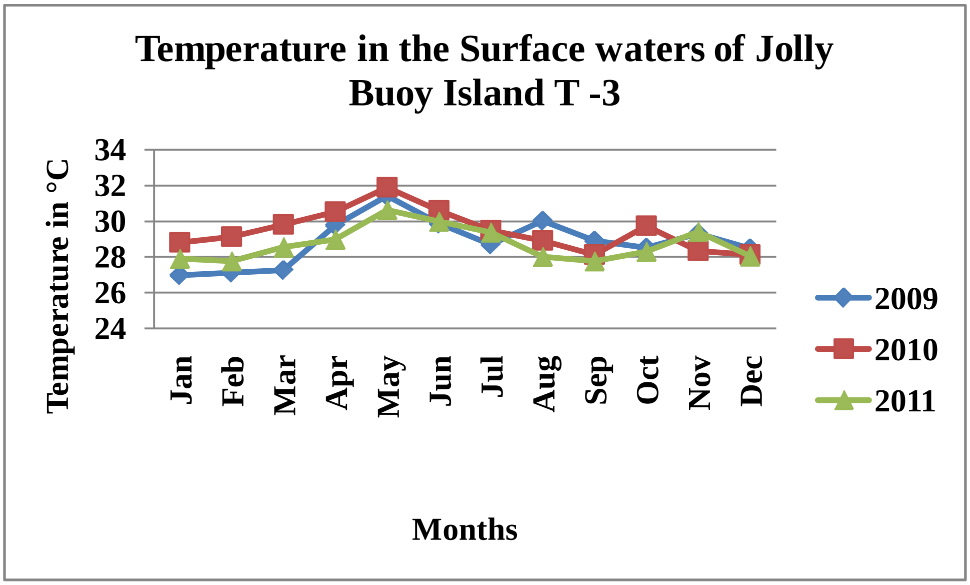

Fig. 4: A. Temperature in Transect 3 of Jolly Buoy Island-Surface Waters

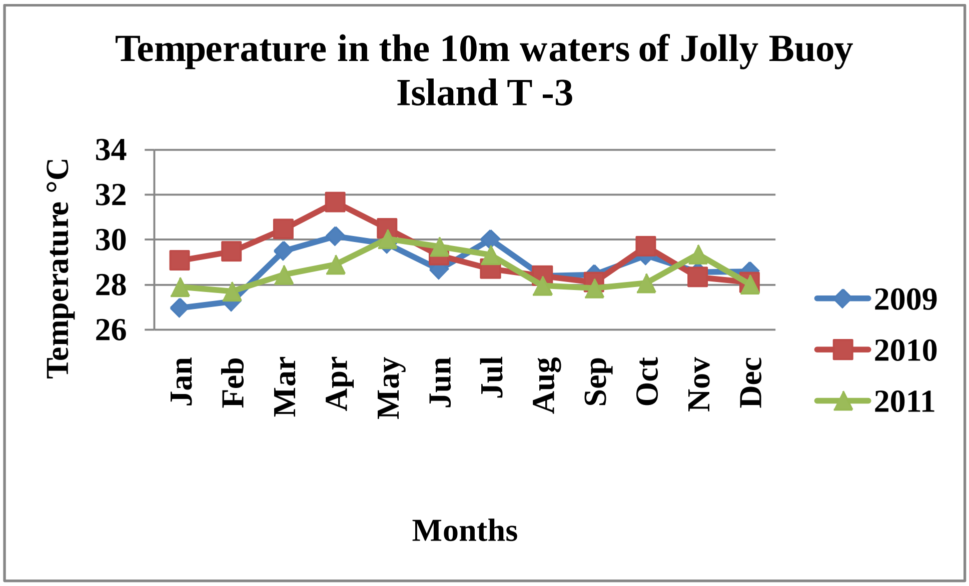

Fig. 4: B. Temperature in Transect 3 of Jolly Buoy Island-10m Waters

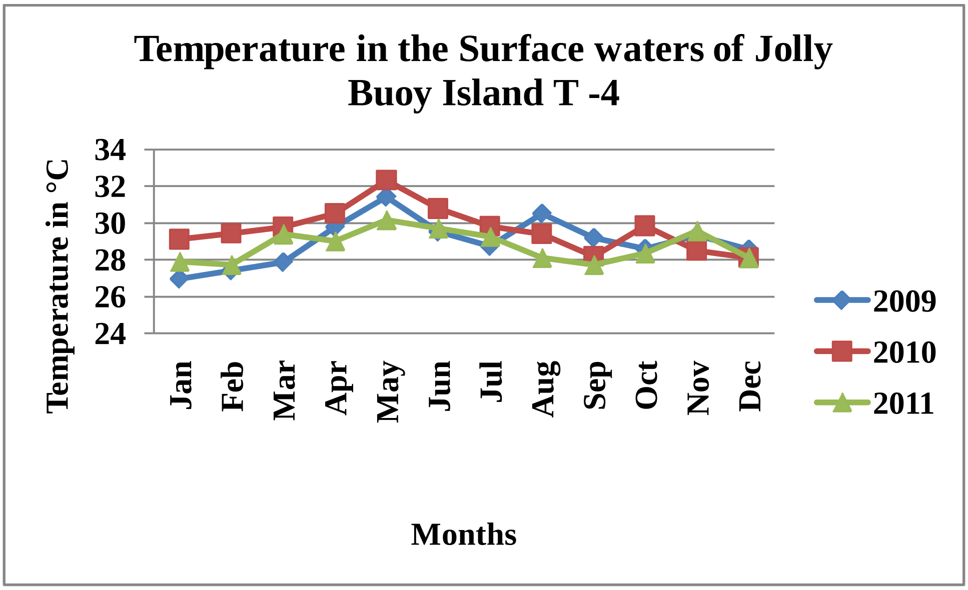

Fig. 5: A. Temperature in Transect 4 of Jolly Buoy Island-Surface Waters

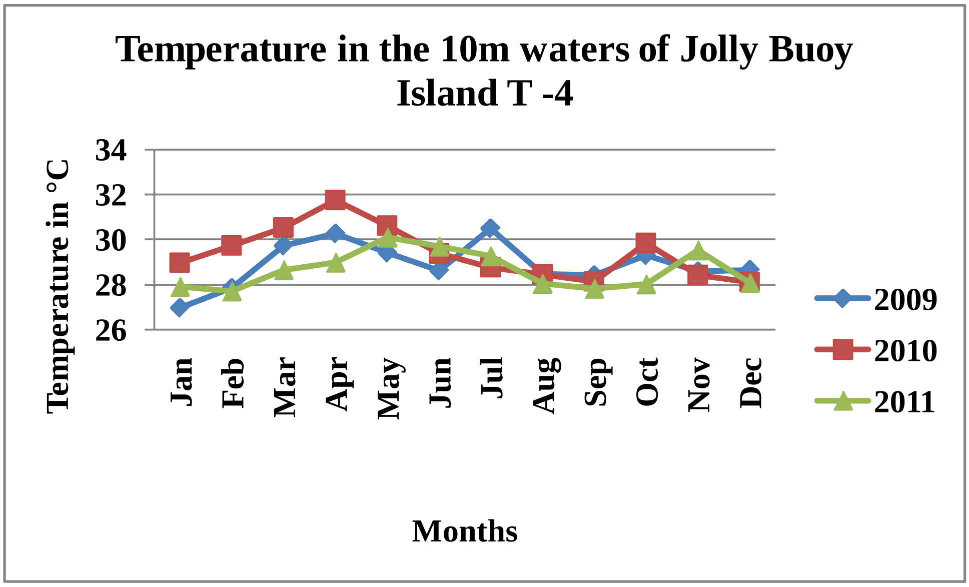

Fig. 5: B. Temperature in Transect 4 of Jolly Buoy Island-10m Waters

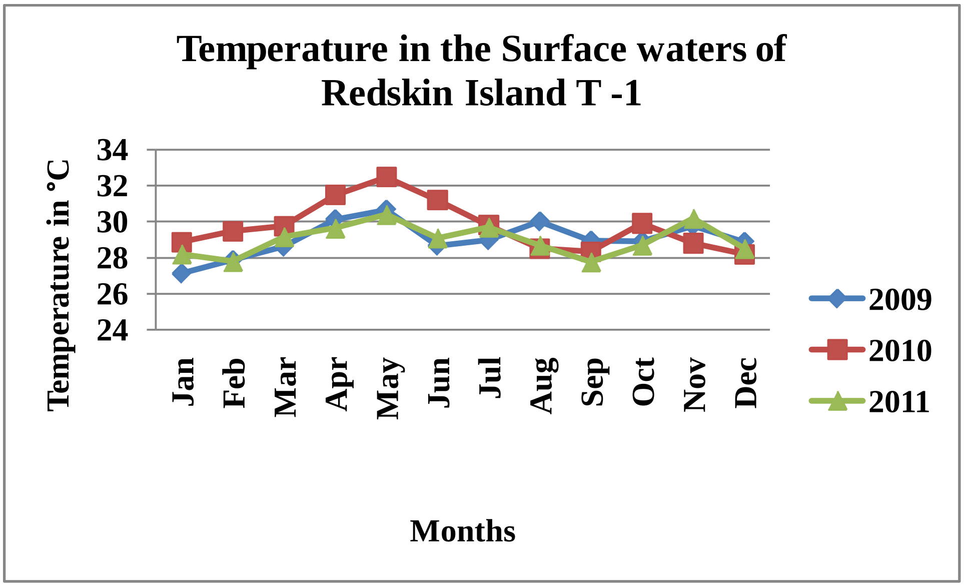

Fig. 6: A. Temperature in Transect 1 of Redskin Island-Surface Waters

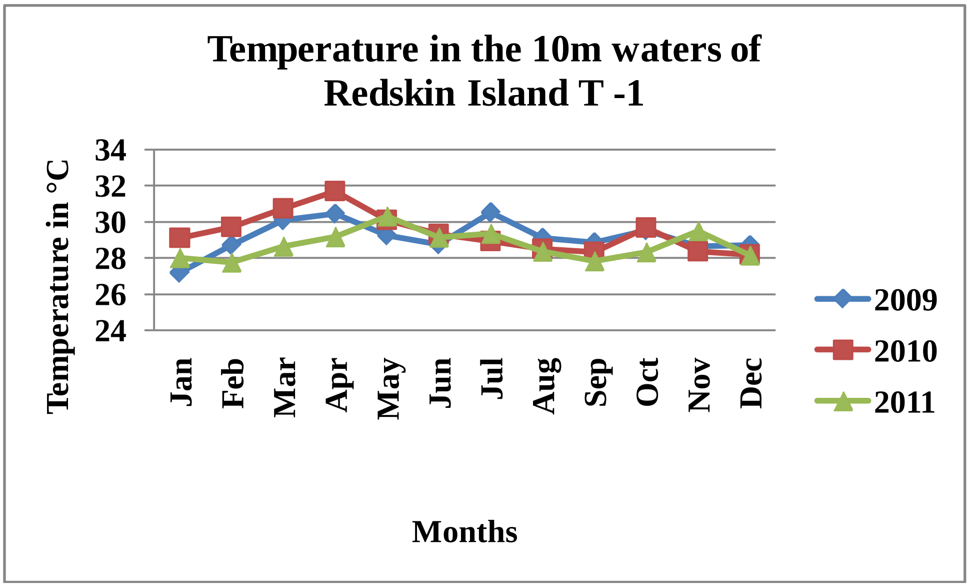

Fig. 6: B. Temperature in Transect 1 of Redskin Island-10m Waters

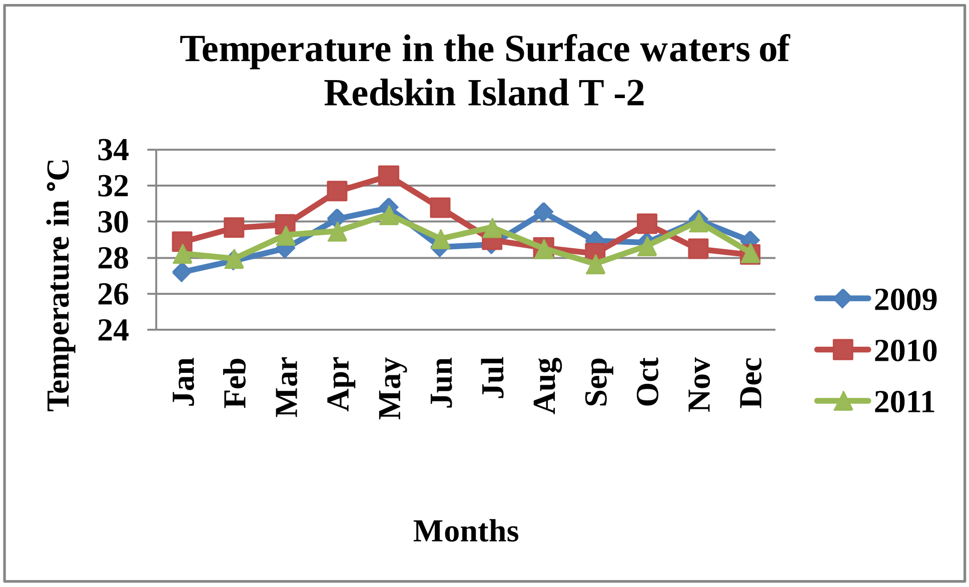

Fig. 7: A. Temperature in Transect 2 of Redskin Island-Surface Waters

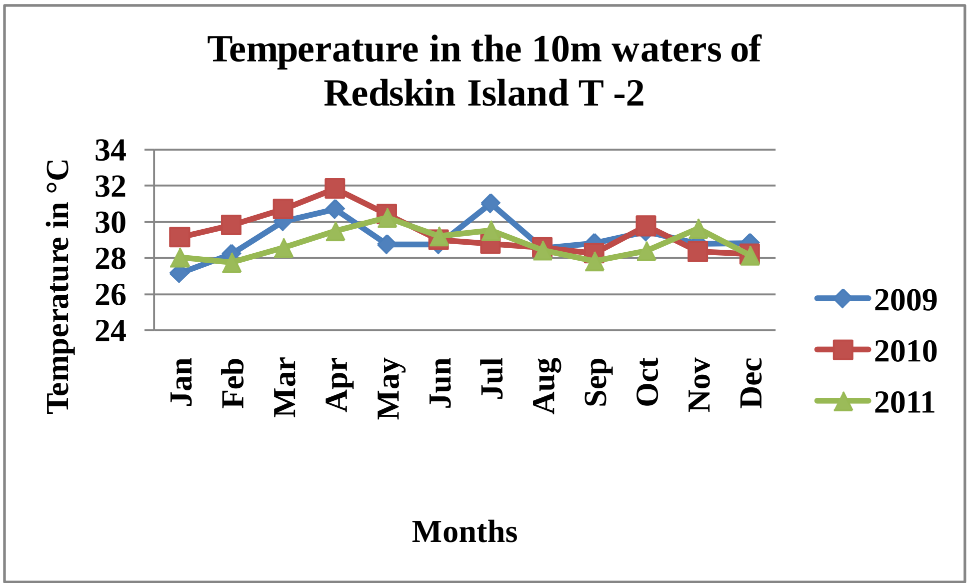

Fig. 7: B. Temperature in Transect 2 of Redskin Island-10m Waters

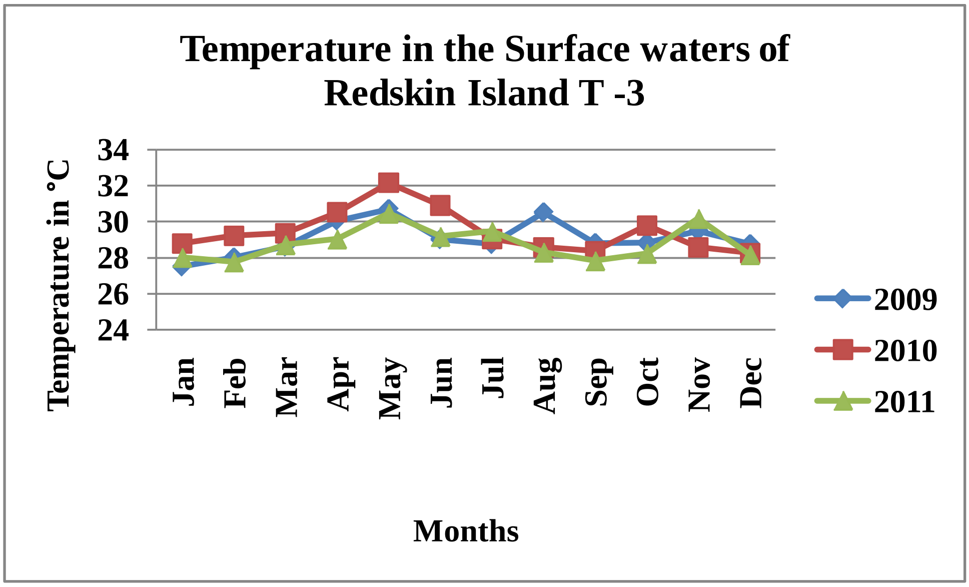

Fig. 8: A. Temperature in Transect 3 of Redskin Island-Surface Waters

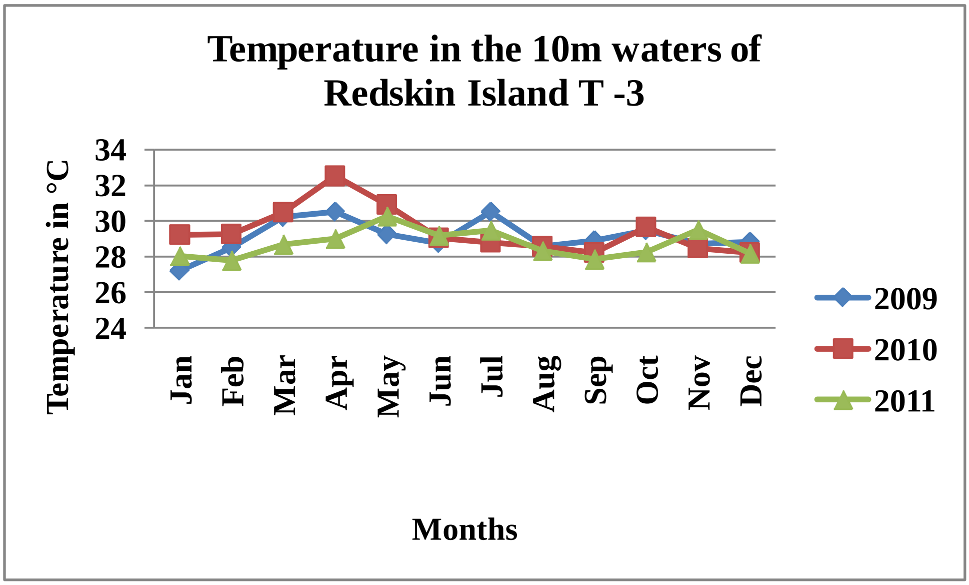

Fig. 8: B. Temperature in Transect 3 of Redskin Island-10m Waters

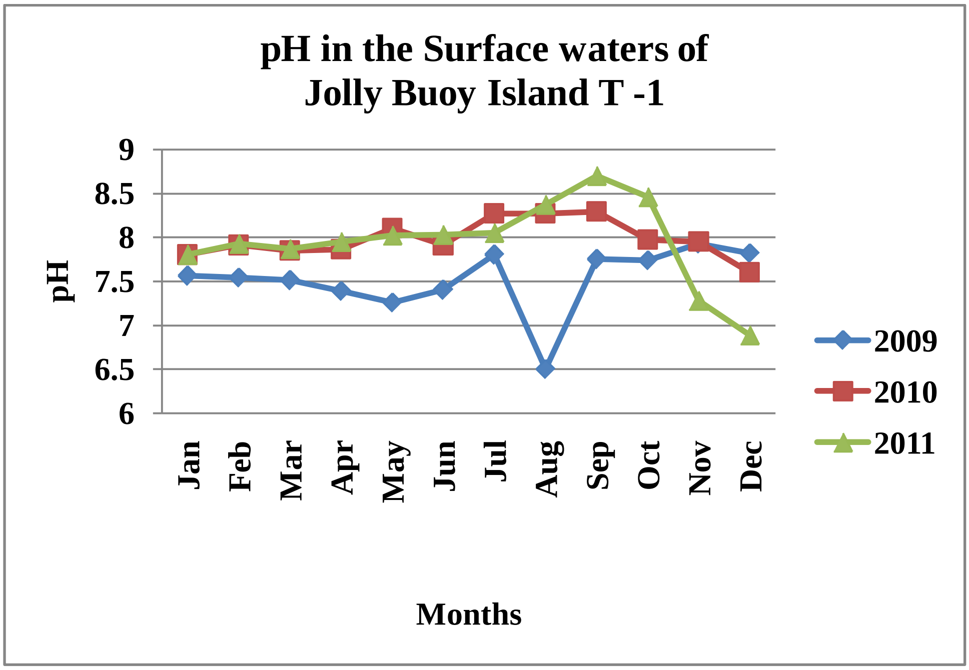

Fig. 9: A. pH in Transect 1 of Jolly Buoy Island-Surface Waters

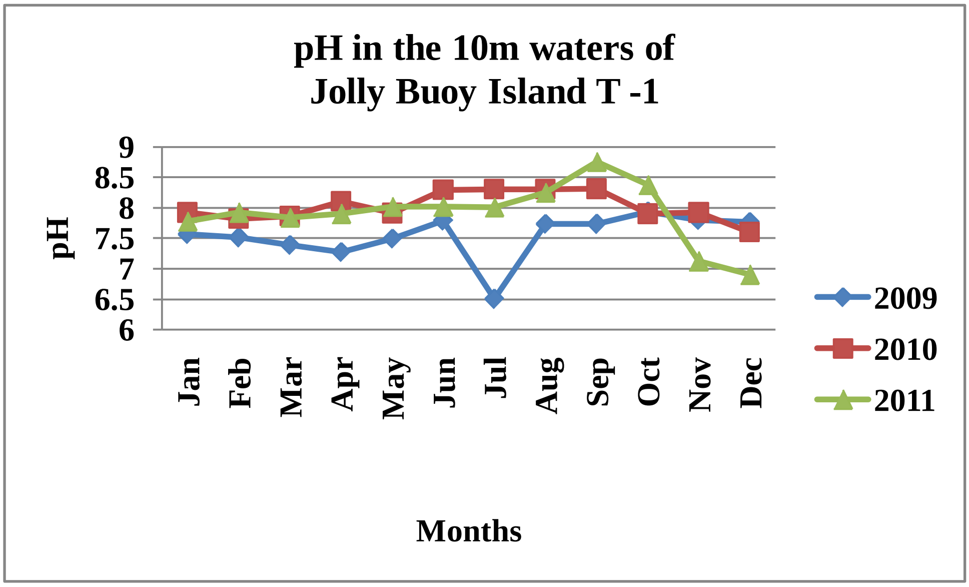

Fig. 9: B. pH in Transect 1 of Jolly Buoy Island-10m Waters

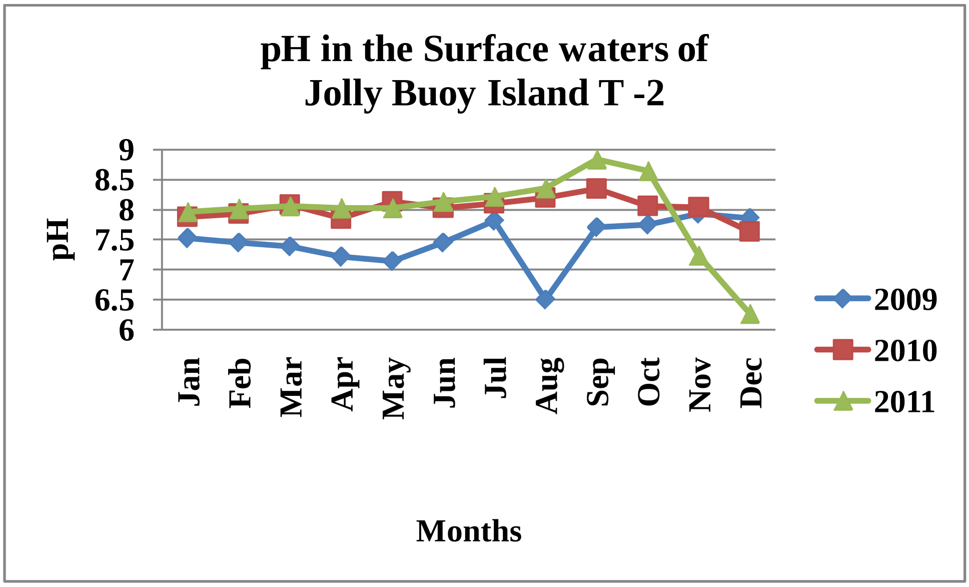

Fig. 10: A. pH in Transect 2 of Jolly Buoy Island-Surface Waters

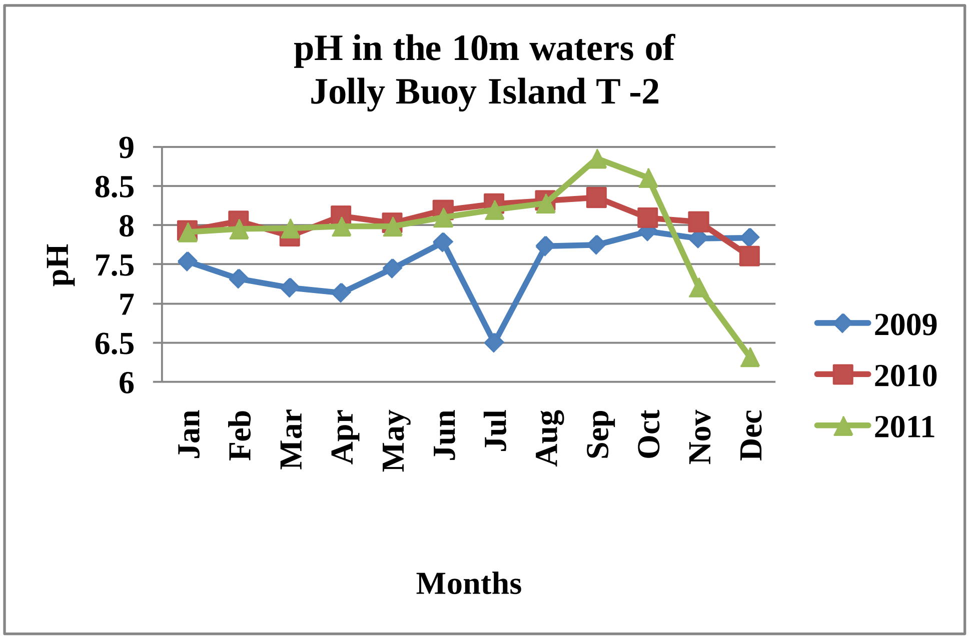

Fig. 10: B. pH in Transect 2 of Jolly Buoy Island-10m Waters

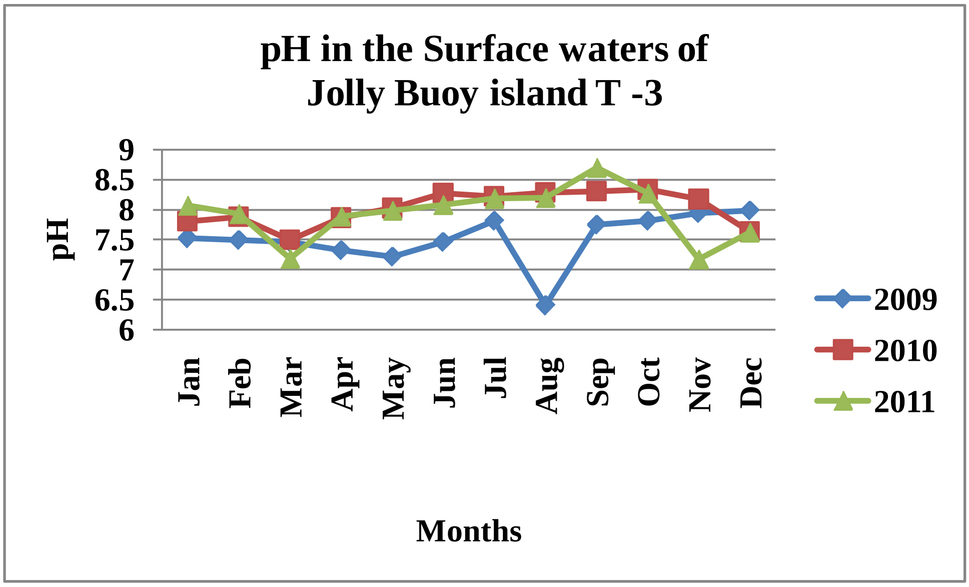

Fig. 11: A. pH in Transect 3 of Jolly Buoy Island-Surface Waters

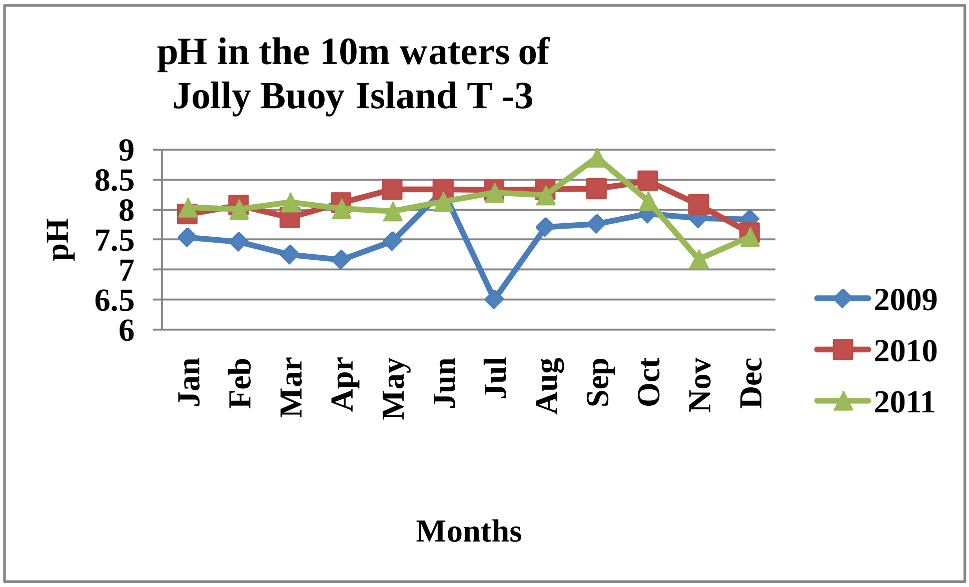

Fig. 11: B. pH in Transect 3 of Jolly Buoy Island-10m Waters

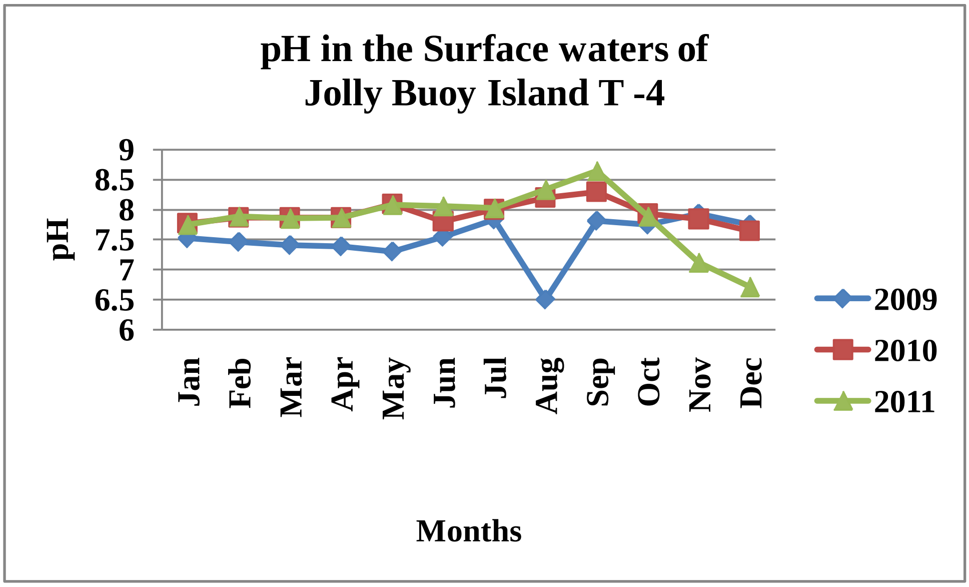

Fig. 12: A. pH in Transect 4 of Jolly Buoy Island-Surface Waters

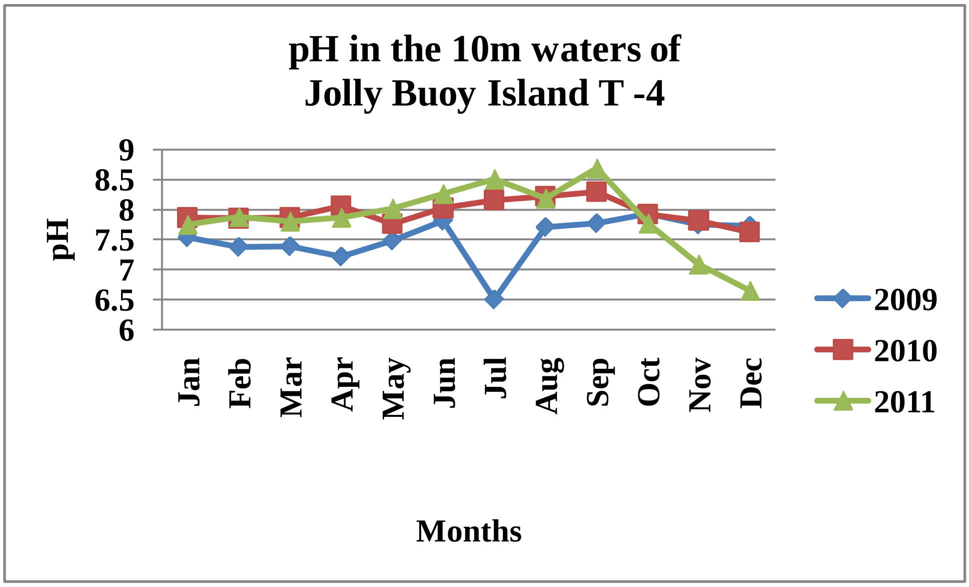

Fig. 12: B. pH in Transect 4 of Jolly Buoy Island-10m Waters

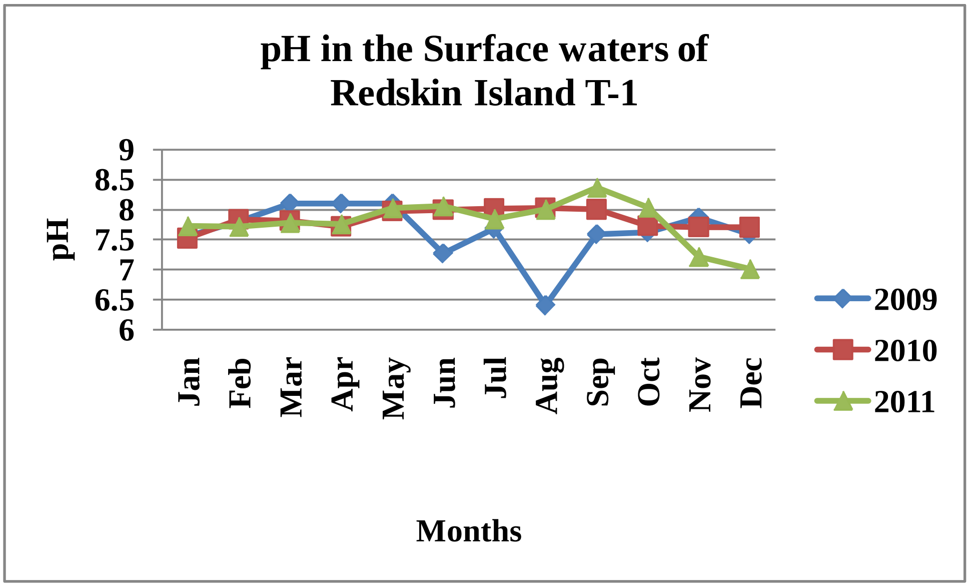

Fig. 13: A. pH in Transect 1 of Redskin Island-Surface Waters

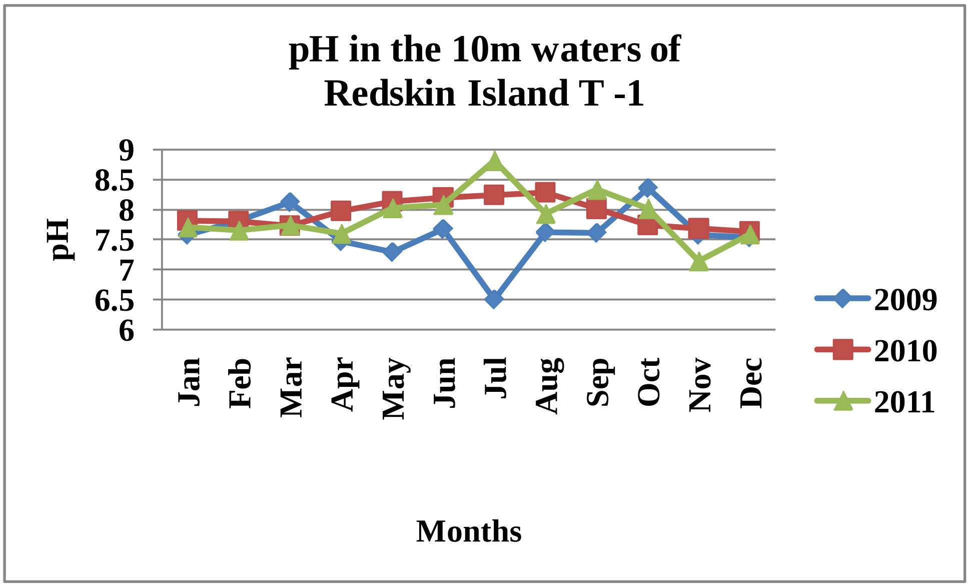

Fig. 13: B. pH in Transect 1 of Redskin Island-10m Waters

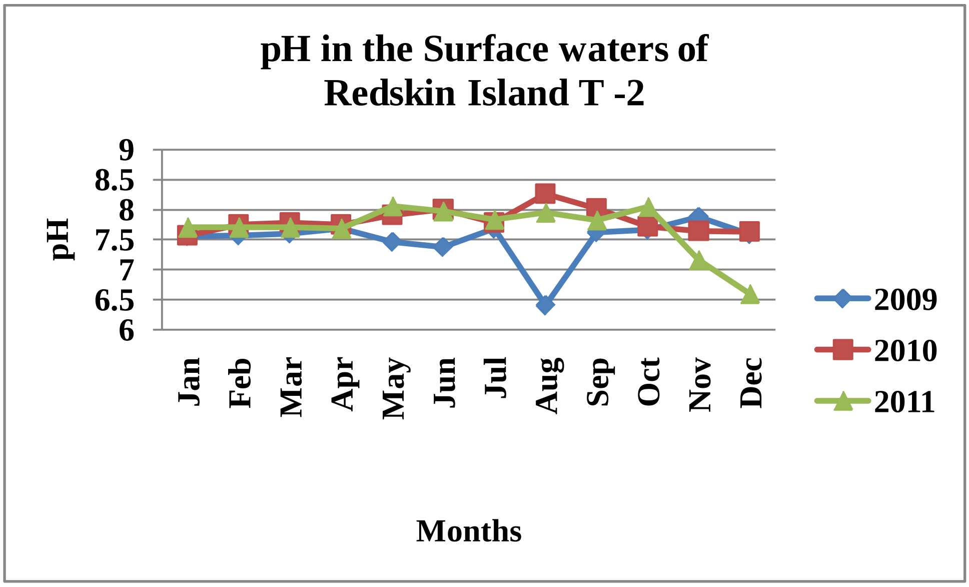

Fig. 14: A. pH in Transect 2 of Redskin Island-Surface Waters

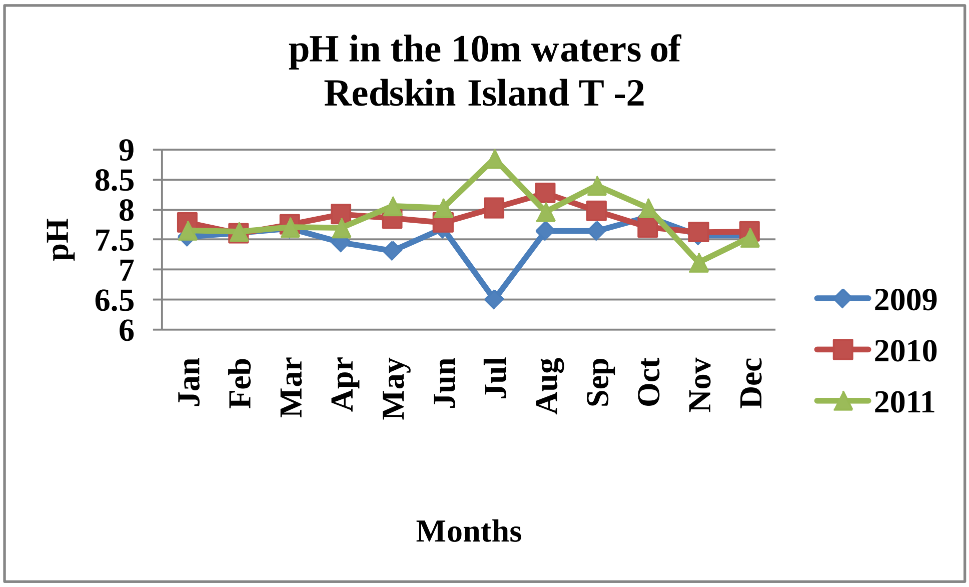

Fig. 14: B. pH in Transect 2 of Redskin Island-10m Waters

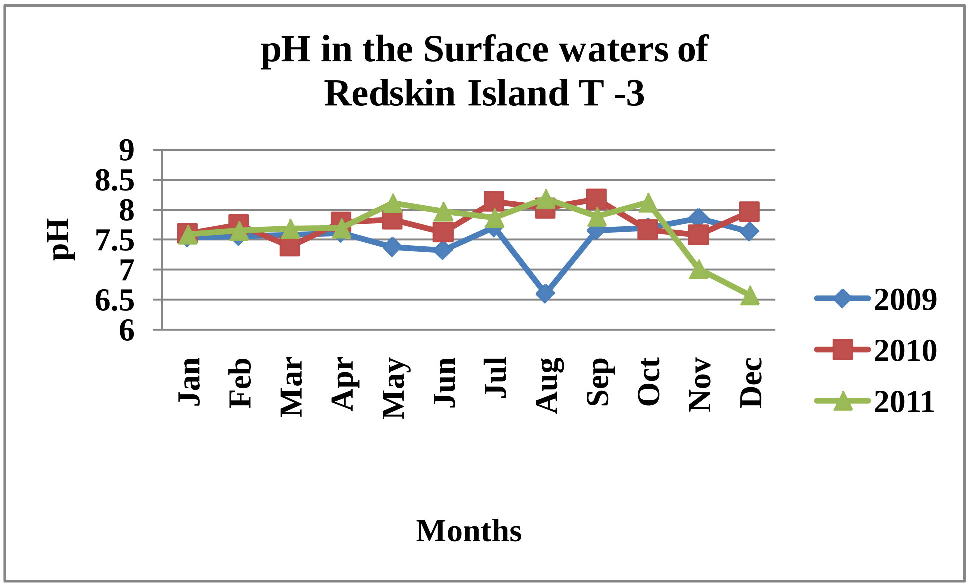

Fig. 15: A. pH in Transect 3 of Redskin Island-Surface Waters

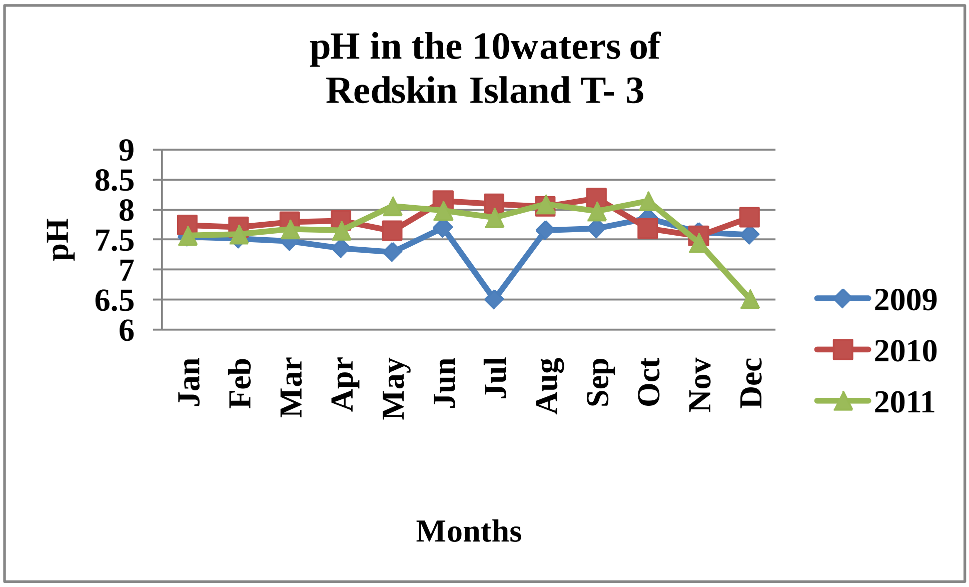

Fig. 15: B. pH in Transect 3 of Redskin Island-10m Waters

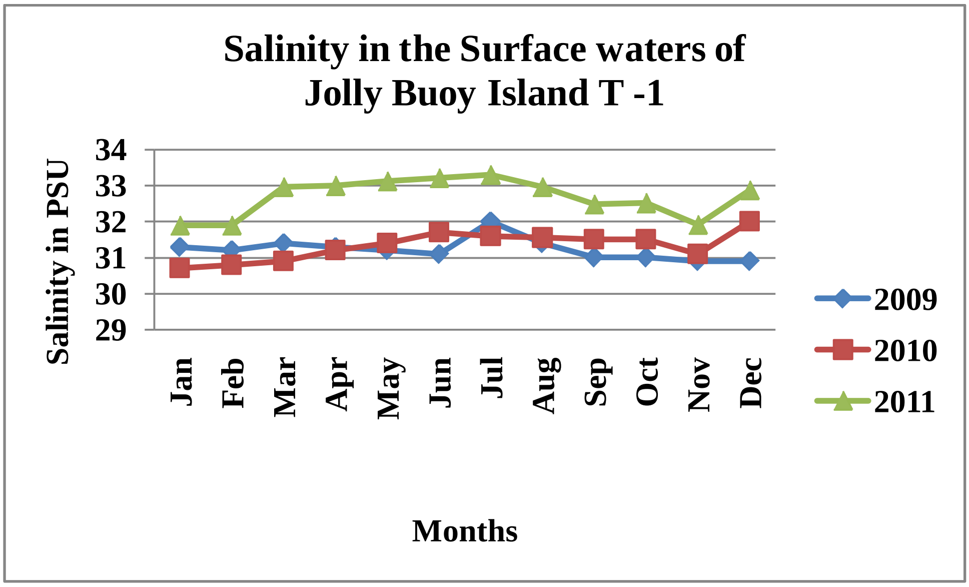

Fig. 16: A. Salinity in Transect 1 of Jolly Buoy Island-Surface Waters

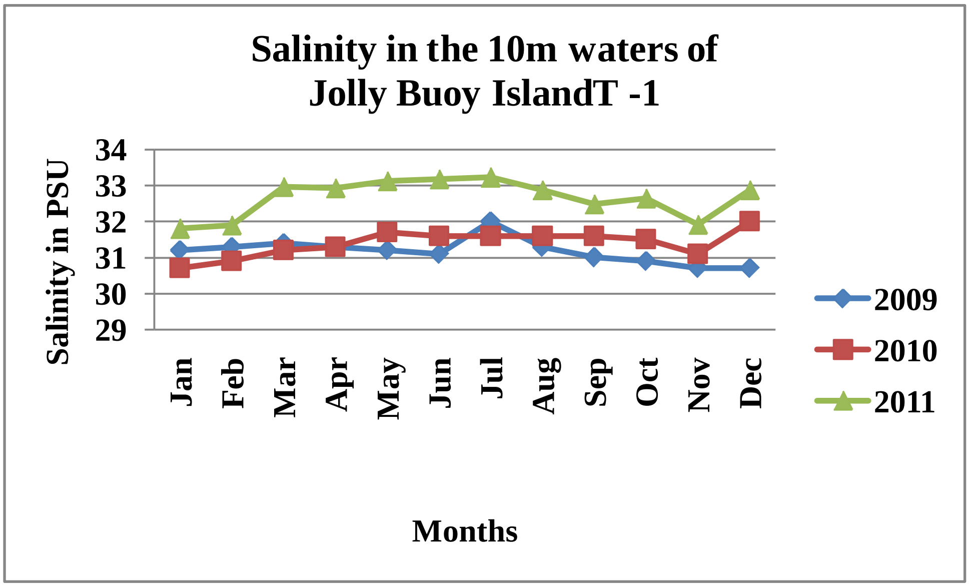

Fig. 16: B. Salinity in Transect 1 of Jolly Buoy Island-10m Waters

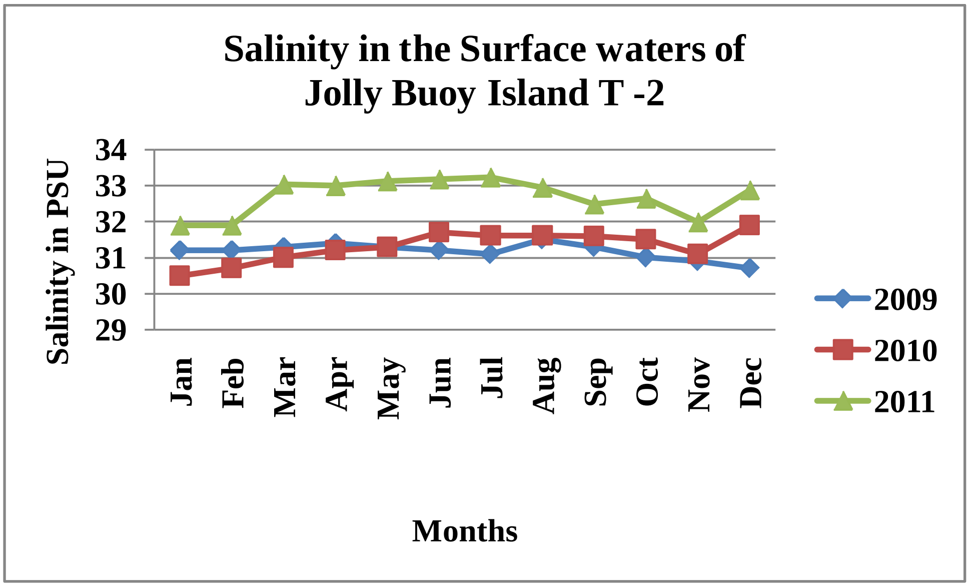

Fig. 17: A. Salinity in Transect 2 of Jolly Buoy Island-Surface Waters

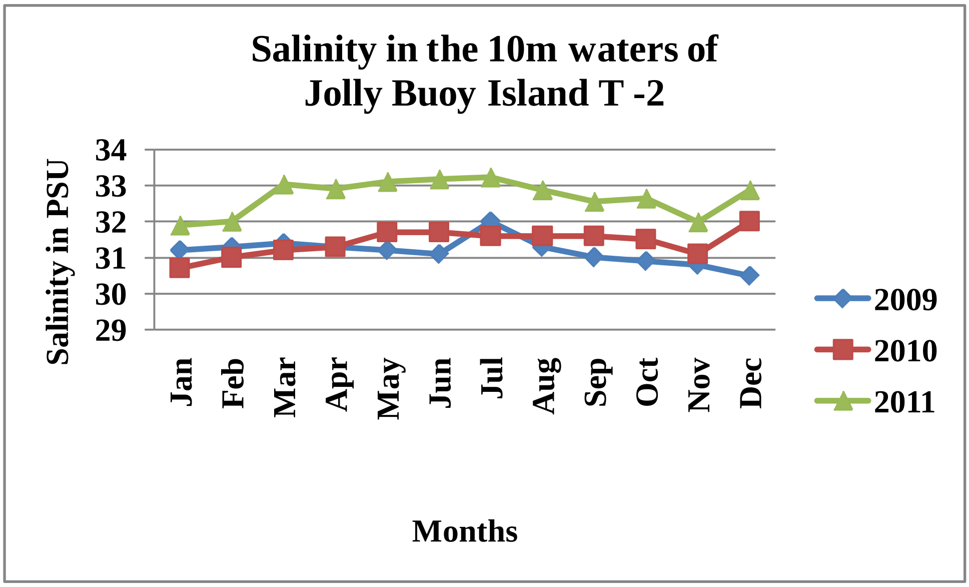

Fig. 17: B. Salinity in Transect 2 of Jolly Buoy Island-10m Waters

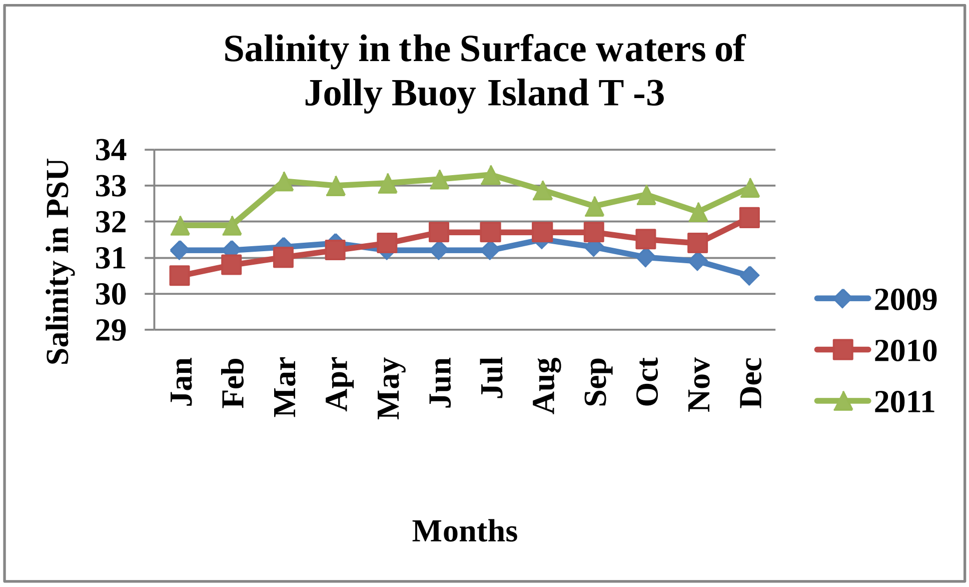

Fig. 18: A. Salinity in Transect 3 of Jolly Buoy Island-Surface Waters

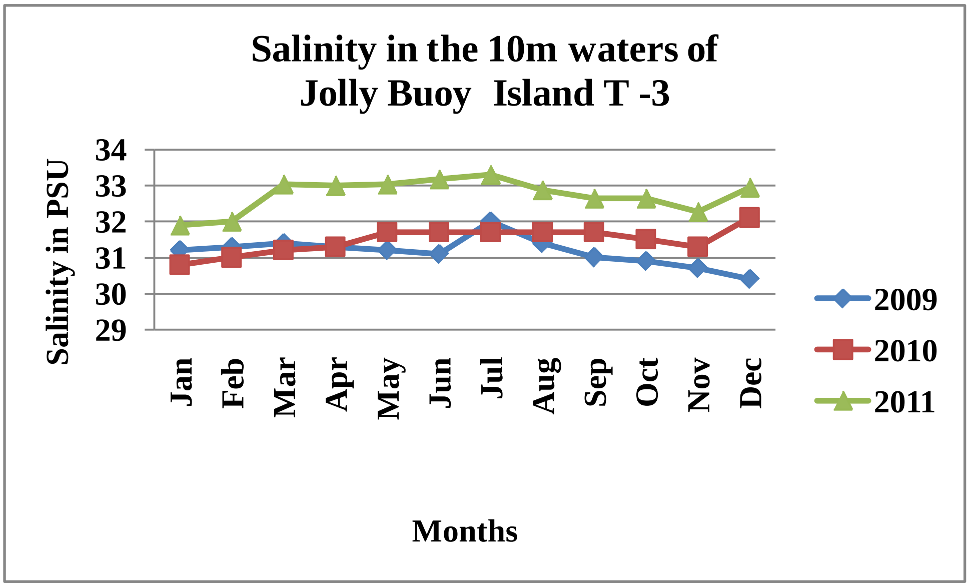

Fig. 18: B. Salinity in Transect 3 of Jolly Buoy Island-10m Waters

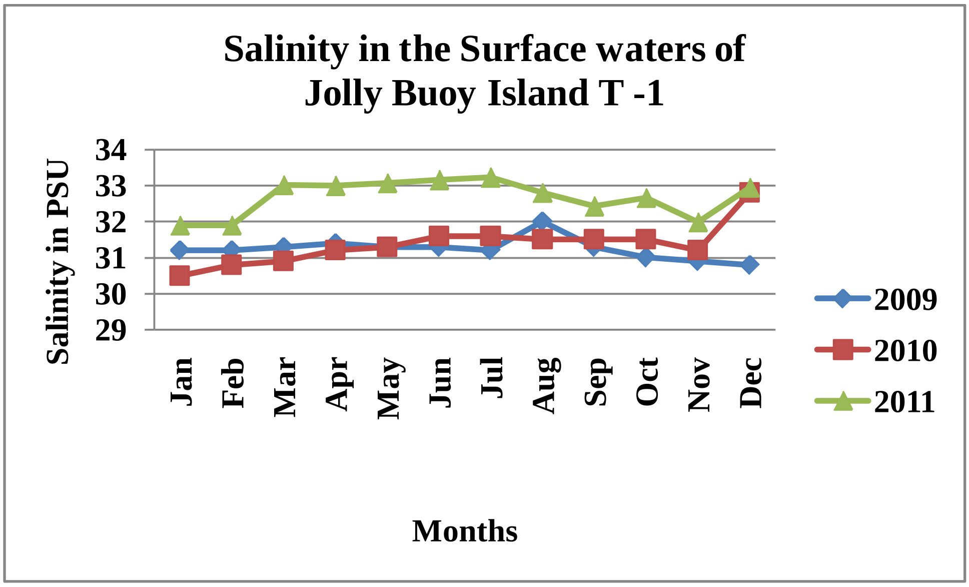

Fig. 19: A. Salinity in Transect 4 of Jolly Buoy Island-Surface Waters

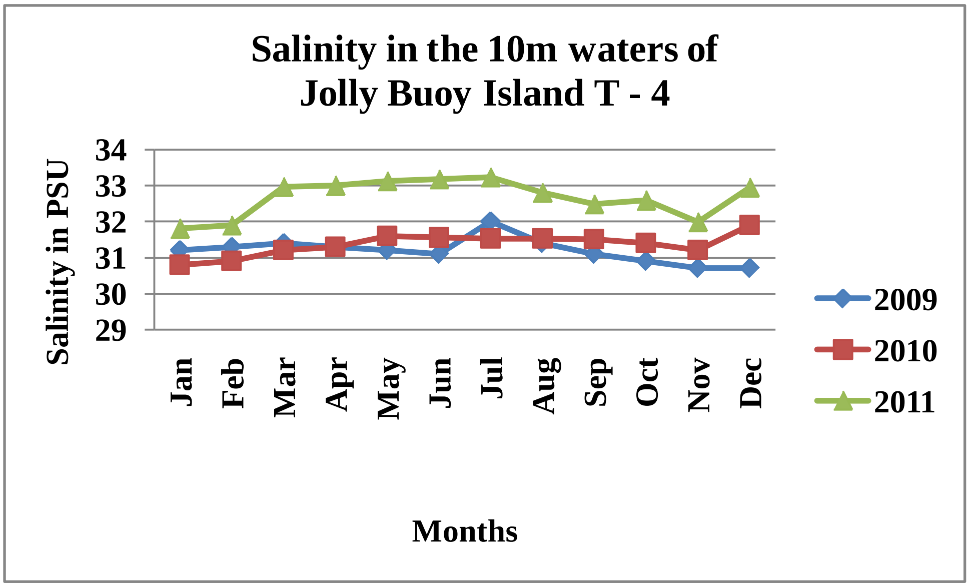

Fig. 19: B. Salinity in Transect 4 of Jolly Buoy Island-10m Waters

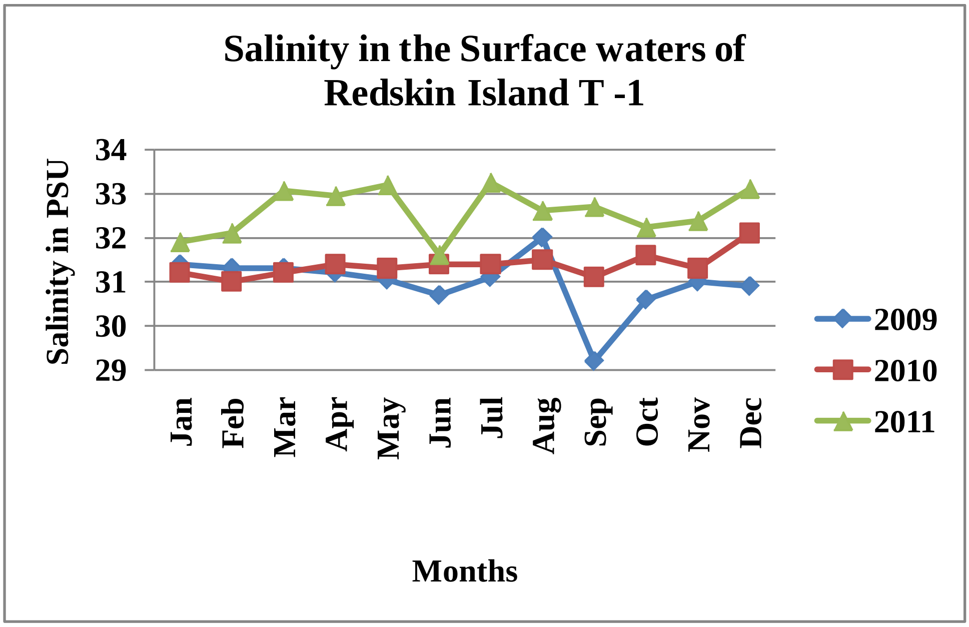

Fig. 20: A. Salinity in Transect 1 of Redskin Island-Surface Waters

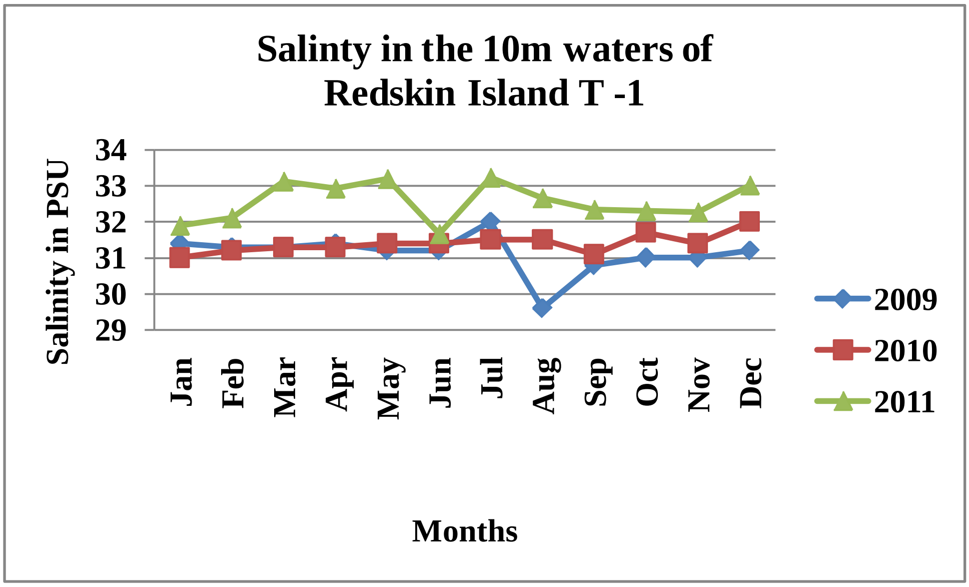

Fig. 20: B. Salinity in Transect 1 of Redskin Island-10m Waters

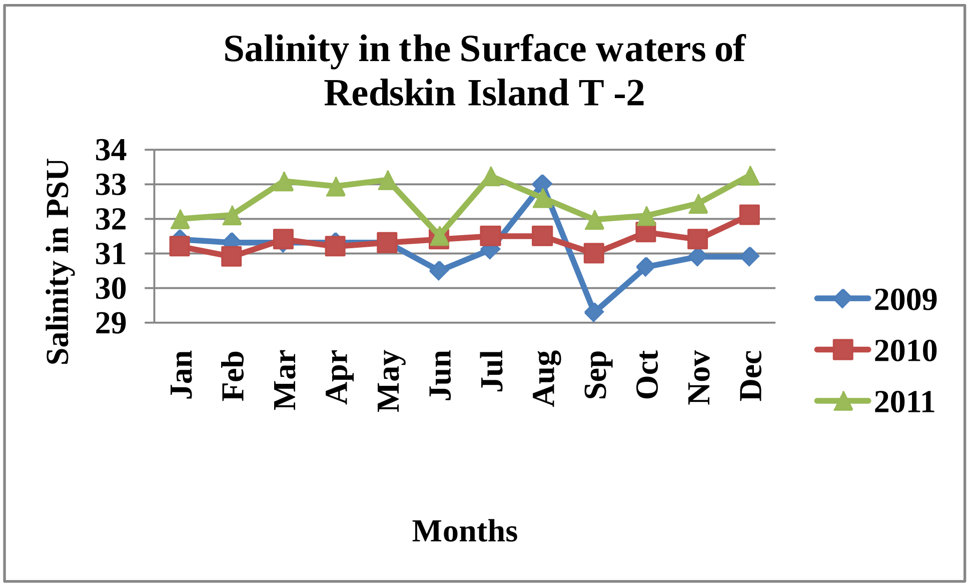

Fig. 21: A. Salinity in Transect 2 of Redskin Island-Surface Waters

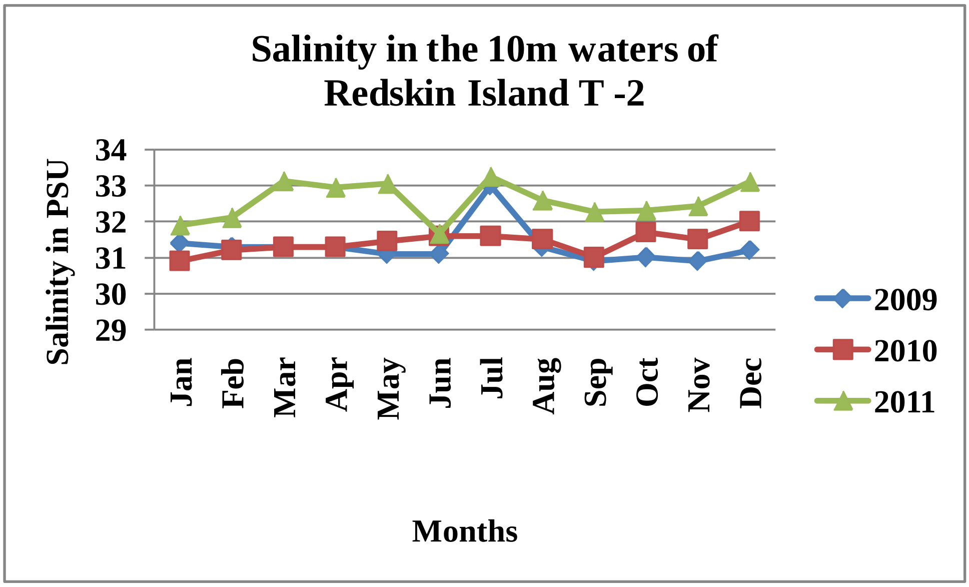

Fig. 21: B. Salinity in Transect 2 of Redskin Island-10m Waters

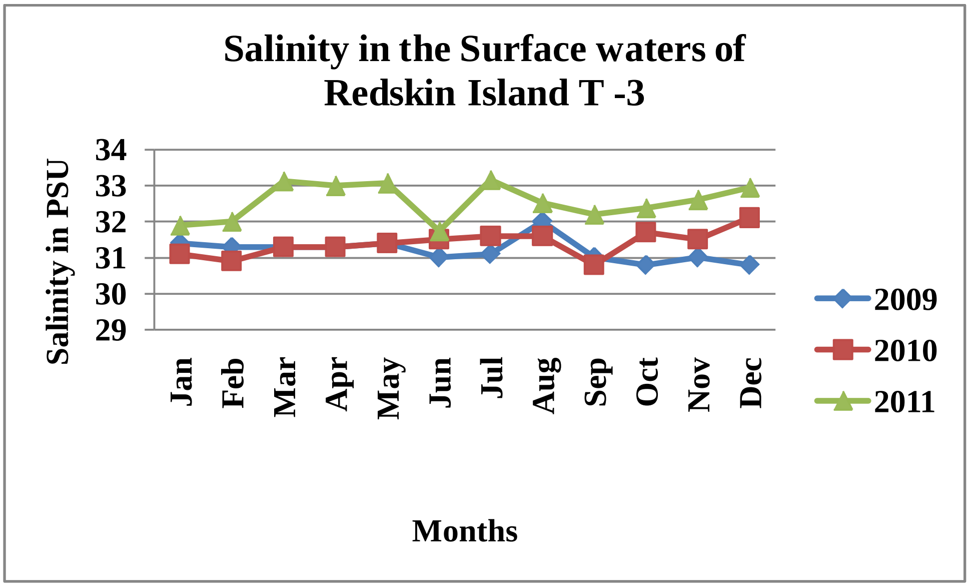

Fig. 22: A. Salinity in Transect 3 of Redskin Island-Surface Waters

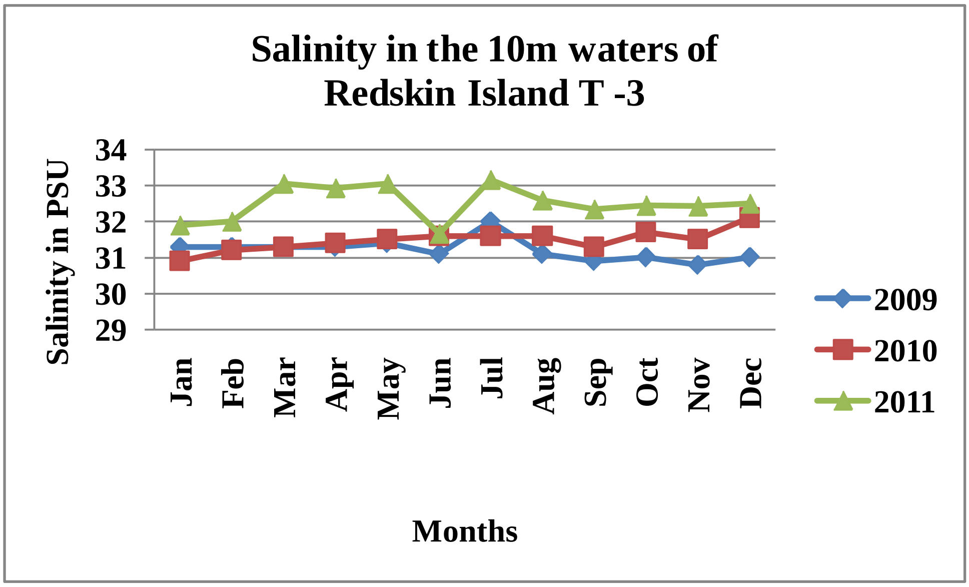

Fig. 22: B. Salinity in Transect 3 of Redskin Island-10m Waters

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Population Dynamics Study of Ribbonfish, *Lepturacanthus savala* from the North-Eastern Tip of Bay of Bengal

By K. M. Shahriar Nazrul, Al Mamun, Md Abdullah Al-Mamun, Suman Barua & Md. Sharif Uddin

Abstract- Land-based survey data were collected from two major fish landing centers of south-east Bangladesh. A total of 1,770 *Lepturacanthus savala in* dividuals were collected for length-frequency and length-weight analysis. The asymptotic length ($L\infty$), growth coefficient (k), theoretical age with length at zero (t_0) and growth performance index (Ø') were estimated to be 111 cm, 0.34 year^{-1}, -0.34 year and 3.622 respectively. Based on the growth parameters total mortality (*Z*), natural mortality (*M*) and fishing mortality (*F*) was found 1.09 year^{-1}, 0.611 year^{-1}, and 0.479 year^{-1} respectively. The exploitation rate (*E*) using the length converted catch curve was found as 0.43 year^{-1} which denotes that the studied population is not in over-exploited condition. Recruitment pattern revealed the peak in July. Length-weight relationship of L. savala was established as $W = 0.0381\ TL^{2.1194}$ where $R^2 = 0.8697$.

Keywords: population dynamics; lepturacanthus savala; bay of bengal.

GJSFR-E Classification: FOR Code: 150799

Population Dynamics Study of Ribbonfish, *Lepturacanthus savala* from the North-Eastern Tip of Bay of Bengal

K. M. Shahriar Nazrul [α], Al Mamun [σ], Md Abdullah Al-Mamun [ρ], Suman Barua [Ѡ] & Md. Sharif Uddin[¥]

Abstract- Land-based survey data were collected from two major fish landing centers of south-east Bangladesh. A total of 1,770 *Lepturacanthus savala* individuals were collected for length-frequency and length-weight analysis. The asymptotic length ($L\infty$), growth coefficient (k), theoretical age with length at zero (t_0) and growth performance index ($Ø'$) were estimated to be 111 cm, 0.34 year^{-1}, -0.34 year and 3.622 respectively. Based on the growth parameters total mortality (Z), natural mortality (M) and fishing mortality (F) was found 1.09 year^{-1}, 0.611 year^{-1}, and 0.479 year^{-1} respectively. The exploitation rate (E) using the length converted catch curve was found as 0.43 year^{-1} which denotes that the studied population is not in over-exploited condition. Recruitment pattern revealed the peak in July. Length-weight relationship of *L. savala* was established as $W = 0.0381\ TL^{2.1194}$ where $R^2 = 0.8697$.

Keywords: population dynamics; lepturacanthus savala ; bay of bengal.

I. INTRODUCTION

Lepturacanthussavala (Cuvier, 1829), commonly known as Ribbon fish or locally as '*Churimach*' is one of the most abundant species in the marine waters of Bay of Bengal Bangladesh part. It is unique for the shape that resembles like a snake, but highly compressed and has a ribbon-like body with silvery in color. The species is benthopelagic and amphidromous (Riede, 2004) and found in tropical waters (Nakamura and Parin, 1993) along the coastal waters of Indo-west Pacific and Indian Ocean (Bianchi, 1985; Nakamura and Parin, 1993). The species is highly carnivorous and predominantly piscivorous feeding both during day and night. The favored food items of *L. savala* includes a variety of small fishes (mostly of the anchovy type, e.g., *Anchoviella)*, prawns and shrimps (e.g., *Acetes*) (James, 1967; Abdussamad, 2006; Mustafa and Begum, 1994).The fish is popular in dry form to the people of Bangladesh and also exported to the countries like UK, Singapore, Middle-East and SriLanka (Mustafa *et al*., 2000).

Very few works have been done for the population dynamics study of *L. savala* in Bay of Bengal Bangladesh part. However, some of the discrete attempts have been taken by Ashraful (1998), Mustafa *et al*. (2000) and Khan *et al*. (2003) to study the growth, mortality and length-weight relationship of the species. Therefore, the objective of this research is to study the growth and mortality parameters along with recruitment pattern and length-weight relationship of *L. savala* using the length frequency data.

II. MATERIALS AND METHODS

a) Study area and duration

The study was conducted in two major fish landing centers of the south-eastern part of Bangladesh (north-eastern tip of Bay of Bengal). The red circle in the map shows the '*Fishery ghat*' landing center (22^{0}19'38.33"N and 91^{0}50'50.15"E) in Chittagong district and the yellow circle designates the 'BFDC *Fishery ghat*' landing center (21^{0}27'04.05"N and 91^{0}58'16.62"E) in Cox's Bazar district (Fig. 1). Data were collected throughout the 24 months tenure from January/16 to December/17 to get an ideal picture of the landing trend and to avoid the bias of length-frequency distribution.

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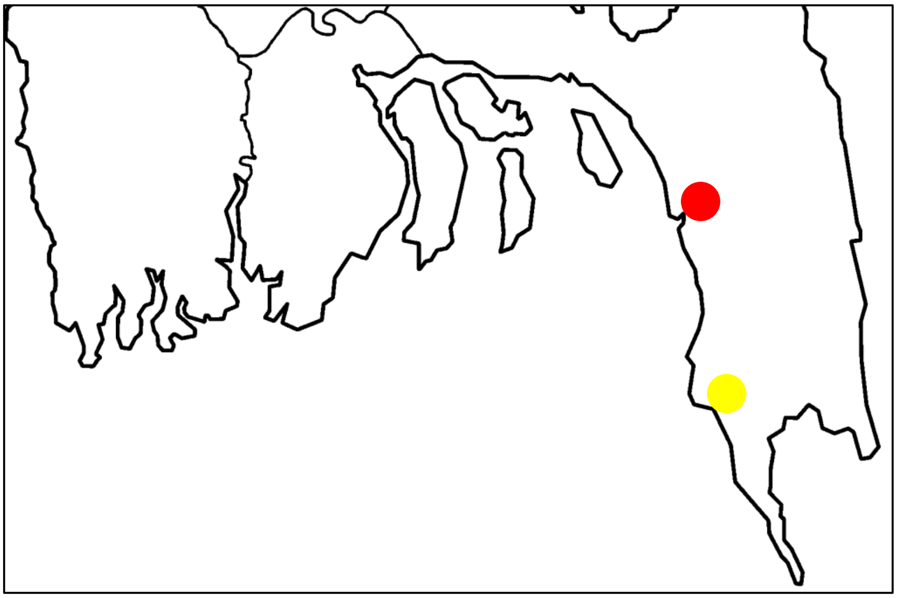

Fig. 1: Red and yellow circles are showing the data collection sites of the present study

b) Data collection

Landing-based data were collected for eight days/month in both the stations throughout the study period. Here selection was like that in every full moon period two days and in every new moon period two days data will be collected. In between full moon and new moon two days, and between new moon and full moon another two days data will be obtained (Fig. 2). This sampling technique was done to avoid sampling error and biases. Moreover, everyday catch composition, length-frequency and length-weight data were collected randomly from two mechanized boats.

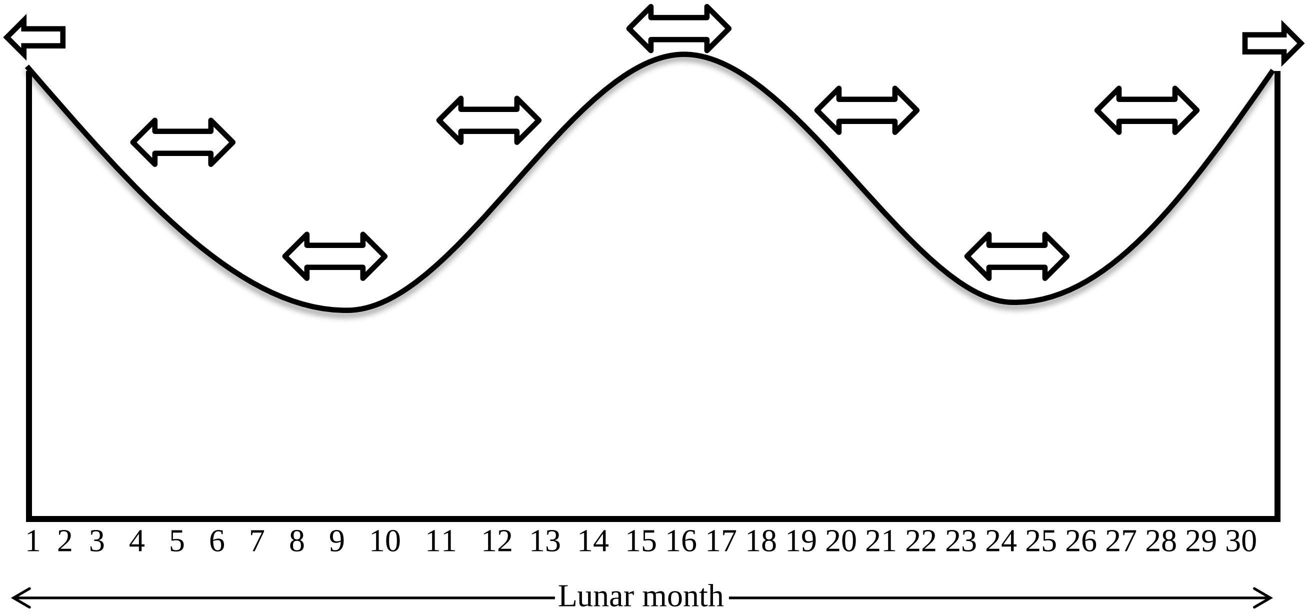

Fig. 2: Arrows are showing the land-based data collection duration in an ideal lunar month where waves are denoting the tidal action due to the full and new moon

III. DATA ANALYSIS

Length-frequency data of *L. savala* were analyzed by FISAT II (FAO-ICLARM stock assessment tool, Gayanilo *et al*., 2003) for the estimation of growth and mortality parameters. However, the length-weight relationship was established on Microsoft Excel version 10.

a) Growth

Von Bertalanffy's growth function (VGBF) was used to estimate the length with age:

$$Lt = L\infty(1 - \exp(-k\ (t-t_0)))$$

Where Lt is the length at age t, $L\infty$ is the asymptotic length, K is the growth coefficient, and t_0 is the theoretical age at zero length (Haddon, 2011) which can be calculated using the empirical equation of Pauly (1983):

$$\log_{10}(-t_0) = -0.3922 - 0.275 \log_{10} L\infty - 1.0381 \log_{10} k$$

Growth performance index (Ø') was calculated according to the formula of Pauly and Munro (1984):

$$Ø' = \log_{10} K + 2 \log_{10} L\infty$$

b) Mortality

The annual total mortality rates (*Z*) were estimated by the length-converted catch curve analysis method of Pauly (1983):

$$\ln(Ni / \Delta ti) = a + bti$$

Where *Ni* is the number of fish in length class i, Δ*ti* is the time needed for the fish to grow through length class i, *ti* is the age (or the relative age, computed with $t_0 = 0$) corresponding to the mid-length of class i, and where *b* is an estimate of *Z*. Natural mortality was estimated by Pauly's empirical formula:

$$\log_{10}(M) = 0.006 - 0.279 \log_{10}(L\infty) + 0.654 \log_{10}(k) + 0.6434 \log_{10}(T)$$

Where *L*∞ is in cm and *K* is in per year. *T* is the annual average sea surface temperature. Fishing mortality (*F*) is estimated by subtracting (*M*) from (*Z*), the exploitation ratio E is calculated from *F*/*Z*.

c) Length-weight relationship

For the estimation of length-weight relationship the power function was used:

$W = aL^b$

Where *W* is the weight of fish in gram, *L* is the length offish in centimeter, *a* is constant condition factor, and *b* is the slope.

IV. Results

a) Growth

Two years (2016 and 2017) land-based data were pooled month-wise, and 1,770 fish samples were clustered in 17 groups (7-125 cm) with seven units of class intervals (Fig. 3). Modal groups 42-48, 49-55 and 56-62 were found every month throughout the study period.

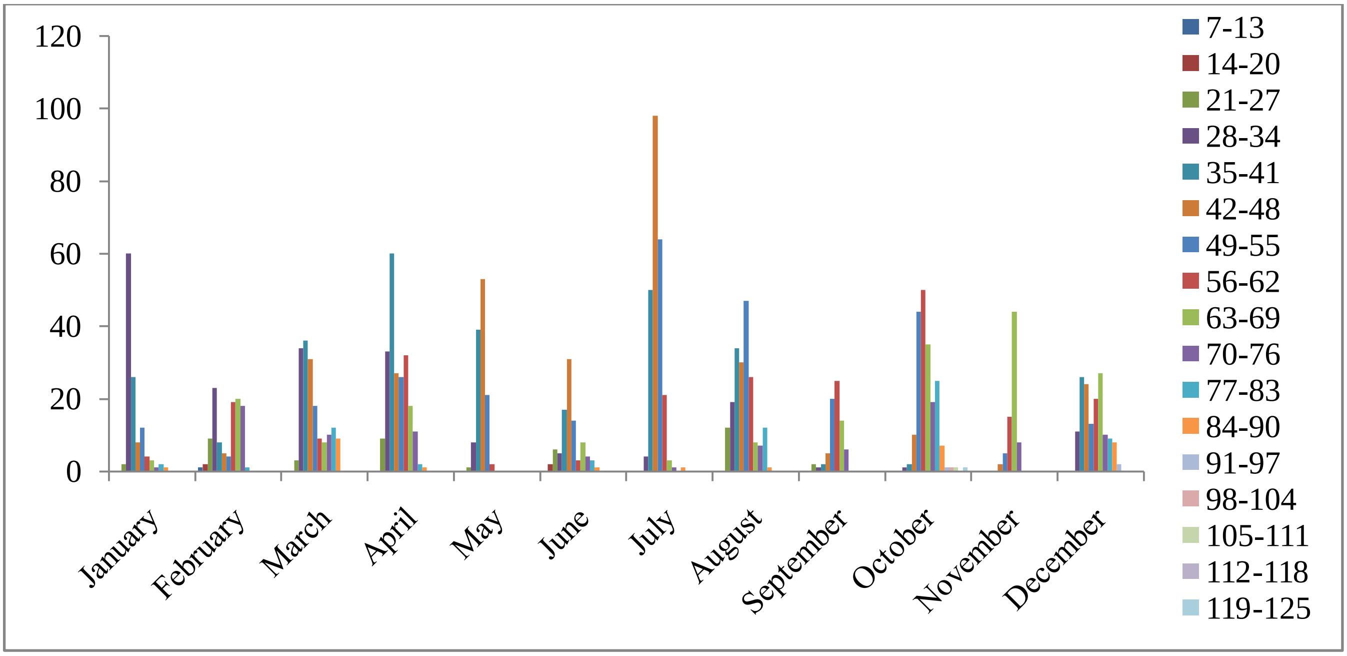

Fig. 3: Pooled month-wise length frequency distribution of *L. savala*

The calculated Von Bertalanffy's growth function (VGBF) parameters of *L. savala* using ELEFAN method in FISAT were $L\infty = 111$ cm, $k = 0.34$ year^{-1} (Fig. 4), $t_0 = -0.34$ year and Ø' = 3.622, while the estimated values of goodness of fit of model estimation Rn = 0.19.

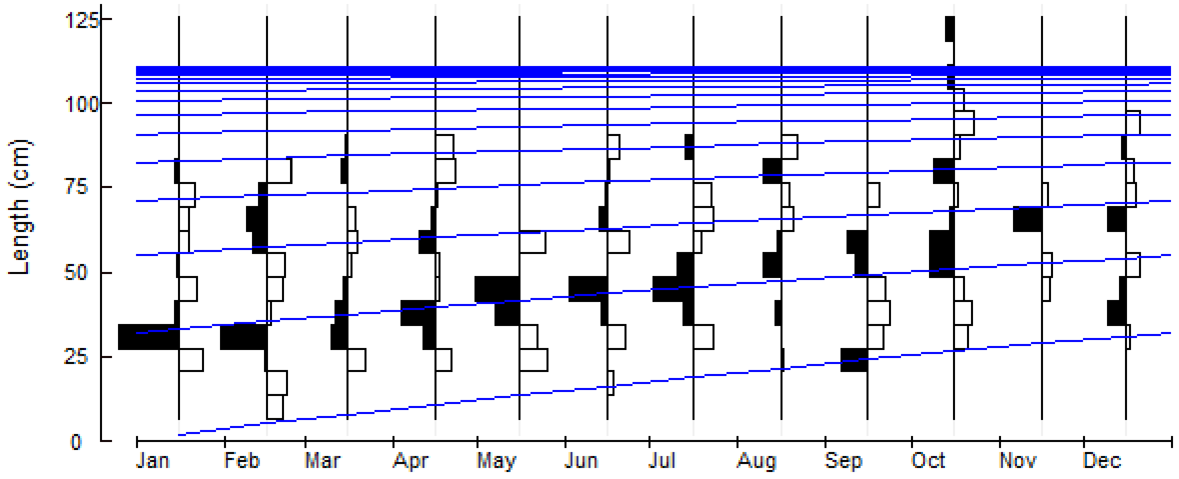

Fig. 4: Length-frequency distribution data and growth curves estimated using ELEFAN method for *L. savala*

b) Mortality and exploitation rate

The estimated rate of total mortality Z applying the length-converted catch curve analysis method for *L. savala* was $Z = 1.09$ year^{-1} (Fig. 5) and the natural mortality, $M = 0.611$ year^{-1} at an annual average sea surface temperature of 28°C in Bay of Bengal Bangladesh part during the study period while the rates of fishing mortality, $F = 0.479$ year^{-1}. Hence, exploitation ratio, $E = 0.43$ year^{-1}.

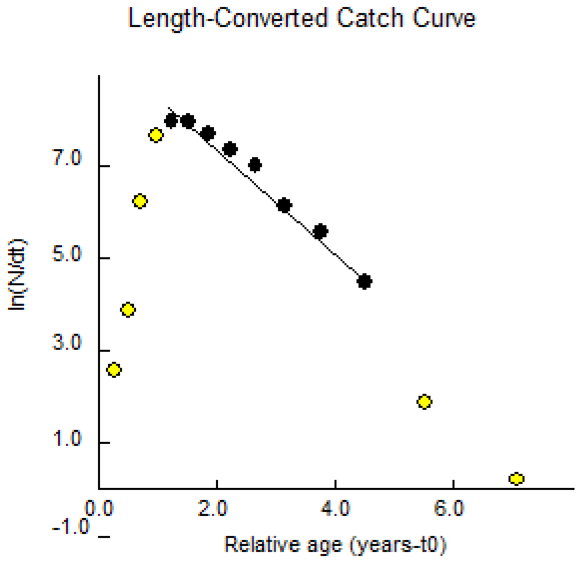

Fig. 5: Estimation of 'Z' by length converted catch curve method for *L. savala*

c) Recruitment

By pooling annual length-frequency, it was found that *L. savala* recruits almost throughout the year (Fig. 6). However, the main recruitment pulse was evident from June-September with the peak in July (20.21%).

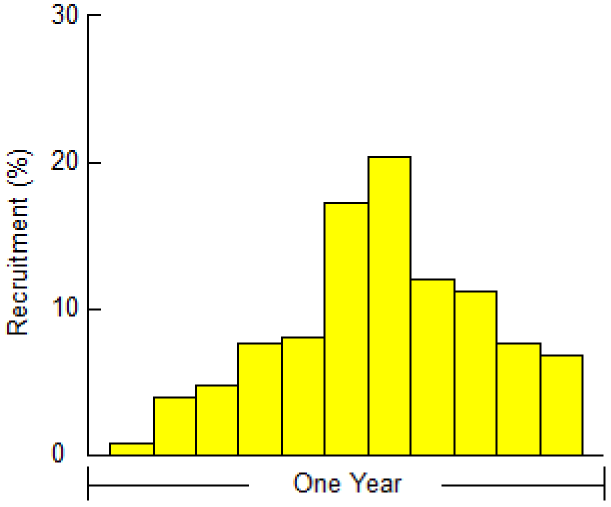

Fig. 6: Annual recruitment pattern of *L. savala* in the present study

d) Length-weight relationship

For length-weight relationship analysis, 1770 individuals were grouped according to length into 76 intervals, and their corresponding weights were averaged to get the standard weight of that length. The values of length-weight relationship for the *L. savala* were estimated as: a=0.0381, b= 2.1194 and R^2 = 0.870 (Fig. 7).

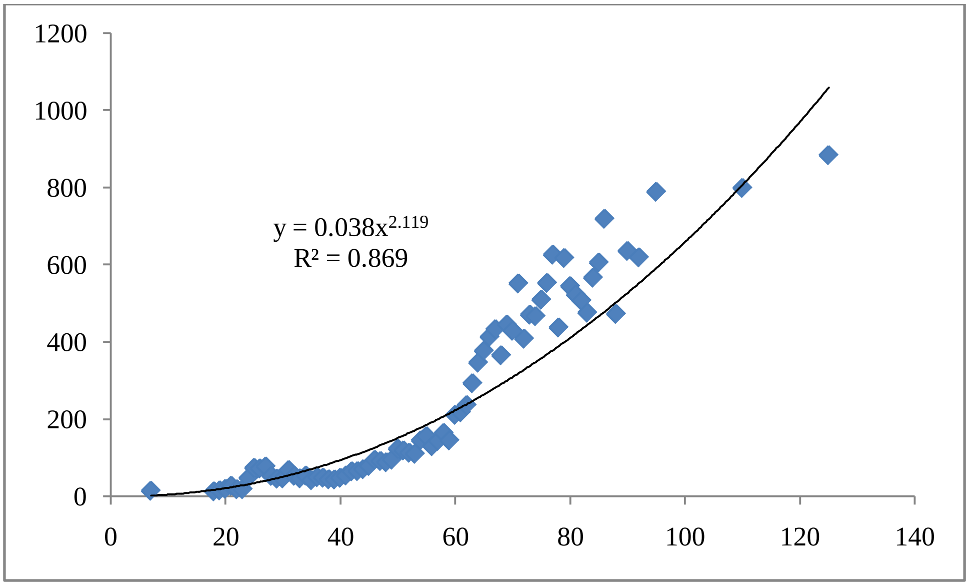

Fig. 7: Length-weight relationship of *L. savala* in the present study

V. Discussion

a) *Growth*

In the present study the length of *L. savala* varied from 7-125 cm and majority of individuals were observed within 28-69 cm range, where in the studies of Pakhmode *et al*. (2013) and Mustafa *et al*. (2000) size varied from 10-70 cm and 32-104 cm with maximum numbers within 20-60 cm and 56-70 cm respectively.

L∞ value of the present study was found close to the findings of Ashraful (1998), Khan *et al*. (2003) and Mustafa *et al*. (2000) whose sampling area was also the Bay of Bengal. However, the studies of Rizvi *et al*. (2010) and Pakhmode *et al*. (2013) revealed quite lower L∞ in Indian waters where Memon *et al*. (2016) found comparatively higher value in Pakistan (Table 1).

Growth coefficient (*k*) ranged from 0.13 to 0.87 year^{-1} and t_0 from -0.0003 to 0.0708 in different studies (Table 1). In this study, the *k* and t_0 value were found as 0.34 year^{-1} and -0.34year respectively.

Table 1: Comparison of growth parameters in studies of different authors

Author	Location	L∞	*k*	t_0	Method
Ashraful (1998)	Bay of Bengal	108	0.75	-	-
Rizvi *et al*. (2010)	Mumbai Coast	68.8	0.87	-0.0003	Length-frequency
Pakhmode *et al*. (2013)	Ratnagiri Coast	68.25	0.55	-0.0396	Length-frequency
Khan *et al*. (2003)	Bay of Bengal	105.4	0.68	-	Length-frequency
Memon *et al*. (2016)	Pakistan	133.4	0.13	-0.877	Length-frequency
Mustafa *et al*. (2000)	Bay of Bengal	106.50	0.80	0.0708	Length-frequency
Present study	Bay of Bengal	111.0	0.34	-0.34	Length-frequency

b) *Mortality and exploitation rate*

Total mortality (*Z*), natural mortality (*M*) and fishing mortality (*F*) were found 1.09 year^{-1}, 0.611 year^{-1}, and 0.479 year^{-1} respectively for *L. savala* in the present study. Comparatively higher mortality rates were found in all the previous studies of different authors except Memon *et al*. (2016) in Pakistan waters. The obtained value of the exploitation rate (E = 0.43) indicated that the said population was not in over-exploited condition.

Table 2: Comparison of mortality parameters in studies of different authors

Author	Location	*Z*	*M*	*F*
Ashraful (1998)	Bay of Bengal	2.58	*1.54*	1.04
Rizvi *et al*. (2010)	Mumbai Coast	4.15	1.3	2.85
Khan *et al*. (2003)	Bay of Bengal	2.03	0.98	1.05
Memon *et al*. (2016)	Pakistan	0.49	0.304	0.185
Present study	Bay of Bengal	1.09	0.611	0.479

c) *Recruitment*

Recruitment pattern of *L. savala* species in the present study reveals that the major pulse takes place in July. A similar trend was also observed in the studies of Mustafa *et al*. (2000) for *L. savala* and Fofandi (2012) for *Trichiurus lepturus*.

d) *Length-weight relationship*

The observed values of *a, b* and R^2 for the *L. savala* were found as 0.0381, 2.1194 and 0.870 respectively. Comparison of some studies in different countries is illustrated in table 3 where *b* and R^2 values showed more or less similar distribution, but the significant variation is observed in case of *a* value.

Table 3: Comparison of length-weight parameters in studies of different authors

Author	Location	Sex	*a*	*b*	R^2
Rizvi *et al*. (2010)	Mumbai Coast	Both Sex	0.00000001	3.611	0.962
Myla *et al*. (2012)	Visakhapatnam	Male	0.00001	2.894	0.857
		Female	0.000014	2.517	0.825
Al-Sakaff, and Esseen (1999)	Yemen	Male	0.01300	2.776	0.97
		Female	0.01100	2.814	0.966
Pakhmode *et al*. (2013)	Ratnagiri Coast	Both Sex	0.0006049	3.2285	0.92
Memon *et al*. (2016)	Pakistan	Both Sex	0.0001	3.191	0.960
Present study	Bay of Bengal	Both Sex	0.0381	2.1194	0.870

VI. Conclusion

Like previous works of Bangladesh and adjacent countries, almost similar results have been identified in the present study. However, further extended work is needed to estimate the maximum sustainable yield (MSY) level of *L. savala* in the Bay of Bengal Bangladesh part and to take necessary management measures by that.

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Nuclear Propulsion in Merchant Ship Operations and Implications

By MD Ziaul Haque

Introduction- Nuclear fuel cycle and its application to the marine propulsion draw attention to the international and maritime policymakers. It has further been geared up after the Copenhagen summit on global climate change. This worldwide congregation has facilitated to conceptualise the fundamental issues of regarding global warming that leads to global climate change. It seems that the nuclear fuel and its application in marine propulsion and environmental issues should be looked at in parallel. From that point of view, it has been given an assignment on nuclear fuel which is much talked, global concerns, and expectation nowadays. The regular atomic enrichment program and some allegations of handing the nuclear technology over led the global concerns and dismay. With the emergence of atomic technology and clandestine nuclear supply besides global needs for electricity to promote the civilization ahead, all these elements have put the nuclear fuel cycle under controversy and suspicions and mistrust internationally. In this occasion, the efforts have been made to understand the nuclear fuel cycles in broader perspectives and its implications on merchant ship if nuclear propulsion is introduced in broader scale into the marine industry.

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NUCLEARPROPULSIONINMERCHANTSHIPOPERATIONSANDIMPLICATIONS

Nuclear Propulsion in Merchant Ship Operations and Implications

MD Ziaul Haque

I. INTRODUCTION

Nuclear fuel cycle and its application to the marine propulsion draw attention to the international and maritime policymakers. It has further been geared up after the Copenhagen summit on global climate change. This worldwide congregation has facilitated to conceptualise the fundamental issues of regarding global warming that leads to global climate change. It seems that the nuclear fuel and its application in marine propulsion and environmental issues should be looked at in parallel. From that point of view, it has been given an assignment on nuclear fuel which is much talked, global concerns, and expectation nowadays. The regular atomic enrichment program and some allegations of handing the nuclear technology over led the global concerns and dismay. With the emergence of atomic technology and clandestine nuclear supply besides global needs for electricity to promote the civilization ahead, all these elements have put the nuclear fuel cycle under controversy and suspicions and mistrust internationally. In this occasion, the efforts have been made to understand the nuclear fuel cycles in broader perspectives and its implications on merchant ship if nuclear propulsion is introduced in broader scale into the marine industry.

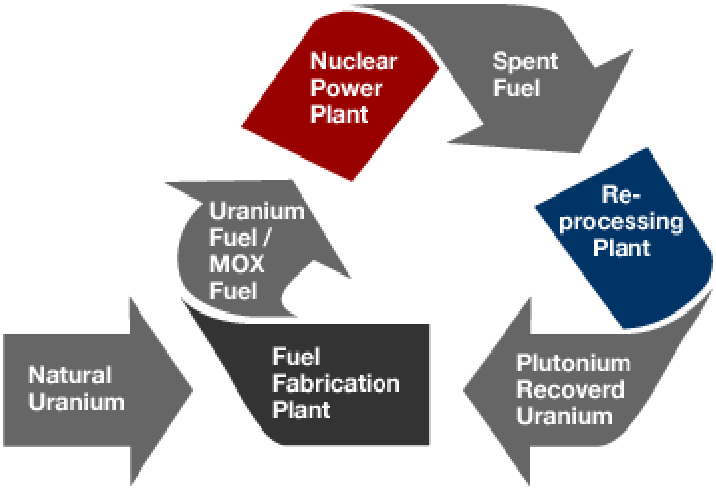
a) *Aim & Objectives*

To grasp the nuclear cycle and the impacts of the atomic propulsion with the fuels with a relatively low enrichment of uranium U-235 consistent with use in merchant marine practice.

b) *Methodology*

This particular study has been developed through secondary research which includes consulting relevant books, some legislation national and international. However, a few numbers of professionals working in the maritime industries have been interviewed in this particular context.

II. NUCLEAR FUEL CYCLE (FRONT END)



Source: Japan's Nuclear Power Program

Fig. 1: Nuclear Program

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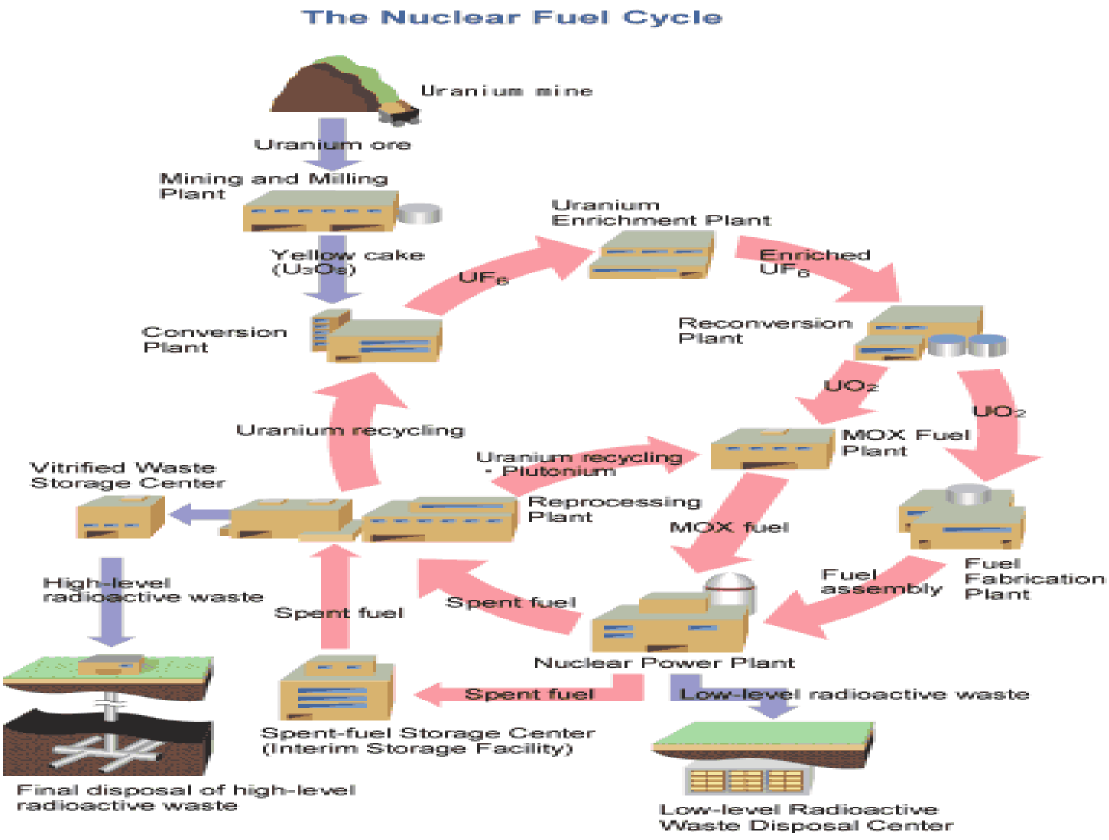


Source: Japan's Nuclear Power Program

Fig. 2: Nuclear Fuel Cyclic Process

a) Uranium Recovery and Conversion process

It is distinctive and complicated cycle rather than other energy resources such as coal, oil and natural gas. Nuclear fuel emerges from uranium, which is the raw material of nuclear fuel and at the same time, it is slightly radioactive metals. To have nuclear fuel, uranium recovery is an important part which focuses on extracting (or mining) natural ore from the Earth crust and concentrating (or milling) that ore which results from Yellow Cake. (USA NRC)

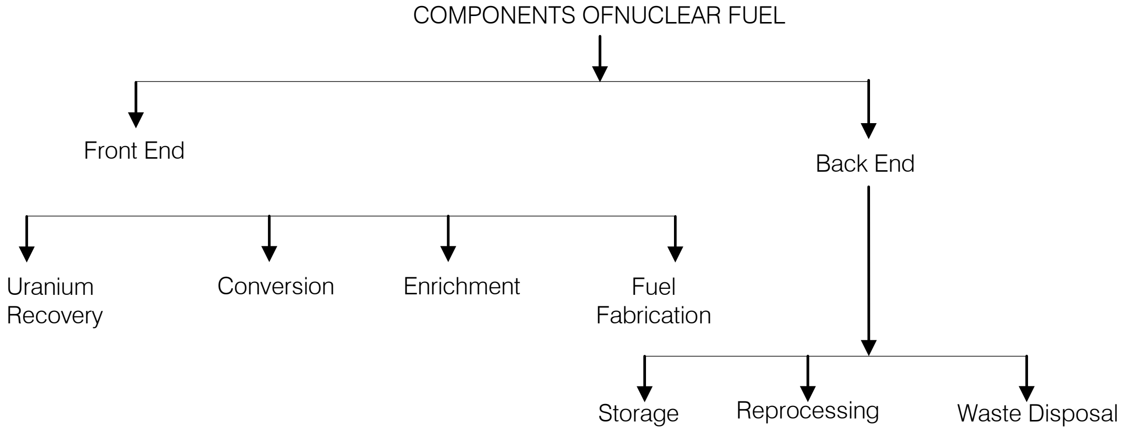


Fig. 3: Front End and Back End components of Nuclear Cycle

Two techniques are generally used to recover uranium ore such as Excavation and situ techniques-

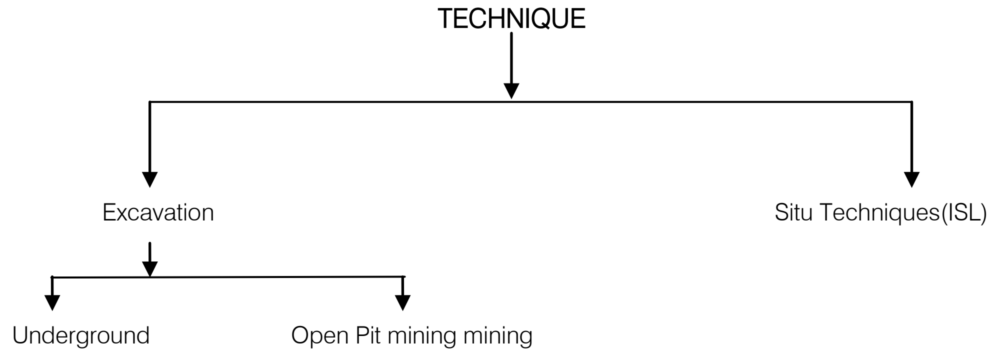
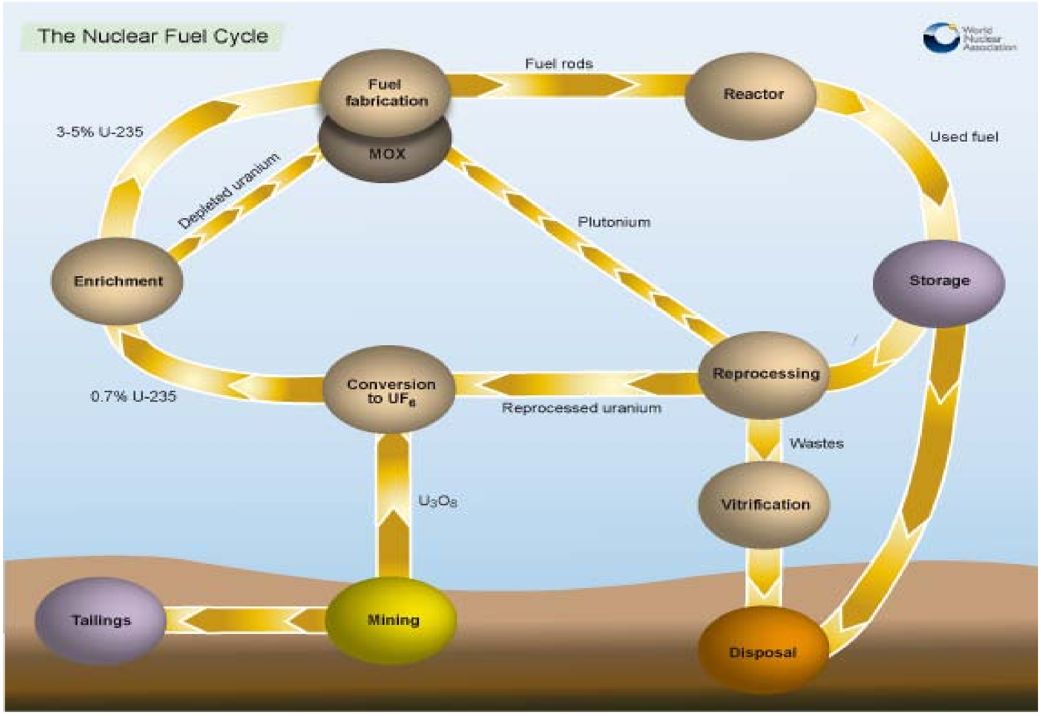


Fig. 4: Techniques of the Fuel Process

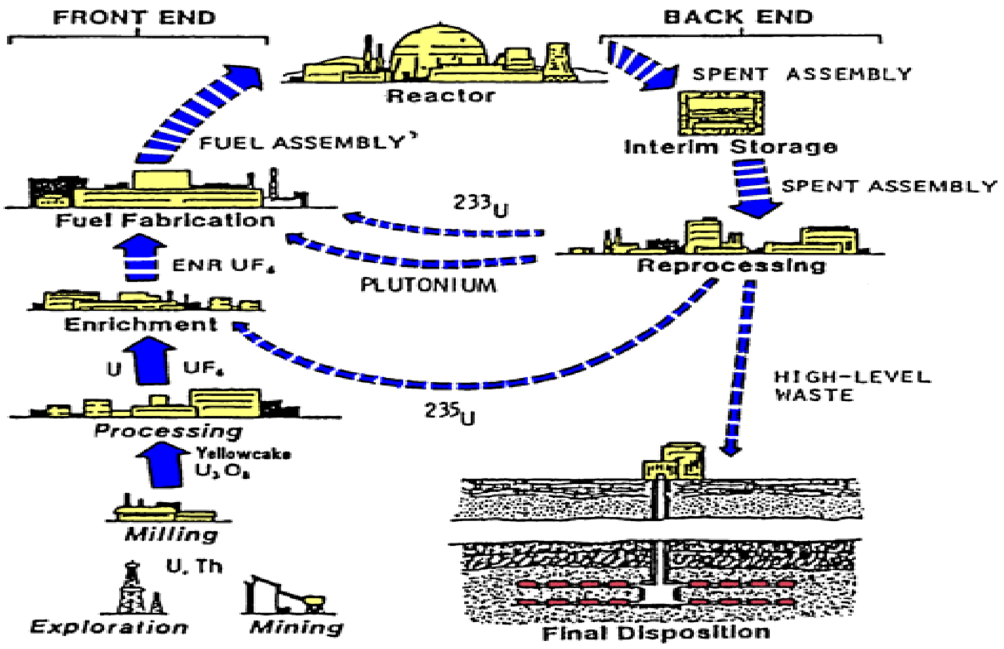
Yellow Cake is commonly known as U3O8. This yellow cake transforms into fuel for the nuclear reactor. To achieve so, a series of industrial processes need to be conducted, and the aftermath of these sorts of operations lead to the production of electricity in the nuclear reactors. The nuclear fuel cycle starts with mining and ending with disposal through specific intermediary processes as shown below-



Source: World Nuclear Association: The Nuclear Fuel Cycle (2009) (Online)

Fig. 5: The Nuclear Fuel Cycle

These collective activities can be referred to the nuclear fuel cycle



Source: United States Nuclear Regulatory Commission (U.S NRC)

Fig. 6: Stages of the nuclear fuel cycle

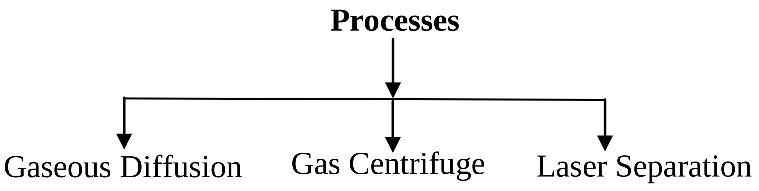
It has two ends such as Front End and Back End. The Front End includes mining and milling, conversion, enrichment and fuel fabrication stages where the uranium is prepared accordingly to use in the nuclear reactor. On the other hand, Back End involves temporary storage, reprocessing, recycling and eventual disposal of nuclear waste. From the Figue01 mentioned above and Figure02, it is evident that the source of atomic energy is plutonium which comes up from the used fuel through reprocessing stage. From that point of view, reprocessing of used or spent fuel can be considered as an option of nuclear energy. The global concerns are centred on the end of reprocessing of used fuel or spent fuel as it is the only way to produce plutonium and plutonium is the central element to acquire nuclear weapons.

b) *Conversion*

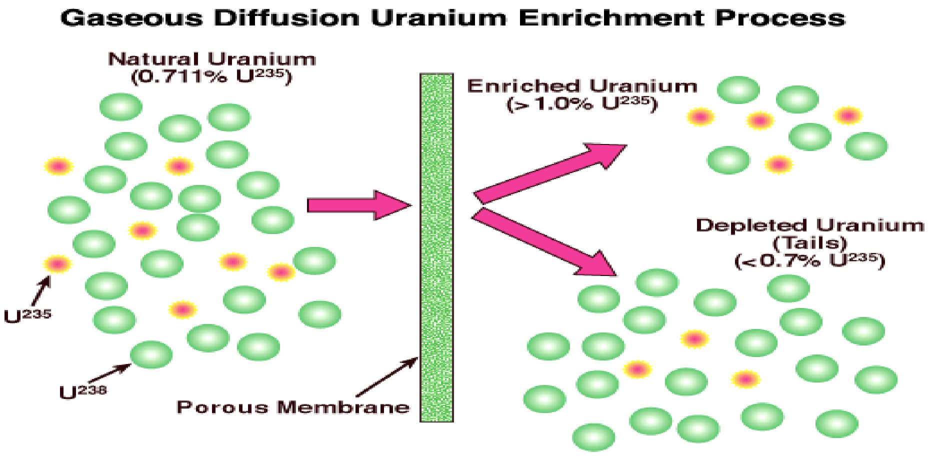
The conversion process involves the conversion of yellowcake (U3O8) into the uranium hexafluoride (UF6) gas combining the Uranium and Fluorine which is suitable for the enrichment operations. All impurities are removed in this conversion process, and UF6 is pressurised and cooled to a liquid which is taken into 14-ton cylinders where it solidifies after cooling for approximately five days. An enrichment plant replaces UF6 cylinders.

c) *Enrichment*

It is the process through which the concentration and increase of U-235 fissile isotope are ensured to undergo fission to produce energy into the nuclear reactor. Uranium Hexafluoride (UF6) needs to be enriched to having fissile isotope U-235 as Uranium Hexafluoride (UF6) gas contains both isotopes U-235 and U-238 in the ratio of 0.7 to 99.3. It means that only 0.7% of natural uranium is fissile and capable of undergoing into fission and fission is the process through which the energy is produced in a nuclear reactor. However, the enrichment process increases the fissile isotope U-235 ranging from 0.7% to 3.5% or little more. Generally, a nuclear reactor requires the concentration of fissile uranium U-235 ranging from 3.5% to 5%. There are two enrichment processes out of three primarily used to concentrate on fissile isotope U-235 as-



The following figure shows the gaseous diffusion process.

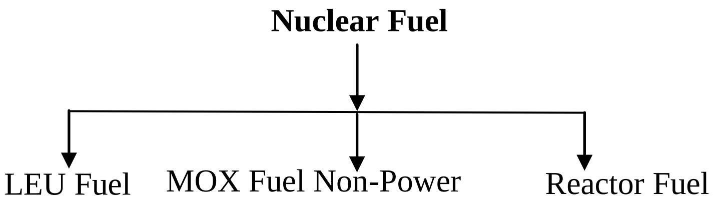

Gaseous Diffusion Uranium Enrichment Process
Natural Uranium (0.711% U235)
Enriched Uranium (>1.0% U235)
Depleted Uranium (Tails) (<0.7% U235)
U235
U238
Porous Membrane

Source: *United States Nuclear Regulatory Commission (U.S. NRC): Uranium Enrichment*

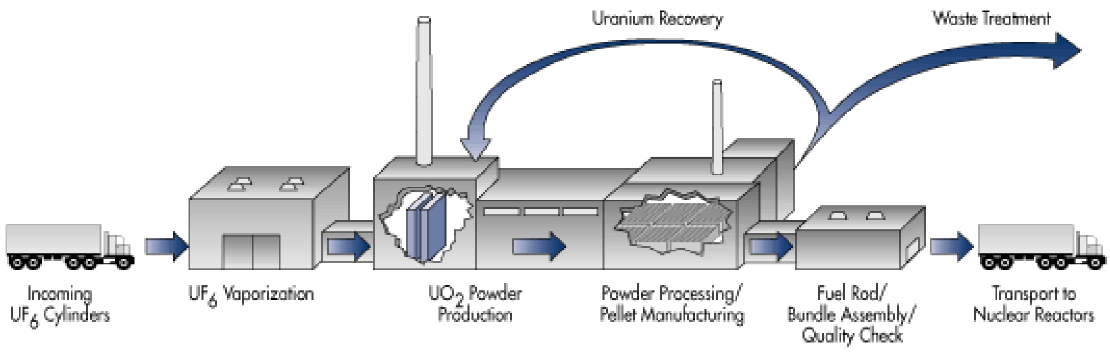
Fig. 6: Gaseous Diffusion Uranium Enrichment Process

d) *Fuel Fabrication*

It is the process of conversion of enriched Uranium Hexafluoride (UF6) into fuel for a nuclear reactor and is the last stage of Front End of the nuclear cycle. In the fuel fabrication stage, there are three kinds of nuclear fuel can be produced as-



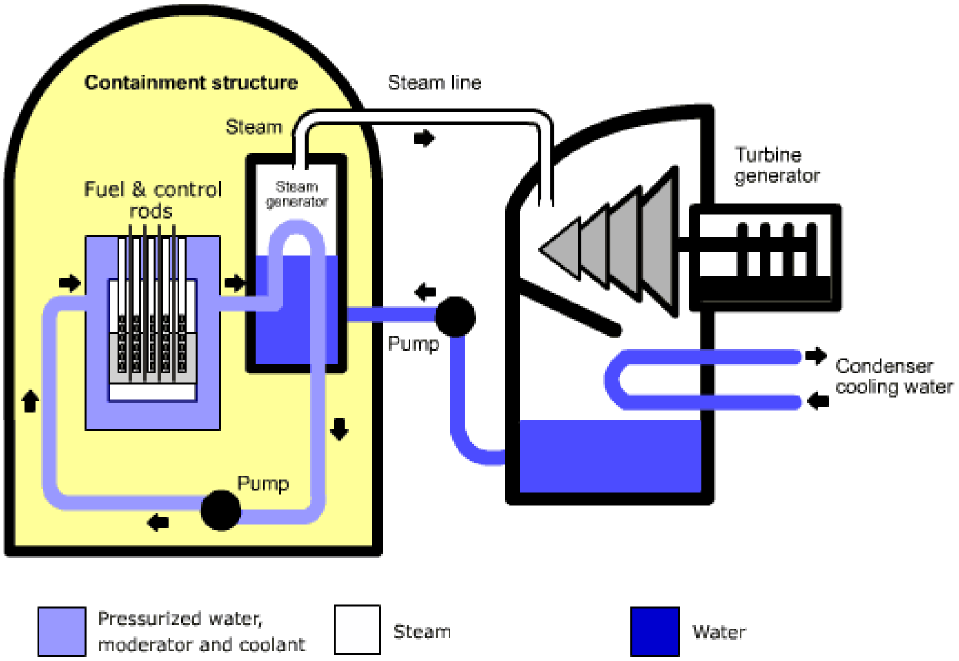
In this stage of the cycle, enriched Uranium Hexafluoride (UF6) is passed through the fuel fabrication plant where it changed into LEU uranium dioxide powder.


Uranium Recovery
Waste Treatment
Incoming UF6 Cylinders
UF6 Vaporization
UO2 Powder Production
Powder Processing/ Pellet Manufacturing
Fuel Rod/ Bundle Assembly/ Quality Check
Transport to Nuclear Reactors

Source: United States Nuclear Regulatory Commission (U.S. NRC)

Fig. 7: Light Water Reactor Low Enrichment Uranium (LEU) Fuel

This powder is used to form fuel rod by pressing it into pellets and then putting it into metal tubes (Zircaloy tubes). With the help of these fuel rods, a fuel assembly is formed through putting all fuel rods together. These fuel assemblies are placed into the core of nuclear reactor along with moderator such as graphite or water where control rods used to stop or slow down the nuclear chain reaction process into the reactor where they absorb the neutrons.



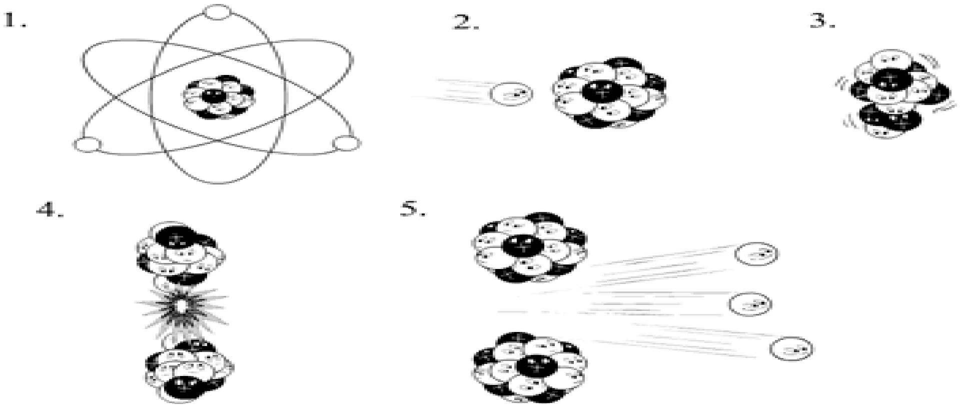
Source: Uranium SA

Fig. 8: Pressurised Water Reactor

Water absorbs the heat and ultimately converted into steam which operates the turbines and generates electricity. On the other hand, MOX fuel differs from LEU fuel in that in case of MOX fuel, Dioxide powder in the pellets is a combination of uranium dioxide UO2 and plutonium dioxide PO2. This MOX fuel used to make nuclear weapons. The no power reactor fuel is used for research, testing and training purposes. It is not used to produce electricity.

e) Reactor

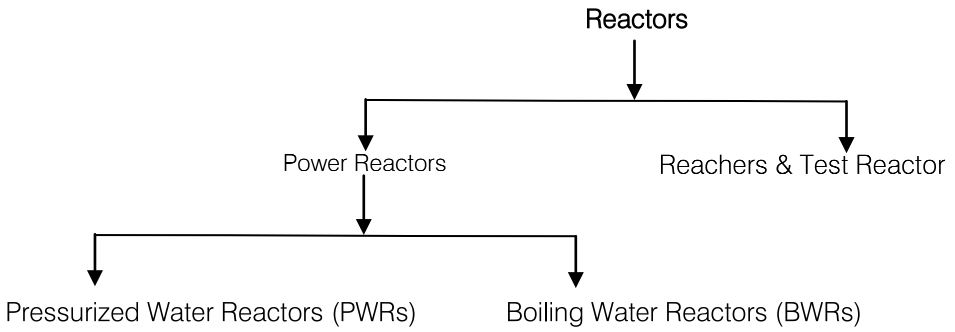
It is a sandwich stage between the Front End and Back End of the nuclear cycle. Inside the reactor, the nuclear fission process takes place where the nuclei of U-235 split and release energy. The energy released inside the reactors makes the water heated and eventually produces steam. The steam produced operates the turbine and generates electricity. Here the fission process is shown where atoms splitting process is visible.



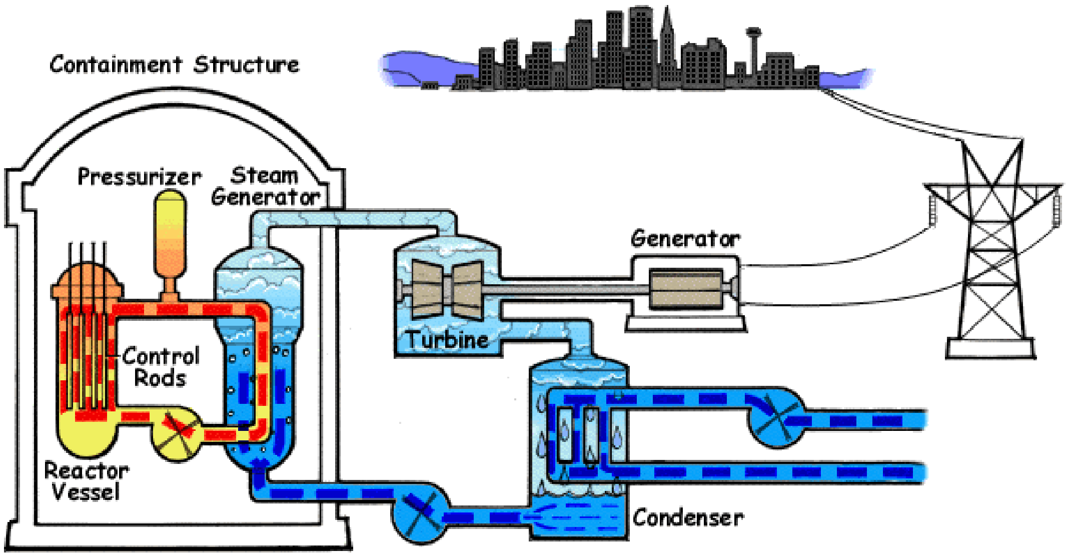
Source: Uranium SA

Fig.10: Nuclear Fission process

There are different types of reactors in use as-


Reactors
Power Reactors
Reachers & Test Reactor
Pressurized Water Reactors (PWRs)
Boiling Water Reactors (BWRs)

Both power reactors are designed to generate electricity commercially. Following a detailed presentation depicts an overall idea of its operations.



Source: United States Nuclear Regulatory Commission (U.S. NRC)

Fig.11: Pressurized Water Reactors (PWRs)

III. BACK END OF NUCLEAR CYCLE

a) *Spent Fuel*

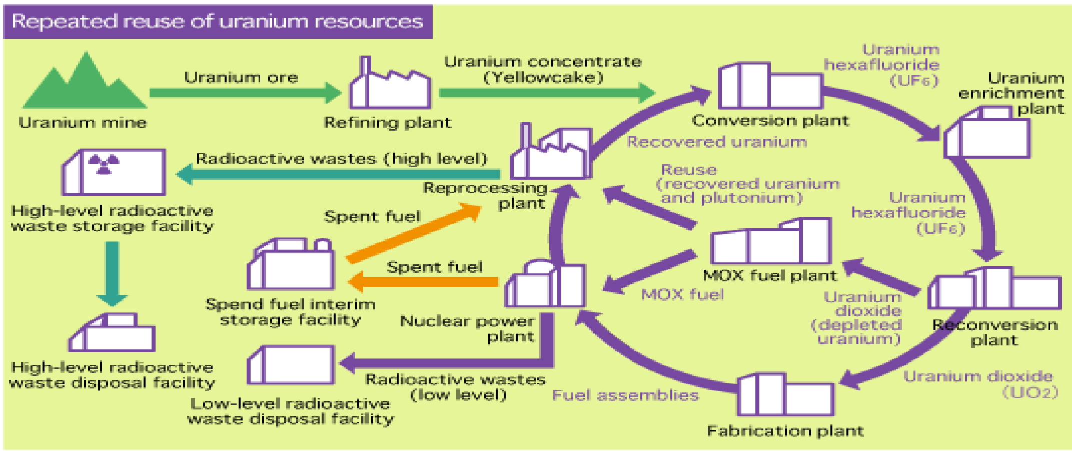
With the pace of time, the concentration of fission fragments and heavy elements are formed inside the reactors, and after a certain point it becomes convenient that the fuel should no longer use and which dictates the authority concerned to remove the spent fuel from the reactors. However, the ultimate point is that it is as risky as the spent fuel is very hot and radioactive.

Fig. 12: Spent Fuel Cooling Pond

In consideration of the fact, the spent fuel is discharged into the storage pond immediately to decreasing the radiation. These two functions of the cooling pond as it shields the radiation and absorbs the heat which protects the people involved in the workplace. It may be mentioned that the spent fuel requires to be either reprocessed or permanent disposal and it depends on the policy of the respective party.

b) Reprocessing of Nuclear Fuel

Regarding reprocessing of Nuclear Fuel, it needs to mention that the spent fuel contains about 96% of un-burnt uranium and about 1% of plutonium which comes from U-238 that absorbed neutrons. The above mentioned 96% un-burnt uranium contains about 1% U-235(fissile) and 95% U-238. The sole purpose of reprocessing of spent fuel is to recover the uranium and plutonium to generate power through the repeated use of them as it is the basis of nuclear energy policy. Following diagram enables to grasp the reprocessing of nuclear fuel in wider perspectives.


Repeated reuse of uranium resources
Uranium mine
Uranium ore
Refining plant
Uranium concentrate (Yellowcake)
Uranium hexafluoride (UF6)
Conversion plant
Uranium enrichment plant
Recovered uranium
Radioactive wastes (high level)
Reprocessing plant
High-level radioactive waste storage facility
Reuse (recovered uranium and plutonium)
Uranium hexafluoride (UF6)
Spent fuel
Spent fuel
MOX fuel plant
Spend fuel interim storage facility
Nuclear power plant
MOX fuel
Uranium dioxide (depleted uranium)
Reconversion plant
High-level radioactive waste disposal facility
Radioactive wastes (low level)
Low-level radioactive waste disposal facility
Fuel assemblies
Uranium dioxide (UO2)
Fabrication plant

Source: Tohoku Electric Power Co. Inc: Recycling of Nuclear Fuel

Fig. 11: Reuse of Uranium Resources

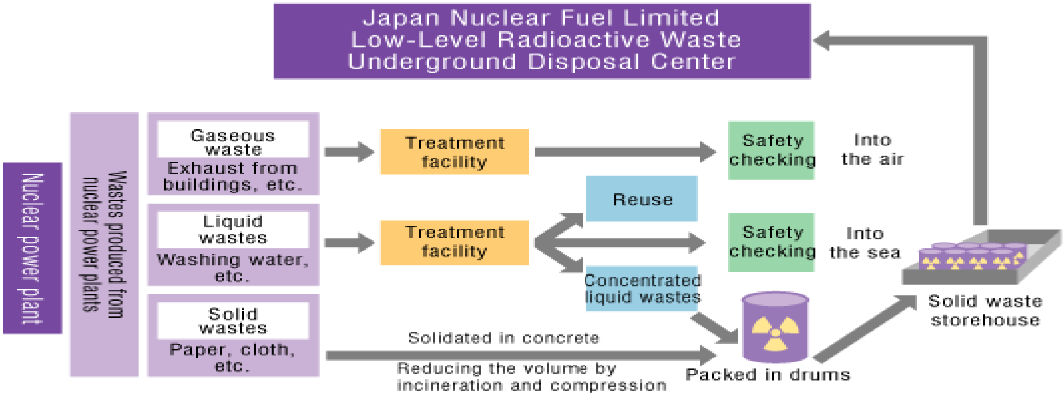
Regarding reprocessing of nuclear MOX fuel, a plus thermal process can be used.

c) Waste Disposal

The waste disposal is substantial environmental and safety concerns as nuclear waste is radioactive. Two methods are applied to serve the purposes as-

i. *Method of Low-Level Radioactive Waste Treatment and Disposal*

It is evident from the schematic diagram that a nuclear power plant produces three types of waste as Gaseous, Liquid and Solis waste. Gaseous waste is released into the atmosphere once sure standard safety checking is done with confirmation that the radioactivity is adequately attenuated. In case of liquid from waste, a small amount of such waste is released from outlets after filtration, ion exchange, and concentration etc. Most of the liquid wastes are reused after the treatments mentioned above.



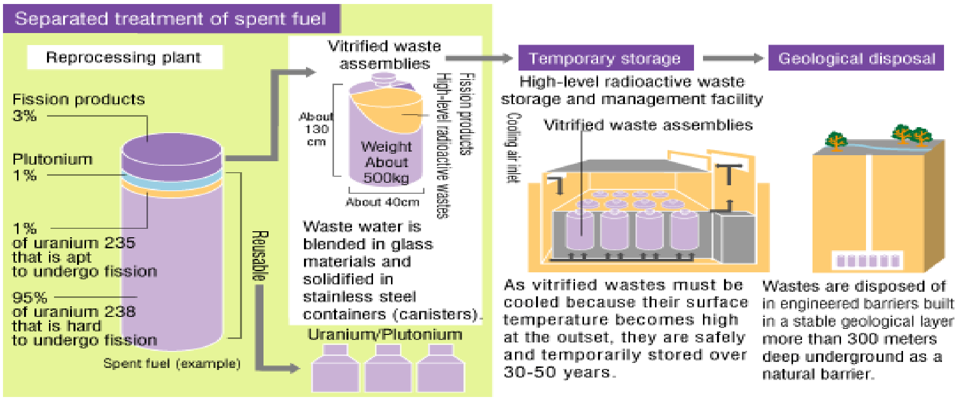
Source: Tohoku Electric Power Co. Inc: Recycling of Nuclear Fuel

Fig.12: Low-Level Radioactive Waste Treatment and Disposal

On the other hand, solid wastes usually are burnt and compressed to reduce the volume and then put into the drums for stable waste storehouse or underground disposal centre.

ii. *Method of High-Level Radioactive Waste Treatment and Disposal*

When spent fuel is reprocessed then some amount of wastewater has remained from the extraction of uranium and plutonium which is highly radioactive and contains fission products. Following schematic diagram depicts a clear picture in the understanding disposal of the High-Level Radioactive Waste where wastewater is blended in glass materials and solidified in canisters. This process is called vitrification process. It is the safe method of treating, transporting and storing of HLW.


Separated treatment of spent fuel
Reprocessing plant
Fission products 3%
Plutonium 1%
1% of uranium 235 that is apt to undergo fission
95% of uranium 238 that is hard to undergo fission
Spent fuel (example)
Reusable
Vitrified waste assemblies
About 130 cm
Weight About 500kg
About 40cm
Fission products
High-level radioactive wastes
Waste water is blended in glass materials and solidified in stainless steel containers (canisters).
Uranium/Plutonium
Temporary storage
Geological disposal
High-level radioactive waste storage and management facility
Cooling air inlet
Vitrified waste assemblies
As vitrified wastes must be cooled because their surface temperature becomes high at the outset, they are safely and temporarily stored over 30-50 years.
Wastes are disposed of in engineered barriers built in a stable geological layer more than 300 meters deep underground as a natural barrier.

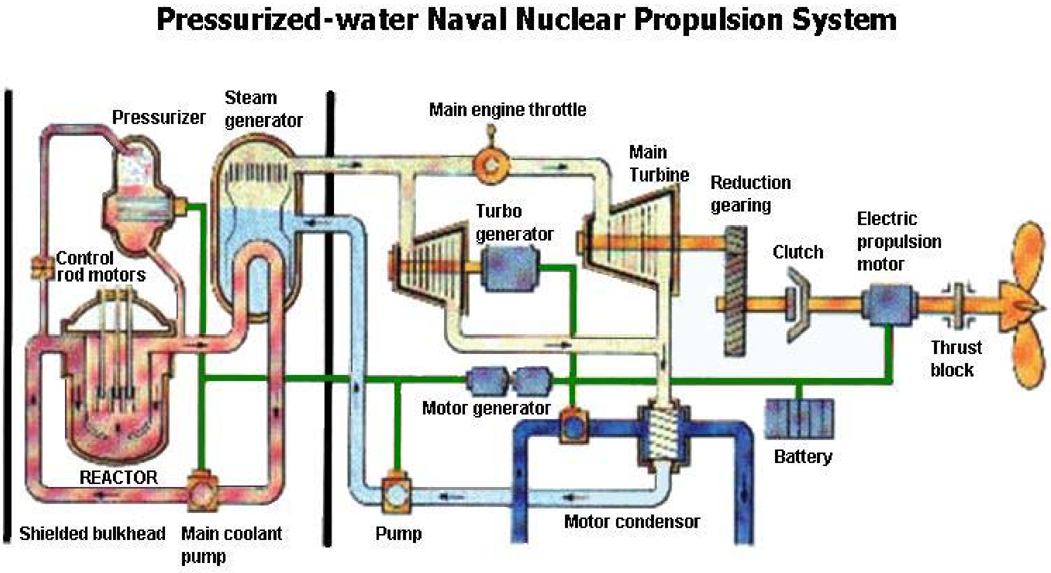
Source: Tohoku Electric Power Co. Inc: Recycling of Nuclear Fuel

Fig. 13: High-Level Radioactive Waste Treatment and Disposal

In the same time, the vitrified waste assemblies are placed in temporary store up to 30-35 years, and after then geological disposal is carried out.

IV. Nuclear Propulsion In Merchant Ship Operations and Implications

Following the schematic diagram enables to grasp the nuclear propulsion system where the main turbine is connected with main propulsion motor through the reduction gear and shafting with a propeller. In an earlier attempt (in section 2.2), it has been discussed how nuclear fission takes place inside the reactor and produces energy to rotate the turbine. The atomic propulsion ship is considered to be the source of radiation as the reactor deals with uranium which is one of the few materials that can produce heat in a self – sustaining the chain reaction. From that point of view, it has great significance regarding the generation of propulsion power.



Source: Federation of American Scientists: Nuclear Propulsion

Fig.14: Nuclear propulsion system

Moreover, it is contributing to global warming and greenhouse gases and harming ozone layer which permits UV rays to reach in the Earth. On the other hand, nuclear fuel requires no oxygen (O2) in the fission process and zero emission characteristics (no exhaust gases) which attract the attention of the decision makers of the marine industry. In nuclear propulsion, a ship has zero spill possibilities which save the increasing cost of bunkering. It needs to bear in mind that the liability of oil spillage in ports or sea is strict and severe. Possible impacts of NOX and SOX on the conventional engines and environment are other concerns.

Regarding the reliability of the engines, the fossil fuel engines are not reliable for a long time in the sense that it requires the continuous and constant supply of fuel. In contrast, an atomic engine, where nuclear fission takes place, is the compact source of an endless amount of heat it can last a long time without refuelling. Moreover, much marine accident takes place due to the failure of conventional propulsion system where nuclear propulsion system rules out those chances with the higher degree. From that point of view, it has excellent reliability characteristics. When the world is welcoming the containerization concepts, the container ship needs excellent speed characteristics to serve global peoples. To meet those, nuclear propulsion ship has a speed advantage over fossil fuel propulsion ship. There is no scope to deny that nuclear propulsion system is economically and environmentally superior to the conventional propulsion system. Moreover, atomic fuel concept will reduce the vibration of machinery and gives the stable propulsion and motion of the ship if the nuclear reactor is installed amidships. The debate on the nuclear issues are still on, the issues raised regarding international approach, economic justification, nuclear acceptability in world community especially in the green lobby and the fact of fossil fuel pricing and global reserve and environmental issues.

According to Mr John Carlton, Global Head, Marine Technology and Investigation- “The technology is there to commence building nuclear ships. The issues regarding their acceptability and the need for a culture step-change in shipping still need to be addressed so that society is comfortable any risk is being managed."

Source: MER.(2010), IMarEST

However, the other side of the coin is- if nuclear fuel introduced on merchant vessel propulsion system then what would be the scenario in case of piracy? The significant global security concern can arise. Nowadays any sort of decommissioning is costly if nuclear plants need to dismantle it can cause substantial costs, the safety concern for both those who will be involved in the decommissioning process and the surrounding environment. Although nuclear fuel life is very long. Other issues are –what will be the regulatory process of nuclear plant onboard, and training of seagoing staffs? Moreover, also need to think about the mutual relation between the shipping management and nuclear management, and necessary legal framework to ensure the safety of atomic fuel onboard, the Environment Group and People’s perception need to be considered as well.

V. CONCLUSION

Is Nuclear fuel the best alternative or not, it is difficult to predict right now as the full information has not been disclosed yet. However, it seems a good idea and concept if the vulnerability and consequence matrix can be identified and appropriate global collective efforts and framework can be established.

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A Study of Mangrove Crab (S*cylla serrata*) Aquaculture Cultivated by Means of Silvofishery Method with Different Doses of Waste Fish Feed

By Muhammad I. Wamnebo,Andi Niartiningsih & Muhammad Y. Karim

Hasanuddin University

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Keywords: mangrove crab (Scylla Serrata), waste fish feed, proximate, silvofishery, survival rate and growth.

GJSFR-E Classification: FOR Code: 040399, 070499

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Keywords: mangrove crab (Scylla Serrata), waste fish feed, proximate, silvofishery, survival rate and growth.

I. Introduction

Indonesia has a vast potential of mangrove forests (4.25 million ha) and is spread across several islands such as Java, Sumatra, Kalimantan, Sulawesi, Maluku and Irian Jaya; the area is suspected to be habitat and fishing ground for mangrove crabs (Rangka, 2007).

Mangrove crabs (*Scylla Serrata*) are favored by consumers as a quality food because they have good meat taste, texture and nutritional value, are very potential to be commercially cultivated in the Indopasifik region (Blackshaw, 1999 in Trino and Rodriguez, 2002).

Cultivation management systems that are associated with mangrove forests are being developed and are known as *silvofishery*or wanamina, meaning intercropping between fisheries and mangrove forests. Initially, the system was the management of ancient mangrove forest areas which needed a more modern research and assessment approach (HTTP: // Mangrove Resource Utilization Through Silvofishery.com. 2010, Accessed December 5, 2011).

The success of enlarging mangrove crabs in ponds or a controlled container is determined by the suitability of the feed provided, both in dosage and type (Fujaya, 2008).

II. Materials And Methods

a) Material

The test animals used in this study were mangrove crabs (*S. Serrata*) with an average body weight of 22.3 ± 0.01 g and an average carapace width of 3.38 ± 0.02cm obtained from the catch of fishermen in the village Sanleko, Namlea District, Buru District, Maluku Province.

b) Methods

The container used in this study is a bamboo cage of length, width, and height of 1.5 x 1.5 x 1.5m, totaling 12 units. The bamboo is divided into 5 x 200cm width and height which are plugged the 50cm deep mud. The distance between the bamboo blades with one another is 1 cm, each cage contains ten crabs. The feed used was trash fish in the form of red anchovy (Stolephorusheterolobus) with a dose: 0.5%, 10%, and 15% of the weight of biomass given twice a day for two months.

c) Analysis of Nutrient Content and Growth

The proximate analysis includes protein, fat, and BETN, following the AOAC procedure, (1999), while energy is measured with a Bomb calorimeter. The research data obtained were analyzed using variance (ANOVA) and W-Tukey test (Gasperz, 1991).

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III. Results and Discussion

The average value of increasing chemical composition (protein, fat, carbohydrate) and body energy of mangrove crabs (S. *Serrata*) is presented in Table 1.

Table 1: The average increase in chemical composition and body energy of mangrove crabs during the study

Dosen of feed (%)	Protein (%dry weight)	Fat (%dry weight)	Carbohydrate (%dry weight)	Energy (kcal/kg)
0	0,77 ± 0,24^{a}	1,82 ± 0,16^{a}	14,88± 0,63^{a}	156,352 ± 0,60^{a}
5	1,44 ± 0,09^{a}	3,25 ± 0,09^{a}	16,18± 1,0^{a}	181,513 ± 0,44^{b}
10	4,28 ± 0,27^{b}	6,55 ± 0,25^{b}	19,05± 0,19^{b}	243,998 ± 2,16^{c}
15	4,51 ± 0,52^{b}	4,67 ± 0,08^{b}	18,45± 0,59^{b}	221,998 ± 6,09^{d}

Note: Different letters in the same column show significant differences between treatments at 5% level (p <0.05).

The results of the analysis of variance showed that different doses of trash feed had a very significant effect (p <0.01) on increasing the chemical composition (protein, fat, BETN) and body energy of mud crabs. The average values of survival of mangrove crabs (S. *Serrata*) are presented in Table 2.

Table 2: The average survival rate of mangrove crabs (S. Serrata) maintained by silvofishery patterns with different feed doses

Dosen offeed (%)	Survival (%)
0	46,67 ± 5,77^{a}
5	66,77 ± 5,77^{b}
10	83,33 ± 5,77^{c}
15	83,33 ± 5,77^{c}

Note: Different letters in the same column show significant differences between treatments at 5% level (p <0.05).

The results of variance analysis showed that the administration of trash feed with different doses had a very significant effect (p <0.01) on the survival of mud crabs.

The survival of mangrove crabs at the 5% feed dose treatment was significantly lower than the 10 and 15% feed dose treatment, and the highest survival rate was produced at 10 and 15% feed dosage treatments, and there was no difference between the two. This is because the control treatment is not given additional feed and maintained in limited confinement. Thus crabs only utilize natural feed that is in the maintenance environment. The high survival rate of crabs produced in the treatment of 10 and 15% feed doses is due to the dose of feed provided to meet crab requirements for various needs including for motion activity and maintaining survival.

Carapace width growth, absolute growth, and daily specific growth (SGR) Mangrove crabs are presented in Table 3.

Table 3: The average growth of carapace width, absolute growth and daily specific growth (SGR) of mangrove crabs (S. Serrata) maintained by silvofishery patterns with different feed doses

Doseoffeeed (%)	Carapace (cm)	Absolute growth (g)	SGR (%/hari)
0	3,38 ± 0,24^{a}	36,6 ± 0,17^{a}	1,64 ± 0,02^{a}
5	3,61 ± 0,04^{a}	41,1 ± 1,00^{b}	1,79 ± 0,02^{b}
10	3,74 ± 0,07^{ab}	55,0 ± 0,55^{c}	2,11 ± 0,01^{c}
15	4,00 ± 0,08^{bc}	52,5 ± 2,21^{d}	1,99 ± 0,06^{d}

Note: Different letters in the same column show significant differences between treatments at 5% level (p <0.05).

The results of the analysis of variance (Appendix 17) showed that giving different doses of feeding had a very significant effect (p <0.01) on the growth of mangrove crab carapace width.

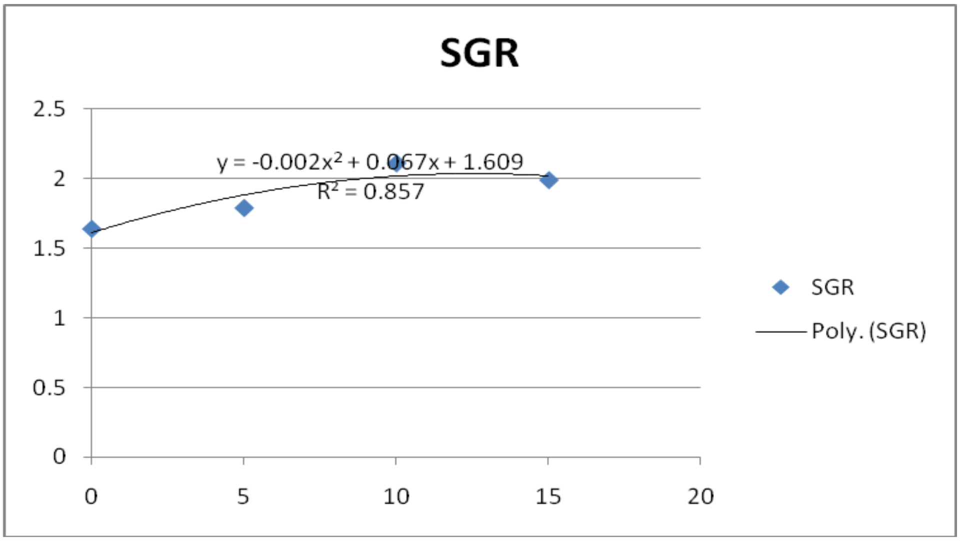

Fig. 1: Growth curve of mangrove crabs (S. *serrata*)

The value of water chemistry physical parameters is the temperature ranging from 28-32°C where the optimum temperature for mangrove crabs is 26-32°C (Christensen et al., 2005). Salinity from 5-13 ppt; mangrove crabs can tolerate the salinity range from <15 to> 30 ppt (Kasry, 1996 in Purnamaningtyas and Syam, 2010). pH ranges from 6.2-8.2 where the optimum pH for mangrove crabs is 7.5-8.5 (Christensen et al., 2005). Dissolved oxygen ranges from 5.1-7.6 ppm, the oxygen demand for mangrove crab life is> 4.0 ppm (Susanto and Murwani, 2006). Ammonia ranged from 0.0005 to 0.0038 ppm where ammonia levels for mangrove crab cultivation were <0.1 ppm (Christensen et al., 2005).

IV. CONCLUSION

The highest increase in chemical composition, especially protein, was obtained in the treatment of 15% feed dose (4.51 ± 0.52) while the highest fat, BETN and body energy were sequentially obtained in the 10% feed dose treatment (6.55 ± 0.25), (19.05 ± 0.19), and (243.998 ± 2.16).

Survival, growth in carapace width, absolute growth, and highest daily specific growth were produced at ten doses and 15%, respectively 83.33%, 4.00 cm, 55.0 g and 2.11% / day

The dose of feed that produces the highest survival rate and growth is achieved in the treatment of 10% feed dose while the lowest is in the control dose.

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To Examine the Feasibility, Achievability of the CSI, And its Implications in Global Context

By MD Ziaul Haque

Abstract- This study focuses on the Container Security Initiatives taken by the US Government and its global implications. The CSI influences the maritime transport industry in the greater extent that works within some constraints and limitations. This paper provides a general overview of the compatibility of the CSI with both the existing constraints and limitations of the shipping industry and international seaborne trade. The significant concerns of the proposed CSI have been identified in this secondary research and analysed.

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I. INTRODUCTION

The 9/11 attack, in the USA, suggests that the terrorists are extending their operational mandates beyond the land-based threats. The container security initiatives come into light as an institutional response to terrorists' threat to improving the borders security and global trading system through pre-screening 100% US-bound shipping containers from all ports around the world. After the 9/11, the exposure of the risks and the severity of the security threat bring a new dimension to think and act right now. The threats and the perception of the security threats have changed the security matrix of the USA in large scale. The 9/11 was a significant trauma for the United States itself and the world community those who are directly or indirectly involved in maritime transportation as well as the civil society around the globe. From that point of view, the USA security top brass has redesigned their strategies to combat the threats stemming from the terrorists globally. (Source: Fact Sheet, 2007). The attempt has been made here to scan the initiatives taken by the USA in global scale regarding feasibility, achievability and its implications in the international trade and commerce.

a) The aim and objectives

This study aims to look at the matter in broader perspectives especially in the context of existing limitations and constraints of the international seaborne trade and commerce. The objectives are plural that is to examine the feasibility, achievability of the CSI, and its implications in a global context.

b) Methodology

This particular study has been developed through secondary research that includes consulting relevant books, journals, publications, and various UNCTAD reports. However, a few numbers of professionals, academics, and logistic consultants in maritime industries have been interviewed.

II. THE CSI IN BRIEF

The container security initiatives (CSI) are based on the bilateral agreements signed between foreign customs, and the US Custom and Border Protection (CBP). The primary function of the CSI is to target and pre-screen the containers destined for or transiting through the USA from the rest of the world which may pose a potential security risk to the United States. The CSI is a reciprocal programme; under CSI, the US customs will have the access and will station in the ports of the CSI participating countries to ensure the security compliance and criteria under these regimes while the participant countries will enjoy the same opportunity if they wish to. The CSI designates three core elements:

- Identify high-risk containers
- Pre-Screen and evaluate the containers before placed on vessels.
- Use technology in order to pre-screen the high-risk containers without slowing down the movement of the legitimate trade.

It is believed that some factors influence the authority concerned to introduce the CSI. Firstly, lax of port security, inadequate ocean surveillance after cold war, overwhelming dependences on maritime trades and transportation, the trend of littoral states concentrates their resources on land-based structures to protect, Secondly, maritime attack has given the opportunity to the extremist lobby to cause the massive economic destabilisation through shutting down the critical Sea lanes of Communication(SLOC), Thirdly, maritime based terrorism has given the opportunity of the terrorists as viable means of inflicting coercive punishment on enemy audiences. Fourthly, the global containerisation complex provides the extremists with a logistical channel facilitating a covert movement of weapons and personnel. (Chalk, P. 2008).

III. INTERNATIONAL SEABORNE TRADE, CONSTRAINTS, LIMITATIONS AND THE CSI

The containerised shipping has been a critical component in the global trade due to containerization nowadays. It carries great significance in international

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trade as the 108 million cargo containers are transported each year around the world with various means of sea transportation. Regarding manufactured goods, 90 percents of world manufactured goods are being transported through containerised mode. In 2006, 11.6 million containers arrived in the USA that is 32000 containers per day.

The vast volume of international seaborne trade and the globally integrated supply chain that deal with demand and supply equation, emphasis on the needs for of security of the supply chain players and respective trading countries. Particularly in the USA, six million containers enter into the States every year and projected figure by 2010 will be doubled. The US imports in 2000 were 23% of Global Imports according to IMF Direction of Trade Year Book 2001 and 50% of these imports stem from developing countries (Developing Asia, America, and Africa). The imports from Developing Asia, America and Africa, are 25%, 17% and 2% respectively to the USA while this much import is equivalent to 23%, 54% and 19% exports of this three country groupage respectively. This scenario depicts an overall picture of world trade and the US trade where the CSI seems to have a significant influence over the US and international trade.

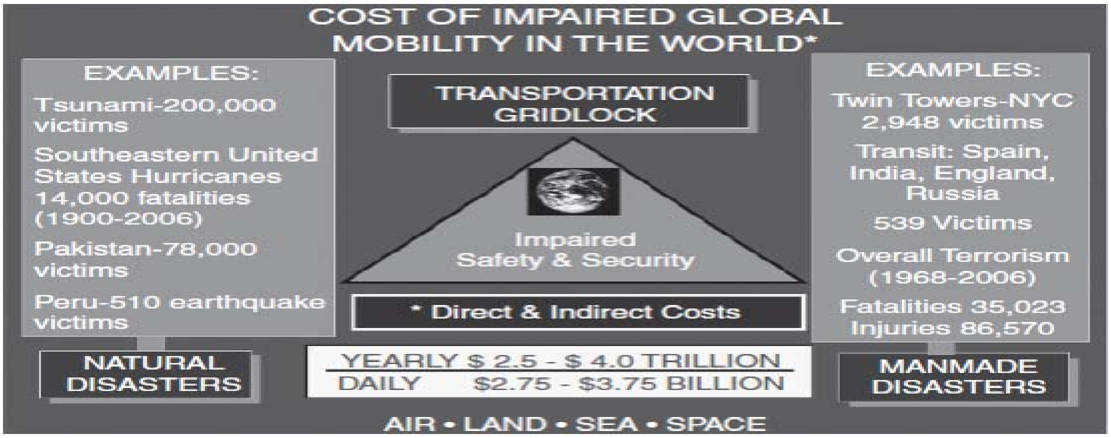
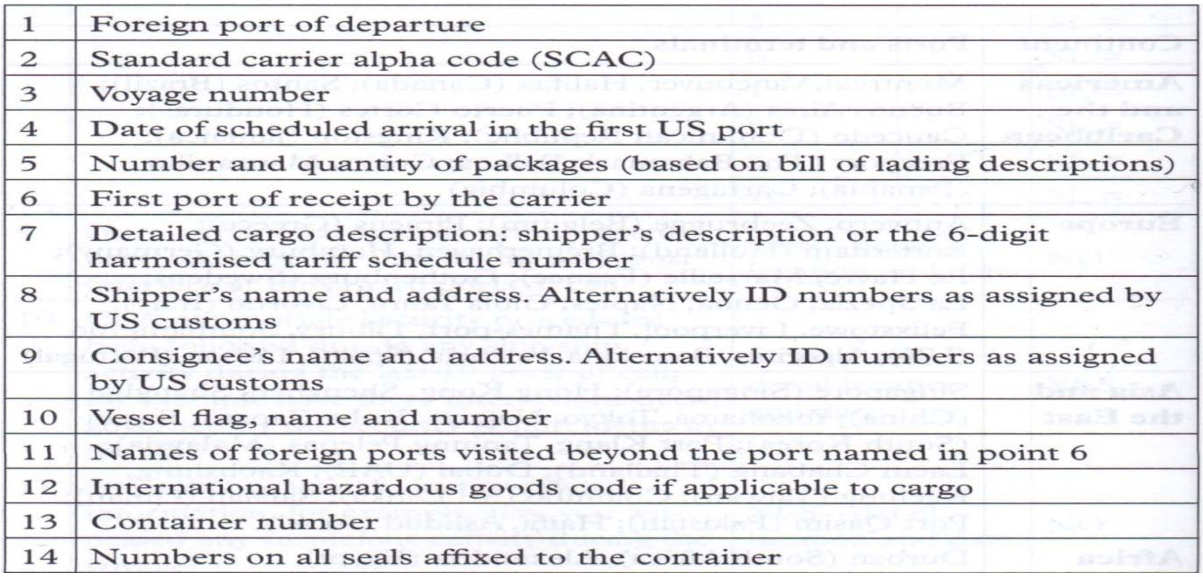

COST OF IMPAIRED GLOBAL MOBILITY IN THE WORLD*
EXAMPLES:
Tsunami-200,000 victims
Southeastern United States Hurricanes 14,000 fatalities (1900-2006)
Pakistan-78,000 victims
Peru-510 earthquake victims
NATURAL DISASTERS
TRANSPORTATION GRIDLOCK
Impaired Safety & Security
* Direct & Indirect Costs
YEARLY $ 2.5 - $ 4.0 TRILLION
DAILY $2.75 - $3.75 BILLION
EXAMPLES:
Twin Towers-NYC 2,948 victims
Transit: Spain, India, England, Russia
539 Victims
Overall Terrorism (1968-2006)
Fatalities 35,023
Injuries 86,570
MANMADE DISASTERS
AIR • LAND • SEA • SPACE

Fig. 1: Cost Projection

The container security initiatives incorporate 24 hours advance vessel manifest rule that allows the officer of the US Customs stationed in a foreign port to analyse information of the containers and identify any potential threats before loading on board and target high-risk cargo destined for and transiting through the US. The 24-hour rule obligates the respective players to submit 14 data electronically to the CBP as shown in figure 01 below:



1	Foreign port of departure
2	Standard carrier alpha code (SCAC)
3	Voyage number
4	Date of scheduled arrival in the first US port
5	Number and quantity of packages (based on bill of lading descriptions)
6	First port of receipt by the carrier
7	Detailed cargo description: shipper's description or the 6-digit harmonised tariff schedule number
8	Shipper's name and address. Alternatively ID numbers as assigned by US customs
9	Consignee's name and address. Alternatively ID numbers as assigned by US customs
10	Vessel flag, name and number
11	Names of foreign ports visited beyond the port named in point 6
12	International hazardous goods code if applicable to cargo
13	Container number
14	Numbers on all seals affixed to the container

Fig. 2: 14 Data Requirements

Source: CBP (2007), Bichou, K (2009)

All data outlined above need to be supplied mandatorily to the CBP through electronically for their approval and further verification. This measure repeals the vague cargo descriptions such as Freight-all-Kind totally, Said to contain, foodstuff or general merchandise etc.

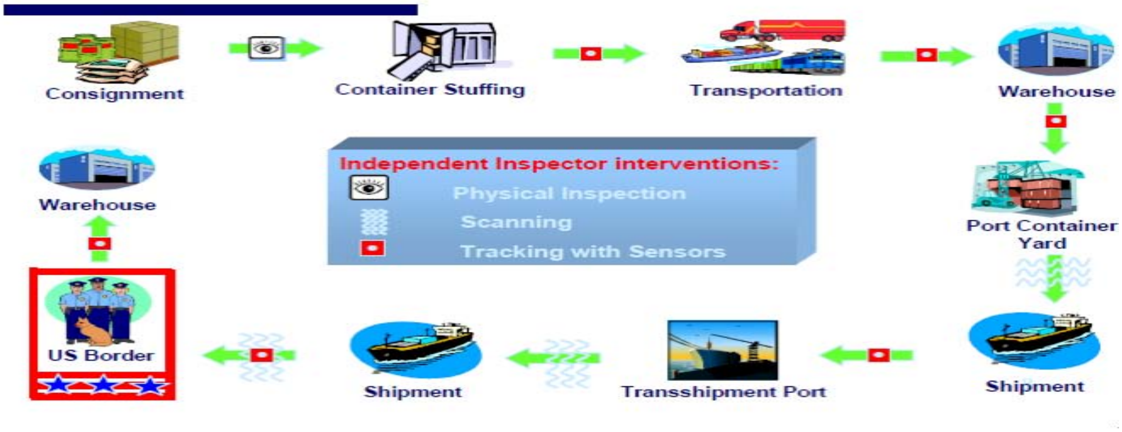


Fig. 3: Container Security Validation

Source: UNCTAD Transport Newsletter (2003)

C-TPAT, another approach, is a joint of government and business initiative to strengthen the cooperative relationship regarding overall supply chain security and border security through exchanging reliable and verifiable security information about their suppliers.

The participants in C-TPAT enjoy the first lane preferential treatment during the customs inspection and expedited procedures under the auspices of C-TPAT.

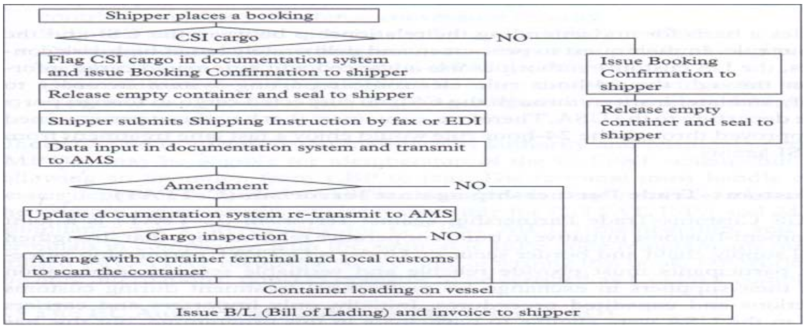

Shipper places a booking
CSI cargo
NO
Flag CSI cargo in documentation system and issue Booking Confirmation to shipper
Issue Booking Confirmation to shipper
Release empty container and seal to shipper
Release empty container and seal to shipper
Shipper submits Shipping Instruction by fax or EDI
Data input in documentation system and transmit to AMS
Amendment
NO
Update documentation system re-transmit to AMS
Cargo inspection
NO
Arrange with container terminal and local customs to scan the container
Container loading on vessel
Issue B/L (Bill of Lading) and invoice to shipper

Fig. 4: A Decision Support System of 24 Hour Rule

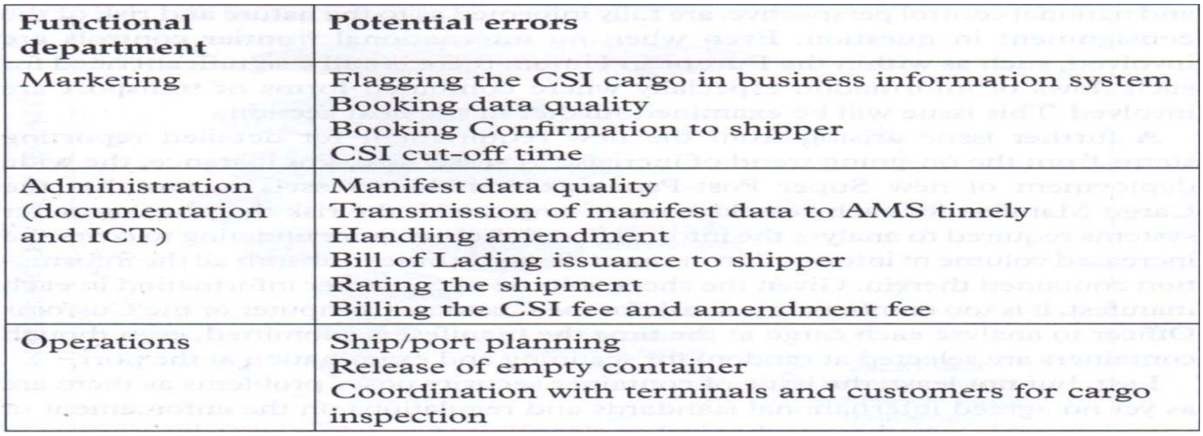
Source: Bichou, K (2009)

Now the question is whether the CSI arrangement either feasible or achievable? Regarding feasibility, it can be argued that this measure is not out of the elaborate security management information system. The proposed CSI embraces the independent inspector intervention includes physical examination, Non-Intrusive examination (Scanning with Gamma Rays), and tracking with sensors at different processes of container loadings. The vessel requires 14 specific data about the container. The availability of massive data, transmission and verification of these data with the CBP, and its clearance may delay the loading operations could require the cargo to be loaded in the next vessel. This warns that the possible disruption of vessel scheduling, increasing demand for shore-based storage infrastructure, and commercial loss due to the cargo being time sensitive, are expected. The CSI uses intelligence and automated information to identify the suspected containers have some drawbacks as the intelligence report does not always provide the crosscheck of statistical reasoning that leads to high level of noise in background data. (Bichou,2009), (Nagle, K.N.2009-10).

The coordination of the all reliable information is a precondition to ensure the objectives of the regime proposed. It is the requirement to collect information, analyse, and assimilate the threat information and need to pass information to the right people to deal with in time, to ensure the purpose of the regime. However, the question arises-what would be the scenario when the intelligence reports and the scanning reports on particular container contradict each other? In this case, the delay is imminent. In the crisis time, if the management of the information system fails to coordinate and obtain exact data from the exact people on time, then the total system of systems may fail to work. (Natale, P.J 2009).

The CSI has been undertaken to thwart the security threats to the US. From that point of view, it can argue that this is a biased security approach, like a USCG deepwater project rather than inspection biased approach.

This approach stresses the prevention rather than inspection. However, these measures have some positive aspects such as the compliance of all transportation regimes can be ensured and complied with, and will increase the supply chain visibility. In the assessment of feasibility, the following dimension needs to inspect and analyse such as marketing, administration (documentation and ICT) and operations are regarded as three functional departments in container transportation as shown in figure 05 below- (Bichou, K .2009)



Functional department	Potential errors
Marketing	Flagging the CSI cargo in business information system Booking data quality Booking Confirmation to shipper CSI cut-off time
Administration (documentation and ICT)	Manifest data quality Transmission of manifest data to AMS timely Handling amendment Bill of Lading issuance to shipper Rating the shipment Billing the CSI fee and amendment fee
Operations	Ship/port planning Release of empty container Coordination with terminals and customers for cargo inspection

Fig. 5: Potential Errors of 24 rules

Source: Bichou, K (2009)

Any local or international legislation needs to conform to the maximum utilisation of resources available, stakeholder interests, and pace of the industry concerned. As the shipping is now derived demand in the world's current context, then the economies of scale come to the corner to consider.

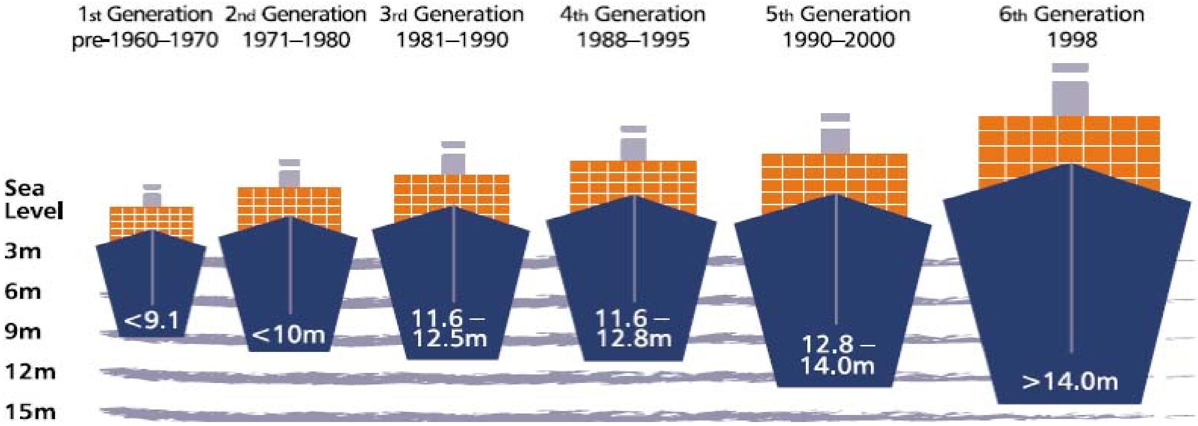


Fig. 6: Evolution of Container Ships

Source: Victorian ports strategic framework

The evolution of container day by day is taking place to keep the economies of scale in the right figure. As the carrier becomes bigger, under 24-hour rule, the inventory lists will be more significant. This inventory seems to be critical in case of group age cosmetics consignments where the carriage of goods ranging from aromatic oils to soaps to lipsticks to nail varnish. Some of them are dangerous goods due to flammable nature. In that case, the computer system of CBP may tend to be laden or require extra time to assess and analyse satisfying their standards set. The likelihood of delays is expected. It seems to be a cumbersome task for the respective custom officer or the CBP due to the sheer volume of container information even that is true in case of random inspection as well. (Bichou, K.2009).

The security literature and economic or financial literature does not exist in the same axis in all time. With the CSI, The US has made great strides in transportation security is beyond doubt. The US-led CSI needs to analyse from the viewpoint of- whether the US authority has taken into account the nature, limitation of regulatory context in which the maritime industry works or operates in the home or international level. The maritime security literature implies to do so before any development, application, management, and risk assessment of any proposed law or regulations. In this case, such initiatives either have been taken or not, have not reported yet. Any international regulatory instruments provide prescriptive guidelines for compliance, implementation while the developments, management of risks are entrusted down to the government agencies, or authorised organisation.

The US-led CSI, it is so far clear that both the regulatory body (CBP), and body of management and implementation of proposed security regime, is the same department which raises the significant question of reliability and impartiality of information they will be gathering in verification and decision-making process. In the same time, the CBP may not allow anybody or third party to access their data or information gathered in any particular case for crosscheck assuming that it is sensitive to be shared. The shippers or carriers may tend to hide information as required by the CBP (14 data) in fear of the fate of transportation of goods, commercial reputation standing in the community, and international arena. This point needs to look at before implementation of the US-led CSI regime on a global scale. If the transparency and accountability of the CBP are not set in a comprehensive framework of an independent body, then the international business community may lose the confidence over the system, or there will be a scope to make or to be victimised commercially. (Bichou, K .2009).

However, it is still unclear –whether the CBP is looking at to the point. In the current trend of international business, the bill of lading is the critical item for international documentary credits, and its behaviour varies with the context especially in shipping as far as concerned. In this case, full and accurate information regarding the final owner of the cargo or cargo movement throughout the supply chain may not be available instantly to the CBP or designated customs officer stationed at the foreign port due to frequent trade made en route that lacks both the feasibility and achievability of the CSI. (Wilson, J.F.2008).

In those particular cases, the situation will lead to congestion at the loading ports because of mandatory 14 data requirements under 24 Hour Rule. The host country will endure the all possible impacts. The maritime security literature both suggests and stresses on international harmonisation and reciprocity rather than a single concept to set common standards and requirements through international bodies and instruments such as the IMO and its legislation. This harmonisation concept facilitates to improve security, increase trade and commerce, better relations and save money. The US-led CSI seems to lack such opportunities. However, regarding reciprocity, the CBP assures the willing participant to join in the CSI, but that is also not out of the US imposed requirements and domination. Regarding security question, it has been seen that either the measures are “The US imposed and other countries conform” attitudes. This unilateral approach and attitude raise the fundamental question of the effectiveness of the measures taken in the global context as the threats of terrorists are not limited to the jurisdiction of the USA authority and CSI participant countries only but have the international dimension. (Natale, P.J .2009).

The conventional risk targeting is based on the assumptions of un-intentional (not deliberately) human or system behaviour to cause harm(safety-risk approach) but in case of the formulation of the CSI has not got the same perspective as the threats stem from terrorists or malicious acts that have the global dimension. The feasibility assessment implies to examine - whether the US-led CSI impede the flow of cargo and commerce. The CBP has undertaken a program, under the CSI, to improve the quality of information provided by the carrier to evaluate the potential risks, put the ocean carrier under the burden. On the other hand, the Importer Security Filing or ‘10+2’ obligates the importers to provide ten specific data to CBP before loading. The ocean carrier is under obligation to place 2 data files before CBP within 48 hours before departure. The 10+2 initiatives will add the annual costs in between $390 million to $ 690 million to the supply chain costs due to filing fees.

Dr Stephen E Flynn, Fellow of the Counterterrorism and National Security Studies, estimates that the 100% container inspection will result in a half day delay per container and radioactive x-ray system will cost $15 to $20 per container. This Estimation indicates that the global supply chain tends to be slower and costly. Nobody is against the principle of security of cargo, vessel and so on but the question of feasibility comes to the corner when security is ensured at the expense of benefits from the globalised economy. (Leone, A.M. 2009-10). It can be argued that the information technology is there for a radical technical solution which raises the concerns- whether that is economical especially for developing CSI countries.

Moreover, the current facility design of the ports and the security dimension sought under CSI are not compatible with the existing global ports. This is the critical point of conflict which gives rise the supply chain cost and raises the question of feasibility from the infrastructural point of view. The argument is that the integration of port facility design and security aspects can minimise the costs and expedite the flow of commerce and cargo throughout the supply chain. (Abbott, S.P. 2009-10). The feasibility examination needs to look at the financial capability point of view. The combating terrorism suggests that three elements are instrumental such as Crisis Management, Consequence Management, and Protective Measures. Crisis management requires plans and methods, and Consequence Management requires strategies and resources. Finally, Protective measure implies to make sure proper planning and resources (Technology, Skilled and trained Manpower, infrastructure), to protect resources. (Christopher, K. (2009).

However, according to the customs of the Netherlands and the United Kingdom, one scanner can scan 30,000 containers per year although the long time is needed to analyse and interpret the image taken. According to British Customs, the mobile scanner costs from $1.5 million to $3.3 million while the fixed scanner is costing about $ 20 million. FEMA (The Federal Emergency Management Agency) under the Port Security Grant Program, the US government, shares the port security costs regarding security equipment maintenance contracts, warranties, repair, or replacement costs and upgrades. It indicates that the USA can share the expenses mentioned above assuming that it is a shared responsibility. In a similar vein, could the CSI governments' effort the same expenses through cost sharing like the USA? What would be the stake holder's' perceptions in CSI countries regarding costs sharing? If not, what would be the alternative? The alternative could be the granting soft loans for the CSI country, but it will also put the CSI members under financial burden. Significantly, it raises the question of the financial and technological capabilities of the allied countries to adopt this measure.

IV. Implications On International Seaborne Trade

The literature of Cost-benefit analysis implies to find out the answer of the question- whether security is a cost or enabler of trade and commerce, whether it is regarded as expense or trade facilitator in the current globalised economy? The current reality is- the emerging security issue seems to be inconsistent with the principle of facilitation of international trade due to additional costs. The additional costs lead to the financial burden to the respective port players that imply to have a right balance between trade facilitation and security measures. The balance between costs and security measures is essential because the additional costs may reduce the consumer's demand for the lower value of goods transported in a container and finally products can be uncompetitive. This issue might impact the economy and the trade of developing countries. (UNCTAD). The maritime operators of the CSI country need to invest vast amounts on security equipment, procedures, and recruitment of additional security personnel in compliance with CSI. The stakeholders seem to endure the CSI compliance, procedural and operational costs. (Bichou, K .2009).The efficient operations of any transport modes are dependent on the modern but simplified procedures and reduced barriers, simplified legal regime, adequate resources, management efficiency and capability etc. in order to facilitate both the integrated logistics operations and consumer's comfort. Dr Stephen E Flynn attempts to investigate- whether security initiatives interrupt the flow of commerce and cargo, does the supply chain seem to be expensive with the CSI? The estimation of Dr Stephen E Flynn indicates that the global supply chain tends to be slower and costly as mentioned earlier (Leone, A.M.2009-10).

The security needs to be ensured to measure the performance of the supply chain in order to have uninterrupted service up to the consumption unit. However, the other side of the security has - the compliance costs, procedural and operational costs. These additional costs seem to be exerted negative pressure on the CSI participant economies. On the other hand, the competitiveness of internationally traded products is influenced by some specific factors such as the Costs including direct costs, indirect costs, additional costs(insurance) etc., Time, Safety, Risks, and finally Security. It seems that the CSI security initiative may increase the direct and indirect costs (due to delay under conventional arrangement such as CSI) but can save the significant costs as the goods flow will not be interrupted by other constraints such as terrorist threats. The insurance premium will be low due to the immediate effect of security. The OCED (2002) estimates that the costs of delays and procedures range from 5 to 13% of the value of the goods traded. (Source: OCED.2002). These estimates suggest to having secured supply chain and if the security question is ignored may become the source of delays. The above recommend that the trading opportunity can be benefitted through organised and harmonised security approach.

All possible circumstances point the finger to the possible delays that are the central concern of all players involved with maritime transportation sectors. The delays have the series of consequences as the delays lead to congestion in ports leads to vessel schedule cancellation and disruption leads to shore-based storage infrastructure demands lead to increased costs of shipper leads to commodity price high and ultimate effects on consumers being deprived of the globalised economy due to the high supply chain. The maritime transport stakeholders involved with trading with the USA may see their economies of scale regarding operating costs in US trade routes(Transatlantic and Transpacific); the CSI may influence their strategies and in setting alternative options.

(UNCTAD Transport Newsletter (2003) FEMA (The Federal Emergency Management Agency) under Port Security Grant Program, the US government, shares the port security costs regarding security equipment maintenance contracts, warranties, repair, or replacement costs and upgrades but the reciprocal program seems to be absent in CSI country which may lead financial burden for stakeholders. AAPA, Port & Politics (2009-2010). In the globalised economy, the literature of integrated logistics system suggests that the goods be produced, consumed, and distributed from the origin (producer) to destination (customer) at right quantity, at the right quality, at the right time and finally at the competitive and right price. As the philosophy is- No transport, No trade and commerce. The integrated transport/logistics ensures the uninterrupted and smooth flow of commerce and cargo and gives the guarantee of transfer at reduced costs to consumers and customers. That means, the optimisation can be achieved through. It can be argued that, with the introduction of CSI, the USA and its CSI allies seek to optimize their own logistical system independently apart from the mainstream global supply chain in the name of security that may result in loss of both the grand integrity of global supply chain and efficient management of product flow across the global chain or pipeline will be sub-optimal and unbalanced due to US-led unilateral approach.

V. CONCLUSION

There is no scope to initiate any measures independently in supply chain management if so, it only will contribute the costs to supply chain. (Banomyong, R. 2005). This may lead to a reduction of efficiency and reliability of the supply chain in particular in the maritime transportation industry. However, the efficient transport and the secured transport are not opposite each other. It can be argued that the world, faces this measure as the first time, has not had any experience and infrastructure to deal with current context, the initial costs will seem to be disappointing to put the new system in place. It indicates that the short-term effects may not be welcoming, but the medium and long-term effects can be a facilitator or driver in trade and overall supply chain enhancements.

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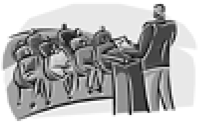
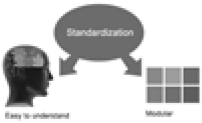


You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The FARSS can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSS, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.



The FARSS will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSS member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A. Once you are designated as FARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSS members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSS member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.

The FARSS is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSS can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSS member can decide its price and we can help in making the right decision.

The FARSS member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

The ' MARSS ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The “MARSS” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSS or William Walldroff, M.S., MARSS.

MARSS accrediting is an honor. It authenticates your research activities. After becoming MARSS, you can add 'MARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSS designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSS, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSS member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

AUXILIARY MEMBERSHIPS

Institutional Fellow of Global Journals Incorporation (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as "Institutional Fellow of Open Association of Research Society" (IFOARS).

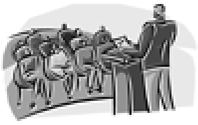
The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.



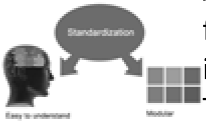
The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.



After nomination of your institution as “Institutional Fellow” and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.

- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.

- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

PREFERRED AUTHOR GUIDELINES

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

BEFORE AND DURING SUBMISSION

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

POLICY ON PLAGIARISM

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

AUTHORSHIP POLICIES

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

PREPARING YOUR MANUSCRIPT

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

FORMAT STRUCTURE

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

PREPARATION OF ELETRONIC FIGURES FOR PUBLICATION

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

TIPS FOR WRITING A GOOD QUALITY SCIENCE FRONTIER RESEARCH PAPER

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- o Single section and succinct.
- o An outline of the job done is always written in past tense.
- o Concentrate on shortening results—limit background information to a verdict or two.
- o Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

CRITERION FOR GRADING A RESEARCH PAPER (COMPILATION)
BY GLOBAL JOURNALS

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	**Grades**		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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