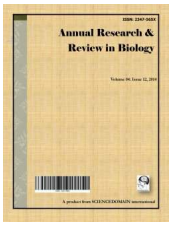

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Ecosystem Perception among Artisanal Fishermen: A Case Study of Akpabuyo and Bakassi Coastal Fishing Communities in Cross River State, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author MOE designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MOE and CUO assessed the analyses and literature searches of the study. Both authors read and approved the final manuscript.

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ABSTRACT

The link between fisheries and their ecosystems are deeper and more significant than those that exist in mainstream agriculture. It is evident that the fisheries sub-sector is experiencing lots of environmental challenges arising from climate change, ecosystem, global warming, amongst others. Artisanal fish productivity is tied to the health and functioning of the ecosystems on which it depends for food, habitat and seed dispersal. This suggest the need to assess the extent to which artisanal fishers perceives the existence of ecosystem effect on artisanal fisheries. Specifically, the study sets to; assess the demographic characteristics and livelihoods of artisanal fishers in the area; assess the perceived impacts of ecosystem on the livelihood of artisanal fisheries; assess the perceptions of artisanal fishers on the ecosystem; determine the difference between mean fishing income and non-fishing income among artisanal fishers in the area; investigate the adaptation strategies adopted by fisher folks to cushion the effects of ecosystem from where the constraints militating

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against artisanal fish production were examined. The data were obtained using a well-structured questionnaire and was analyzed using descriptive and a non-parametric Kruskal-Wallis (Chi-square) test. As a major coastal fishing area in the zone and in Cross River State at large, Akpabuyo and Bakassi Local Government Areas were purposively selected. A multi-stage sampling technique was adopted to select sixty (60) artisanal fishers that constituted the sample size for the study. Results of the demographic characteristics showed that majority (82.1% & 71.9%) of the respondents were males who are married within the age bracket of 51–60 years. Artisanal fishers in the area were not just known for having large family size (between 4-8 and 9-12 children) but educationally disadvantaged as majority (59.4% & 57.1%) had only attend primary and secondary education. The respondents (35.7% and 40.6%) in Bakassi and Akpabuyo saw artisanal fishing as their major occupation as majority had been in the business for more than 15 years. In addition, majority of the respondents (75%) were aware of the existence of ecosystem in the area. Also, majority of respondents (39.3% and 59.4%) in both Bakassi and Akpabuyo affirmed that highest catch is usually recorded between April to June and between July to September for lowest catch in the area. Using the Likert scale approach, a weighted mean of 2.86 and Kruskal wallis test value of 22.519 with df =3, $p<0.000$ was used to assess the perceived impact of ecosystem on the livelihood of artisanal fishers. The result obtained revealed that pollution decreases artisanal fish production, afforestation increases artisanal fish production, increase in rainfall has positive impact on artisanal fish production, soil microbes has positive impact on artisanal fish production, increased temperature from sunlight decreases artisanal fish production, infestation of parasites and soil microbes has a positive impact on artisanal fish production and prolonged dry season decreases fish production. Similarly, a weighted mean of 0.86 and Kruskal wallis test value of 12.617, df = 3, $p<0.006$ indicated that there is a significant difference in the perception of artisanal fishers to ecosystem in the area.

Keywords: Ecological community; environment; perceptivity; artisanal fishermen; coastal fishing communities.

1. INTRODUCTION

Nigeria is blessed with over 14 million hectares of reservoirs, lake, ponds and major rivers capable of producing over 980,000 metric tons of fish annually. Based on water resources, fisheries can be broadly classified into artisanal fisheries (85%), industrial fishing (14%), and culture fisheries (1%) [1,2]. The coastal environments cover 8 per cent of the world's surface, house 70 per cent of the human population, provide 90 per cent of the global fish catch, and deliver 40 per cent of the estimated economic value derived from ecosystem goods and services. The annual fish consumption/demand in Nigeria has been estimated to be over 1.3 million metric tons and the total domestic production is just about 450,000 metric tons per annum [3,4].

According to [1], Nigeria spends N125.38 billion on fish importation annually and the current fish demand in Nigeria stood at over 2.66milliion tones per annum while the present importation rate is over 680,000 metric tons. The country currently has a total local fish production estimated at 551.700 metric tons per annum, which is expected to rise to about 700,000 metric tones in 2015 with an average import of 600,000 metric tons. Artisanal or small-scale fishing operations dominate the fishing industry in Nigeria and employs small, traditional, largely un-motorized craft, simple hand operated gears and small boats, which are highly, labor intensive. It constitutes about 85% of animal protein intake of the entire populace. It is also described as capturing fish from the natural water using traditional fishing gears such as rod and tackles, arrows and harpoons, cast and drag nets, traps, barrier and traditional fishing canoes and boats [5].

Statistical surveys have shown that artisanal fish production is still very low in poor developing countries coupled with the fact that demand for fish in the country exceeds supply between countries considering the increasing human population. This decline has been attributed to a wide range of causes ranging from ecosystem and climate variability, environmental degradation of the water bodies to inadequate management of the fisheries resources [6,7]. For sustainable exploitation of these fisheries, a crucial management tool is to have a comprehensive understanding of the effect of ecosystem and climate variations especially on

artisanal fisheries, which is the most predominant [8].

Most of the decline in production has been attributed to ecological factors such as changes in water temperature, pollution (urban/sewage, industrial, agriculture), urban development, destruction of estuaries, mangrove and coral reefs (climate changes: greenhouse effect, acidification) and ecosystem which restrained their contribution to food security and poverty reduction in the Cross River State and in Nigeria in general. However, the impacts of ecosystem on artisanal fisheries are manifested through increased rainfall, floods, pollution, bush burning, soil, droughts amongst others [9,10].

Though artisanal fish production is the main stay of Nigerian domestic fishing industry, researchers have paid little attention to the experiences of the artisanal fishermen. The capacity of artisanal fisheries to play its triple role of a food supplier, employment provider and income in Cross River State and in the country at large depends on the adoption of appropriate management strategies that will ensure their sustainability in the face of intense fishing pressure [11]. This can be achieved through perception studies of ecosystem influence on artisanal fisheries from were adaptation strategies on how small-scale fishers can make rational production decisions that will positively improve their production and profitability can be addressed. Hence, the need for this study arose, to fill this lacuna.

The study set out to:

- Assess the demographic characteristics and livelihoods of artisanal fishers in the area.
- Assess the perceived impacts of ecosystem on the livelihood of artisanal fisheries.
- Assess the perceptions of artisanal fishers on the ecosystem.

2. METHODOLOGY

2.1 Study Area

The study was conducted in Cross River State. Cross-River is a coastal state in South Eastern Nigeria, named after the Cross River, which passes through the state. It is located on Latitude 4°, 25´ & 7°.00´N, Longitude 7°, 15' & 90.30´E. It shares common boundaries with Republic of Cameroon to the east, Benue State to the north Ebonyi and Abia States to the west and Akwa Ibom State and the Atlantic Ocean to the south. Rainfall distribution is bimodal with a range of 1700-2500 mm, while its peak is in July and September. The temperature range is between 27℃-30℃ [12].

2.2 Population of Study

The population of the study consists of registered artisanal fishermen in Akpabuyo and Bakassi Local Government Areas of Cross River State.

2.3 Sample Size and Sampling Technique

As a major coastal fishing area in the zone and in Cross River State at large, Akpabuyo and Bakassi Local Government Areas were purposively selected. A two-stage sampling technique was employed in this study.

Stage 1 - Random selection of two (2) coastal fishing communities in each LGAs.

Stage 2 - Random selection of sixteen (16) artisanal fishers from each community in Akpabuyo and fourteen (14) artisanal fishers from each community in Bakassi, giving a total of sixty (60) respondents which constitutes the sample size for the study.

Table 1. Summary of the sampling procedure adopted in this study

Agricultural zones in cross river state	Major coastal fishing zone	Major coastal fishing lgas	Major coastal fishing communities	No. of artisanal fishers
Ikom		Akpabuyo	Esuk Idebe	14
Ogoja	Calabar		Offiong Umoh	14
Calabar		Bakassi	Ifiang Oyong	16
			Akwa Obutong	16
Total				60

Source: Field survey, 2016.

2.4 Sources of Data Collection

The data used for the study were obtained from a cross section of artisanal fishers using validated structured questionnaires.

2.5 Data Analysis

Descriptively, Objectives 1, was tabulated using percentages, mean and standard deviation of continuous data and frequencies of categorical data. Objectives 2, 3 and 6 were realized using four point Likert scale from ordinal responses (ranging from "Strongly agree" to Strongly disagree). Non-parametric Kruskal-Wallis (Chi-square) tests were used. The mean score was calculated after respondents' responses were obtained with a four point Likert type of scale. A four point likert scaling procedure was adopted:

SA= Strongly Agree (4)	SD = Strongly Disagree (2)
A = Agree (3)	D = Disagree (1)

The likert scaling type measuring instrument is represented by the formula:

$$X = \frac{\sum fx}{N} \quad (3.1)$$

Where;

X = Mean score
Σ = Summation sign
F = Frequency
N = No. of respondents.
x = Nominal value of each response category (i.e 1, 2,3 and 4)

$$weighted\ \text{mean} = \frac{\sum X}{n}$$

Where;

n = Number of response

Decision rule: Any mean value greater or equal weighted mean is positive (agree statement) while mean value less than weighted mean are negative (disagrees statement).

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristic of Respondents

The result of the demographic characteristics of the respondents is presented in Table 2. It is evident that artisanal fishers in Bakassi and Akpabuyo areas were mostly male, with 82.1% and 71.9% respectively. Thus, there was more male than their female counterparts in the study area. This result can be justified by the assertion of [13] that men mostly dominate fisheries activities.

The results revealed that majority of the respondents (32.1%) in Bakassi were between ages 51 – 60 years and above 60years, while that of Akpabuyo were between 41-50years. This implies that active and energetic individuals who are able to withstand stress in fishing operations in order to have a more effective production system do artisanal fishing activities. This conforms to studies carried out by [14,15]. Majority of the respondents (67.9% and 68.8%) were married in both Bakassi and Akpabuyo LGAs respectively. This gives a clear indication that the married artisanal fishers were predominant in the area. This corresponds to studies carried out by [16] as married class were often more inclined to artisanal fishing primarily to enhance food sufficiency for household consumption.

The educational status of respondents showed that majority (57.1%) of the artisanal fishers in Bakassi had attended secondary education compared to Akpabuyo (34.4%), were majority (59.4%) of the artisanal fishers have only acquired primary education level. In addition, only 3.6% of the respondents had tertiary education in Bakassi, while none was recorded for Akpabuyo. These implies a high illiteracy level amongst artisanal fishers in the area especially in Akpabuyo LGA and suggest the need for extension education to be encouraged in order to bring about a better understanding of new innovations and technologies that will help to improve their production. This is not in consonance with studies carried out by [8,17], were majority of the respondents had formal education ranging from primary to tertiary education. According to [18], the level of people's education bears direct influence on their attitude, belief, values and general behavior.

Similarly, in terms of household size, majority (35.7%) of the artisanal fishers in Bakassi had between 4-8 and 9-8 while a larger percentage of respondents (56.7%) in Akpabuyo had between 4-8 implying a high dependency ratio. Hence, they are known for large family size in order to utilize family labor during their fish catch. This result is in line with studies carried out by [6].

In terms of respondent's years of experience in artisanal fish business, results reveals that only about 40.6% of the respondents in Akpabuyo have had between 9-12 years' experience in artisanal fishing business, compared to Bakassi with a larger number of artisanal fishers (35.7%) with more than 15 years of artisanal fishing business. This implies that artisanal fishing has been a major occupation by majority of the respondents in Bakassi for a long time, thus, its lucrative nature may have encouraged young and more people in places like Akpabuyo to develop interest in the artisanal fishing. [19], noted that farmers sometimes count more on their experiences than educational attainment in order to increase their productivity.

In addition, majority of the artisanal fishers (67.9%, 87.3%) belong to social group in both Bakassi and Akpabuyo LGAs respectively. This suggests the need for proper extension service delivery especially by encouraging adult education amongst artisanal fishers in the area. Majority of the respondents (75%) were seen to have had knowledge about ecosystem, implying that artisanal fishers were aware of the existence of ecosystem in the area. In addition, respondent's major source of finance in the area was from personal savings as they were actively engaged in not just fishing business but into arable cropping in order to make ends meet. Results have also proven that months with the highest and lowest fishing catch was April-June and July –September respectively in both LGAs. This result is in line with studies carried out by [5].

3.2 Perceived Impact of Ecosystem on the Livelihood of Artisanal Fisheries

Table 3 shows the perceived impact of ecosystem on the livelihood of fisheries. Kruskal-Wallis test was used to assess the significant perceived impact of ecosystem on the livelihood of artisanal fisheries. The result indicated a Chi-Square value of 22.519 with df =3, $p<0.000$. This indicated that there is a significant difference in the perceived impact of ecosystem on the livelihood of artisanal fishers. By using the Likert scale approach, a weighted mean of 2.86 was used to obtain the perceived impact of ecosystem on the livelihood of artisanal fishers.

The result obtained from the respondents revealed that pollution decreases artisanal fish production, afforestation increases artisanal fish production, increase in rainfall has positive impact on artisanal fish production, soil microbes has positive impact on artisanal fish production, increased temperature from sunlight decreases artisanal fish production, infestation of parasites and soil microbes has a positive impact on artisanal fish production and prolonged dry season decreases fish production. For instance, pollutants from homes and industrial effluents affect aquatic ecosystem, introducing methyl mercury into the aquatic environment leading to reduction in gonadal development and egg production and limit successful spawning [20,21]. These effects could decrease reproduction and by implication affect fish population [22]. Pesticides which may come from fields through runoffs to water bodies may have affected 27 freshwater fish species in Europe [23]. Also, [24], fish body tissues were reported to have been damaged by pesticides.

In this study by [25] who identified changes in water temperature, precipitation and oceanographic variables, such as wind velocity, wave action and sea level rise, can bring about significant ecological and biological changes to marine and freshwater ecosystems and their resident fish populations and [24] who concluded that extreme weather events may also disrupt fishing operations and land-based infrastructure. These all point to the fact that the ecosystem responds to changes in the physical environment which affects its biological components.

3.3 Perception of Artisanal Fishers on the Ecosystem

The perception of artisanal fishers on the ecosystem was presented in Table 4. The results showed that deforestation, destruction of aquatic habitat, burning fossils and gas flaring by industries with mean score higher than the weighted mean were identified as the perceived factors of artisanal fishers to ecosystem. This result was further supported by that of the Kruskal-Wallis test which revealed a Chi-Square value of 12.617, df = 3, $p<0.006$. This indicated that there is a significant difference in the perception of artisanal fishers to ecosystem in the area. Using the likert scale approach, the result indicated a weighted mean of 0.86. This is in conformity with study by [26] who posits that farmers perceived climate change effects from sustained changes over time in environmental temperatures, rainfall intensity and pattern and also wind variability. Also that of [18,21] who identified temperature changes, pollution and excessive wind as the perception of artisanal fishers to ecosystem.

Table 2. Demographic characteristic of respondents

Variable	Bakassi		Akpabuyo	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Gender				
Male	23	82.1	23	71.9
Female	5	17.9	9	28.1
Total age	28	100	32	100
31-40	4	14.3	7	21.9
41-50	6	21.4	12	37.5
51-60	9	32.1	10	31.3
>60	9	32.1	3	9.4
Total marital status	28	100	32	100
Single	1	3.6	5	15.6
Married	19	67.9	22	68.8
Divorced	4	14.3	1	3.1
Widowed	4	14.3	4	12.5
Total education	28	100	32	100
No Formal Education	2	7.1	2	6.3
Primary	9	32.1	19	59.4
Secondary	16	57.1	11	34.4
Tertiary	1	3.6	-	-
Total household size	28	100	32	100
1-3	7	25.0	5	15.6
4-8	10	35.7	18	56.3
9-12	10	35.7	8	25.0
13-15	1	3.6	1	3.1
Total labour	28	100	32	100
Family	22	78.6	25	78.1
Friends	3	10.7	7	21.9
Hired	3	10.7	-	-
Total social group	28	100	32	100
Yes	19	67.9	26	81.3
No	6	32.1	6	18.7
Total knowledge on ecosystem	28	100	32	100
Yes	21	75	24	75
No	7	25	8	25
Total primary occupation	28	100	32	100
Arable cropping	8	28.6	14	43.8
Civil servant	4	14.3	3	9.4
Hunting	2	7.1	3	9.4
Fishing	13	46.4	11	34.4
Private job	1	3.6	1	3.1
Total Source of finance	28	100	32	100
Family	1	3.6	1	3.1
Friends	6	21.4	8	25.0
Social groups	2	7.1	-	-
Co-operative	6	21.4	1	3.1
Personal saving	13	4.64	22	68.8
Total Years spent in business	28	100	32	100
1-3	1	3.6	-	-
4-8	1	3.6	2	6.3
9-12	8	28.6	13	40.6
13-15	8	28.6	9	28.1

Variable	Bakassi		Akpabuyo	
	Frequency	Percentage (%)	Frequency	Percentage (%)
>15	10	35.7	8	25.0
Total highest catch	28	100	32	100
January- march	6	21.4	-	-
April-June	11	39.3	19	59.4
July-September	2	7.1	1	3.1
October-December	9	32.1	2	37.5
Total lowest catch	28	100	32	100
January- march	**-**	**-**	**-**	**-**
April-June	1	3.6	-	-
July-September	27	96.4	31	96.9
October-December	-	-	1	3.1
Total	28	100	32	100

Source: Computed from field's survey, 2016

Table 3. Perceived impact of ecosystem on the livelihood of artisanal fisheries

Perception	SA	A	SD	D	Cum	Mean	Rank
Increase in rainfall has positive impact on artisanal fish production	17(68)	43(129)	-	-	197	3.28	3rd
Excessive wind increases artisanal fish production	1(4)	30(90)	10(20)	19	133	2.22	9th
Prolonged dry season decreases fish production	5(20)	47(141)	5(10)	3	174	2.90	**7th**
Increased temperature from sunlight decreases artisanal fish production	9(36)	46(138)	1(2)	4	180	3.00	**5th**
Pollution decreases artisanal fish production	25(100)	31(93)	2(4)	2	199	3.32	**1st**
Long period of harmattan season increase artisanal fish production	1(4)	34(102)	11(22)	14	142	2.37	8th
Inadequate rainfall has positive impact on artisanal fish production	2(8)	19(57)	19(38)	20	123	2.05	10th
Infestation of parasites and soil microbes has a positive impact on artisanal fish production	3(12)	55(165)	-	2	179	2.98	**6th**
Afforestation increases artisanal fish production	18(72)	42(126)	-	-	198	3.30	**2nd**
Soil microbes has positive impact on artisanal fish production	9(36)	51(153)	-	-	189	3.15	**4th**

Weighted mean= 2.86, Kruskal-Wallis Statistics, 22.519, p-value is 0.000, 3 df. Cum = cumulative frequency; SA = strongly agree, A = agree, SD = strongly disagree, D= disagree, Source: Computed from Field survey, 2016

Table 4. Perception of artisanal fishers on the ecosystem

Factors	SA	A	SD	D	Cum	Mean
Incidence of heavy rainfall	4(16)	52(156)	1(2)	3	177	0.27
Excessive sunlight	6(24)	52(156)		2	182	0.40
Increased temperature and sea level rise	2(8)	40(120)	6(12)	12	152	0.13
Destruction of aquatic habitat	25(100)	32(96)		3	199	1.67
Deforestations	27(108)	31(93)	1(2)	1	204	1.80
Gas flaring by industries	13(52)	45(135)		2	189	0.87
Burning fossils	16(64)	40(120)	2(4)	2	180	1.07
Weather change resulting in a change in time of rainfall	10(40)	49(147)	1(2)		189	0.67

Kruskal Walis statistics =12.617; p-value = 0.006; df = 3, Weighted mean = 0.86.Cum = cumulative frequency; SA = strongly agree, A = agree, SD = strongly disagree, D= disagree

4. CONCLUSION

There is an indisputable fact that there had been a larger populace of research work on fisheries, yet, Nigeria still imports fish to supplement the domestic fish production with a deficit supply of 50% which constitutes a huge avoidable drain to Nigeria's scarce foreign exchange. In Cross River State, the effect of ecosystem on fish is not in doubt arising from flooding, pollution, drought, sunlight, temperature, habitat, soil type, weather and depositions of silt which not only do physical damage to the structures and profitability but also causes loss of fish and great changes in the quality of water. This suggests the need to assess the extent to which artisanal fishers perceives these impact, from were adaptation measures adopted by fisher folks in cushioning these effects were identified. Ecosystem effect is perhaps the most serious threat to artisanal fishing in the Niger Delta region of Nigeria including Cross River state. The study confirms that the fishers were aware of the phenomenon but their level of knowledge about the impacts on fish was low. The empirical findings of this study showed that the respondents income from fishing were significantly higher than those they obtain from non- fishing activities and the fishers applied daily water check, introduction of organic material through afforestation to minimize sunlight effect, ensuring good water circulating system and minimizing human activities like refuse dumping, burning and bathing to eradicate pollution as a coping strategies to cushion the effects of ecosystem on the fishing environment. The major constraints militating against artisanal fish production in the area were high cost of fishing inputs, high cost of netting and canoe, lack of capital and drying up of river during dry season.

5. POLICY RECOMMENDATIONS

Based on the results of the study, the paper recommends that,

i) There is need therefore, for a multi-media enlightenment campaign on the impact and possible adaptation strategies of ecosystem effect on fishing environment, to reach all fishers, using the available extension services on ground by all stakeholders.
ii) Since the area is dominated with older age fish farmers, the youth should be educated on the benefits of artisanal fishing so as to encourage their effective participation.
iii) Also, there is need for government to help in educating these artisanal fishers through adult education programme in order to improve the literacy level and promote their better understanding on the use of new innovations and technologies that will improve artisanal fish production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Kruskal-Wallis One-way Analysis of Variance for 32 Cases

The categorical values encountered during processing are

Variables	Levels			
VAR(1) (4 levels)	1.000	2.000	3.000	4.000

Dependent Variable	VAR(2)
Grouping Variable	VAR(1)

Group	Count	Rank Sum
1	8	110.500
2	8	202.500
3	8	140.500
4	8	74.500

Kruskal-Wallis Test Statistic: 12.617
The p-value is 0.006 assuming chi-square distribution with 3 df

Conover-Inman Test for All Pairwise Comparisons

Group(i)	Group(j)	Statistic	p-Value
1	2	3.038	0.005
1	3	0.991	0.330
1	4	1.189	0.244
2	3	2.048	0.050
2	4	4.227	0.000
3	4	2.180	0.038

Dwass-Steel-Chritchlow-Fligner Test for All Pairwise Comparisons

Group(i)	Group(j)	Statistic	p-Value
1	2	4.323	0.012
1	3	1.045	0.881
1	4	-2.196	0.406
2	3	-1.563	0.686
2	4	-4.618	0.006
3	4	-1.802	0.579

>REM -- End of commands from the KRUSKAL dialog

▼File: Untitled2.syz
>REM -- Following commands were produced by the KRUSKAL dialog:
>REM NPAR
*>KRUSKAL VAR(1) * VAR(2)/ DWASS INMAN*

▼Nonparametric: Kruskal-Wallis Test

Kruskal-Wallis One-way Analysis of Variance for 40 Cases

The categorical values encountered during processing are

Variables	Levels			
VAR(2) (4 levels)	1.000	2.000	3.000	4.000

Dependent Variable	VAR(1)
Grouping Variable	VAR(2)

Group	Count	Rank Sum
1	10	187.500
2	10	352.000
3	10	129.000
4	10	151.500

Kruskal-Wallis Test Statistic: 22.519
The p-value is 0.000 assuming chi-square distribution with 3 df.

Conover-Inman Test for All Pairwise Comparisons

Group(i)	Group(j)	Statistic	p-Value
1	2	4.667	0.000
1	3	1.660	0.106
1	4	1.021	0.314
2	3	6.327	0.000
2	4	5.689	0.000
3	4	0.638	0.527

Dwass-Steel-Chritchlow-Fligner Test for All Pairwise Comparisons

Group(i)	Group(j)	Statistic	p-Value
1	2	5.242	0.001
1	3	-2.044	0.471
1	4	-1.342	0.778
2	3	-5.314	0.001
2	4	-5.197	0.001
3	4	0.821	0.938

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