6-4. An Enforcement System of Resource Management

(1) Entire picture of management system and role of each component

In recent years, the concepts of Co-Management (CM) and Community Based Fisheries Management (CBFM) have been gaining momentum around the world. CM is meant to have joint management of resources, and the method of control is defined in the context. Meanwhile, CBFM is a fisheries management.

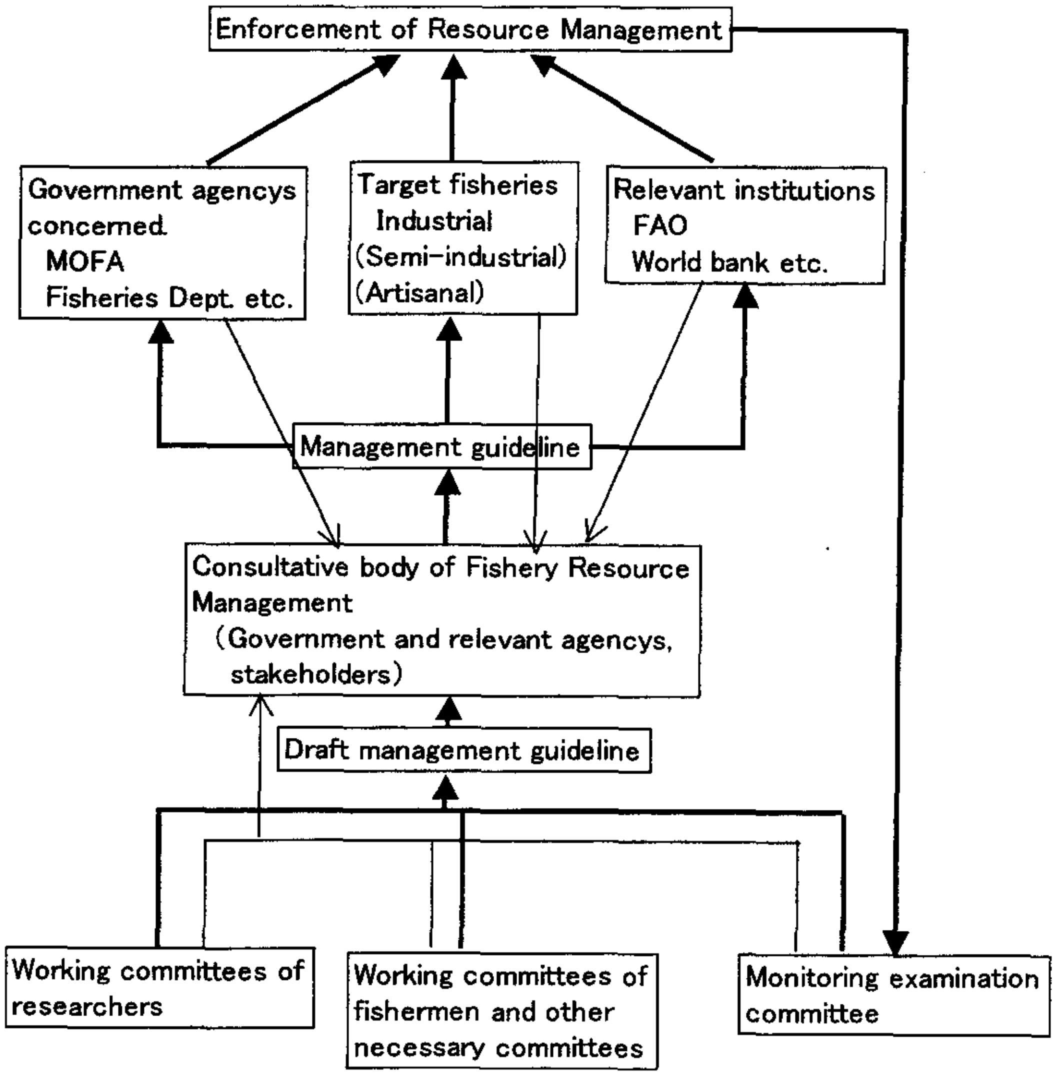
CM is meant that fishermen and people concerned assume joint responsibilities for controlling fishing zones and resources and for making fair distributions of benefits from resources (Borrini-Feyerabend et al., 2000). More specifically, government agencies, fishermen, and NGOs etc. cooperate to have joint management over fishery resources, including *decisions and responsibilities on the use of marine resources.* Although CM has many stages of development, it is considered as ideal to shift from government-initiated CM to fishermen-initiated CM.

We cannot find a typical document where CBFM is clearly defined. However, the CBFM concept aims to promote communities by offering them opportunities to play the major role in the promotion of resource. When such resource management begins to increase and stabilize catch quantity and values of gross landing, relieving poverty and unemployment problems in the area, more effective means of resource management programs can be introduced in the community. This is an ideal image of CBFM. In other words, CBFM will work on a wide variety of problems in the community centering on resource management although its method of resource management is the same as that of CM

It is not desirable that the government enforces its one-sided resource management programs. Instead, we propose CM-initiated resource management. In this respect, as mentioned earlier, the Fisheries Department is aware of the significance of the CM approach and no major problem is expected to take place.

If CM-initiated resource management is applied to Ghana, cooperation between government agencies and fishermen is essential. A consultation body must be set up where officials of the Fisheries Department of the Ministry of Food and Agriculture, FAO and other relevant institutes, and representatives of Industrial fisheries participate as members of the body. The organizer of this body should have a view that fishermen of Semi-Industrial and Artisanal fishing will join the body in the future. Since the body is for consultations among representatives of the government, relevant agencies, and fishermen, resource management will be enforced according to decisions and programs made by them. Evaluation of resource management effects, verification, revisions, and other subjects related to resource management are included in the subjects to be consulted by the body. What is important to note is that resource researchers, who make scientific evaluation on stock, fisheries and economy, and fishermen must be included in the body, besides officials of government agencies and relevant institutions. Accordingly, it is desirable that the body has a number of sub-committees, such as working committees of researchers and that of fishermen (consists of the representatives of local fishermen).

The following figure illustrates an enforcement system of resource management.



Conceptual System of Ghanaian Fishery Resource Management and Enforcement

(2) Monitoring system and working contents

Monitoring is one of the most important things after implementation of the management. Therefore, we repeat here a part of Chapter 5-2-5(5), thought it is redundant.

For the monitoring, it is essential to grasp catch quantity by species and length composition.

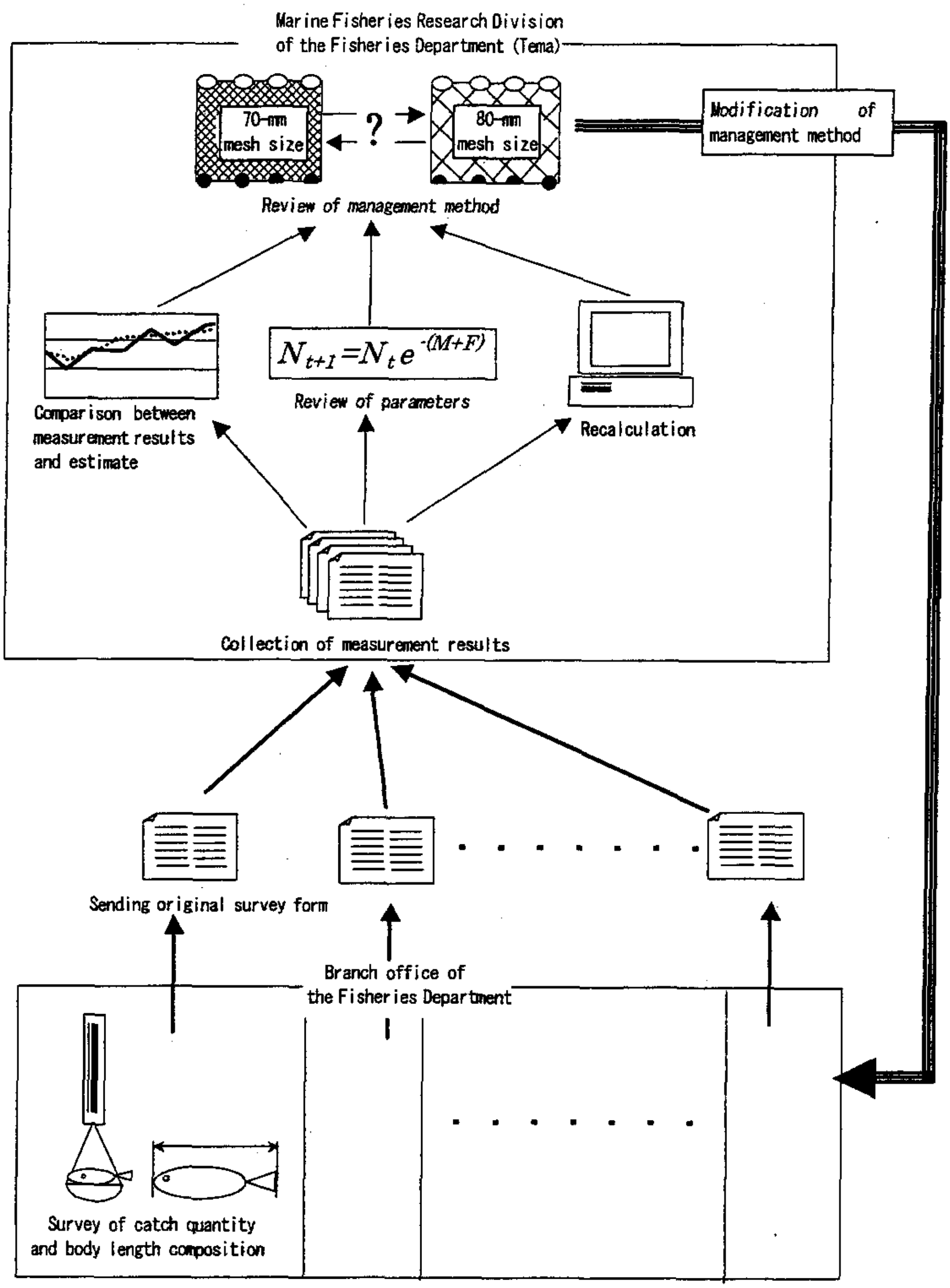
Basically, the present method does not cause any problem to determine the catch quantity by species. Note that even a local staff in the Fisheries Department cannot clearly distinguish from one species to another such as Sparidae (for example, between *S. caeruleostictus* and *D. canariensis*). These species are currently classified under the same classification item in the statistics. For at least evaluation target species, however, it is necessary to prepare a manual for the identification of species and train the local staff so that they can identify the catch quantity by species. It is a matter of course that fishing effort data, such as the total number of the vessel operated, must be collected at the same time.

In such a manner, it is the first step of monitoring to grasp catch quantity and CPUE, which is the most direct indicator of the stock status.

It is necessary to investigate about twice a month the body length composition of all evaluation target species landed from a vessel chosen randomly. At this time, if the body length measurement method by photography used in the present survey is adopted and only pictures are sent together with the original survey form for catch quantity to MFRD of the Fisheries Department, the load imposed on the local staff and fishery operators may be minimized. For cuttlefishes (*S. officinalis*) caught mostly through Industrial fisheries, a responsible person in MFRD must go to the Tema Harbor at the right time when a trawler enters the port and measure the body length composition.

The responsible person in MFRD then classifies data on the catch quantity and body length composition collected throughout the country and converts the body length composition into the age composition to compare it with the simulation results. The parameters will be updated and used for the predictive calculation as required.

The conceptual diagram of the monitoring system is shown on the following page.



Conceptual Diagram of Monitoring System

6-5. Remarks in Enforcing Resource Management

In enforcing resource management programs, it is essential to have cooperation and understanding from fishermen in order to have effective management, besides enforcing relevant laws and regulations. For example, since it is virtually impossible to have around-the-clock crackdown operation on poaching boats along the entire coastal waters of Ghana, enlightening fishermen is essential. When fishermen come to understand the reasons why resource management is needed and expected effects to be brought about by the resource management, they will voluntarily follow the resource management programs. Without cooperation from fishermen, no effective management of resources can be expected.

In case fishermen have not had any experience on "voluntary management," no compulsory programs should be imposed on them. Even when you have gather fishermen and have seminars and meetings for resource management, you should not enforce resource management programs right after such meetings. This is because fishermen may attend such seminars and meetings, they just listen to your talks, which does not mean that they agree to your resource management programs, or they may forget the content of your talks later. Therefore, it is essential to build up reliable relations with fishermen through bodies and agencies under the resource management enforcement system. Successful formation of such reliable relations with fishermen will be the milestone to lead to successful resource management in Ghana.

7. **Suggestions for future resource management**

In the previous chapter, we made suggestions about the draft of guidelines for the future resource management policy. We also made reference to future challenges to the Fisheries Department of Ghana: that is, quantitative monitoring of resource management effects, which will be essential from the start of the resource management, investigation of the actual conditions of semi-industrial and artisanal fisheries, and taking proper measures for resource management for both fisheries based on the actual conditions.

It is necessary to overcome these problems so that the resource management will not end up an armchair plan. We can easily imagine, however, that solution to these problems is not possible in a single day and requires a lot of time. Under these circumstances, while conducting the resource management, the Fisheries Department of Ghana has no choice but to overcome these problems at the same time. Naturally, it is better to minimize the time required to solve the problems. In order to do this, it is necessary to study means to overcome the problems efficiently such as joint research with JICA and international organizations including FAO. In particular, the performance of surveys to determine the actual conditions of artisanal fisheries is indispensable to future resources management. However, due to the facts that there are 276 landing ports in the country and there is no nationally organized fishermen's cooperative society, considerable difficulties are expected to be encountered right from the planning stage. These include the selection of representative landing ports, determination of the contents and frequency of surveys, the securing of cooperation from and the provision of public relations aimed at those who are involved in artisanal fisheries. Furthermore, in light of the need for full-time surveyors who possess knowledge of resources management, fishing operations and the economies of fishery households, we propose the launching of a joint survey project so that resources management will be implemented without delay in the future. For information, details of the above-mentioned survey project will be as follows:

- Scope of survey:

  Representative target fishery landing ports as selected from the entire coastal line in consideration of regional characteristics

- Sectors to be studied:
  Semi-industrial and artisanal fisheries
- Items to be studied:
  Actual conditions of fishing operations, the domestic economies of fishery households, education about the resources management
- Survey periods:
  Stable period, upwelling period and transition period
- Contents of surveys:
  - Actual conditions of fishing operations:
    Fishing seasons and fishing grounds by fishing boat class , species and fishing methods,
    Catchability by fishing boat class, species and methods by purchasing the entire catch of individual fishing boats
    Catch quantity by fishing boat class, species and fishing methods
    State of affairs with regional fishermen's cooperative society and fishing village society
  - Domestic economies of fishery households:
    The value of gross landings by fishing boat class, species and fishing method
    Age structure of shipowners and crew members and their fishery incomes
    Detailed item-by-item fixed and variable costs
    Full-time fishermen's and part-time fishermen's disposable incomes
  - Surveys to determine the actual conditions of awareness-raising activities concerning resources management and to identify the feasibility of conducting appropriate educational campaigns

We suggest that the Fishery Department of Ghana carefully consider and study solutions to the problems above and concrete measures to carry out future resource management to make the most of the product of joint research between Ghana and Japan.

8. REFERENCE

Bannerman, P. O. K. A. Koranteng and C. A. Yeboah. 2001. Ghana Canoe Frame Survey 2001. Fisheries Department, Marine Fisheries Research Division, Ghana.

Borrini-Feyerabend, G., M.T.Farvar, J.C.Nguinguiri, and V.A.Ndangang. 2000. Co-management of Natural Resources: Organising, Negotiating and Learning-by-Doing. GTZ and IUCN, Kasparek Verlag, Heidelberg (Germany).FAO. 2000.

Report of the fifteenth session of the Fishery Committee For The Eastern Central Atlantic(CECAF). Abuja, Nigeria, November 2000. FAO Fisheries Report No. 642.

FAO. 2000. Report of the first session of the Scientific Sub-Committee of the CECAF. Abuja, Nigeria, October 2000. FAO Fisheries Report No. 641.

FMOC. 2000. REVIEW OF AND RECOMMENDATIONS TO OPERATIONALISE MARINE FISHERIES POLICY AND MANAGEMENT PLAN FOR GHANA.

Government of Ghana. 1997. GHANA-VISION 2020, The First Medium Term Development Plan(1997-2000).

Government of Ghana. 1998. GHANA-VISION 2020, Programme of Action For The First Medium-Term Development Plan(1997-2000).

Hosho, T. 1999. First step to KAFS model. Monthly Ocean. Extra edition No. 17. 92-96.

Kimoto, H. 2001. KAFS. Report of the stock assessment system establishment project Instruction of Stock Assessment --. 129-150. Japan Fisheries Resource Conservation Association.

Kodansha Publishing. Co. 1997: Navics 1997.

Koranteng, K. A. 1993. Ghana National Fisheries Development Project, Fisheries Department.

Mace, P.M. 1994 : Relationships between common biological reference points used as thresholds and targets of fisheries management strategies. Can. J. Fish. Aquat. Sci. 51:110-122.

Mensah, M. A. and K. A. Koranteng. 1998. A Review of the Oceanography and Fisheries Resources in the Coastal Water of Ghana, 1981-1986. Fisheries Department, Research and Utilization Branch, Tema, Ghana.

Oda, T. (edit). 1962. New World Geography 9 "Africa," Asakura Publishing Co., Ltd., Tokyo

Otsuki.T. 1999. International Information Basic Series, Africa. Jiyukokumin Publishing Co.

Pauly, D. 1980. On the interrelationships between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks. J. Cons. int. Explor. Mer., 39(2):175-192.

Research Division of Japanese Fisheries Agency, 1990. : Biological Characteristics of Fisheries Target Species in Japan.

Sigbjorn, M., O.Alvheim, K.A.Koranteng and M.Tandstad. 1999. Surveys of the fish resources of the western Gulf of Guinea(Benin, Togo, Ghana, Cote d'Ivoire). Preliminary cruise report.

Takane, T. 1998. Economy of Africa Edit by Suehara.T. Sekai-shiso Publishing Co.

Tanaka, E. 1990. Length composition analysis (LEFRAN ver1.3). Programs for stock assessment by PC (II). 69-82. National Research Institute of Fisheries Science.

Uda, M. 1974. Upwelling Phenomena In The World's Oceans Marine Science 6(6). 14-21

Central Intelligence Agency(USA) (*Web site*). 2000. The World Factbook 2000. http://www.odci.gov/cia/publications/factbook/

ANNEX

Analysis of Fish from Ghana for Mercury (Hg) Levels

This study was done in order to determine the level of mercury (Hg) in five species of fish obtained from two different places in Ghana.

In this report, samples are shown by symbols such as TA01, TB05 or ND10. The first letter (T or N) indicates the site where the sample was collected. The second letter (A, B, C, D or E) indicates species. The numerals (01 to 10) indicate sample number.

Site : T: place close to Tema Harbour N: place distant from Tema Harbour

Species (A, B, C, D, E) : A *Pseudupeneus prayensis*

B *Pseudotolithus senegalensis*

C *Cynoglosus senegalensis*

D *Dentex canariensis*

E *Sparus caeruleostictus*

A Report on Mercury Content of Fish

Clinical Pathology Unit
Noguchi Memorial Institute for Medical Research
University of Ghana,
Legon.

<u>September 3, 2002</u>

Officers in Charge

Professor Alexander K. Nyarko - Pharmacologist/Toxicologist, Head of Unit

Dr. Nii-Ayi Ankrah - Clinical Chemist/Toxicologist, Senior Research Fellow

Research Assistant

Mr. Mark Ofosuhene
Mrs Regina Appiah-Opong
Mr. Osbourne Quaye

Technical Staff

Mr. Y.A. Akyeampong
Mr. J.Y. Assaku
Mr. B.R. Anku
Mr. Eric Dake
Mr. Francis Attigah

TITLE
Analysis of Fish from Ghana for Mercury (Hg) Levels

PURPOSE OF STUDY
The purpose of the study was to determine the level of mercury (Hg) in five species of fish obtained from two different places (sites) in Ghana.

TEST ARTICLES
Five species of fish labeled A, B, C, D and E obtained from two sites coded N and T.

TEST FACILITY:
Noguchi Memorial Institute for Medical Research, University of Ghana, Legon.

METHOD OF DETERMINATION
The method employed for determining levels of mercury in the fish samples involved wet digestion under low temperature followed by atomic absorption spectrophotometry.

STATISTICS
Statistical analysis was performed with SigmaStat version 2.0 statistical package (Copyright 1992-1995 Jandel Corporation). Results are expressed as mean ± standard deviation (or standard error of the mean (SEM)). t-test (parametric) was used to determine if there were differences between the species from the sites and within species when the results of the groups are normally distributed. The Mann-Whitney Rank Sum Test (a nonparametric test) was used in place of t-test when groups failed the normality test. The Kruskal-Wallis ANOVA on ranks followed by Students-Newman-Keuls analysis was performed to confirm the results. Statistical significance was set at p values < 0.05.

RESULTS AND DISCUSSIONS
Table 1 shows that the mercury levels in all the fish species from site N and T are far below the limit of 400 ppb (0.4 ppm). Table 2 shows a comparison of the means of similar species from sites N and T. The mercury levels in similar fish species from sites N and T were not significantly different. Similarly, no significant differences were observed when the mean mercury levels in all species from site N were compared with those from site T.

Table 3 show results obtained when species from site N were compared for statistical differences in their mercury content. All the values were found to be below the cut off limit of 400ppb (0.4ppm). Comparisons however, show that the mercury levels in species A were significantly higher than levels in species B at site N. Table 4 shows results obtained for site T where mercury levels in species A was significantly higher than levels found in species B and D. Again at site T, mercury level in species E was significantly higher than that of species D.

Apart from species A from both sites N and T, which had statistically higher albeit below the limit of 400 ppb (0.4 ppm) the data does not suggest that any of the fish species is contaminated with mercury.

The students' t-test performed above was on request of the client. However, in view of the number of groups involved and the non-parametric nature of the data, Kruskal-Wallis ANOVA on ranks was performed to confirm the results of the t-test. These analyses (Tables 5, 6 and 7) also revealed differences among the groups ($p<0.001$), confirming the t-test analyses above. All pair-wise multiple comparison with Student-

Newman-Keuls post-hoc analyses further showed that at site T, the difference in mercury levels between species B and D, and species C and D are statistically significant (Table 6). Table 7 further shows other differences detected by the ANOVA on ranks test.

CONCLUSION

In conclusion, analyses of five (5) species of fish (labeled A,B,C,D,E) obtained from two sites coded N and T in Ghana had mercury levels below 15 ppb (< 0.015ppm). Species A, which had the highest mercury levels at the two sites was about 30-fold lower than the cut-off limit of 0.4 ppm.

Table 1: **Mercury levels in individual fish specimen from sites N and T**

Sample #	Mercury (Hg) Level (ppb)									
	NA	NB	NC	ND	NE	TA	TB	TC	TD	TE
1	11.14	8.93	7.81	16.74	22.28	11.14	7.36	4.46	2.23	4.46
2	13.37	6.68	17.86	10.04	16.72	15.61	4.46	42.36	2.23	8.91
3	4.46	2.23	5.57	28.97	5.57	18.97	40.13	26.73	2.23	11.15
4	11.15	6.69	7.80	5.13	5.57	24.50	7.81	8.93	2.23	2.23
5	10.02	10.03	11.50	4.46	4.46	16.99	4.46	10.03	5.57	5.57
6	20.07	5.58	8.91	5.57	11.15	6.70	5.57	3.34	4.46	5.57
7	14.49	5.57	10.03	8.91	13.38	11.16	4.46	4.46	4.46	15.61
8	28.98	3.34	5.58	11.14	8.93	6.69	5.57	4.46	6.69	6.69
9	8.93	4.46	5.57	3.34	10.03	22.29	4.46	6.68	6.70	24.52
10	12.28	6.69	2.23	6.69	6.69	5.58	4.46	8.91	6.70	10.03

Table 2: **Statistical determination of differences in mercury levels in similar fish species from sites N and T.**

Species #	Mercury (Hg) Level (ppb)		Statistics		
	Site N Mean ± SD(SEM)	Site T Mean ± SD(SEM)	t-value	DF	p-value
A	13.49 ± 6.76 (2.14)	13.96 ± 6.74 (2.13)	-0.157	18	0.877
B	6.02 ± 2.36 (0.75)	8.87 ± 11.05 (3.50)	109.50*	18	0.762*
C	8.29 ± 4.28 (1.35)	12.04 ± 12.63 (3.99)	106.00*	18	0.970*
D	10.10 ± 7.73 (2.44)	4.35 ± 2.00 (0.63)	134.00*	18	0.031*
E	10.48 ± 5.66 (1.79)	9.47 ± 6.53 (2.06)	0.367	18	0.718
All Species	9.67 ± 5.99 (0.85)	9.74 ± 8.91 (1.26)	2716.50*	98	0.188*

*Mann-Whitney Rank Sum Test

Table 3: **Statistical determination of differences in mercury levels in different fish species from the site N**

Species	t-test t-value (p-value)				
	NA	NB	NC	ND	NE
NA		T = 145.00* (P = 0.003)*	2.057 (P = 0.054)	T = 127.00* (P = 0.104)*	1.080 (P = 0.294)
NB			-1.466 (P = 0.160)	T = 89.50* (P = 0.257)*	t = -2.298 (P = 0.034).
NC				t = -0.649 (P = 0.524)	t = -0.977 (P = 0.342).
ND					t = -0.125 (P = 0.902)
NE					

*Mann-Whitney Rank Sum Test

Table 4: **Statistical determination of differences in mercury levels in different fish species from the site T**

Species	t-test t-value (p-value)				
	TA	TB	TC	TD	TE
TA		T = 71.00* (P = 0.011)*	t = 0.426 (P = 0.675)	T = 148.50* (P = 0.001)*	t = 1.513 (P = 0.148)
TB			t = -0.596 (P = 0.559)	t = 1.274 (P = 0.219)	t = -0.148 (P = 0.884)
TC				t = 1.901 (P = 0.073)	t = 0.570 (P = 0.576)
TD					T = 77.50* (P = 0.041)*
TE					

*Mann-Whitney Rank Sum Test

Table 5: Krukal-Wallis ANOVA on Ranks for statistical determination of differences in mercury levels in different fish species from site N

Species	p-value				
	A	B	C	D	E
A		p<0.05	ns	ns	ns
B			ns	ns	ns
C				ns	ns
D					ns
E					

P< 0.05 = significantly different
n.s.=not significantly different

Table 6: Krukal-Wallis ANOVA on Ranks for statistical determination of differences in mercury levels in different fish species from site T

Species	p-value				
	A	B	C	D	E
A		p<0.05	ns	p<0.05	ns
B			ns	p<0.05	ns
C				p<0.05	ns
D					p<0.05
E					

P< 0.05 = significantly different
n.s.=not significantly different

Table 7: Krukal-Wallis ANOVA on Ranks for statistical determination of differences in mercury levels in different fish species from sites N and T

Samples	p-value				
	NA	NB	NC	ND	NE
TA	ns	p<0.05	ns	ns	ns
TB	p<0.05	p<0.05	ns	ns	ns
TC	ns	ns	ns	ns	ns
TD	p<0.05	ns	p<0.05	p<0.05	p<0.05
TE	ns	ns	ns	ns	ns

P< 0.05 = significantly different
n.s.=not significantly different