WATER HYACINTH COVER HYDROLOGICAL PATTERN OF KANJI LAKE

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ABSTRACT

Bi-annual circum-navigation of Kainji Lake between 1996 and 1999 to determine the level of cover of water hyacinth show that the weeds are more abundant in the high water periods than in the low water times. The surveys were undertaken in August (period of low water) and December/January (period of high water). Results from eight surveys show that all the high water periods had the greatest spatial cover totaling 664.86Km^2 or 56.18% compared to low water coverage of 101.74Km^{2}or 8.6%. The reason for this can be attributed to the annual hydrological cycle of the lake which cause the weeds to be pushed far inland at high water and leaves them stranded at shore where they wither as the floods recedes. Over the years the population of water hyacinth at high water dropped from 16% in 1994 to 10.36% in 1999 and from 1.9% at low water to 0.74%. Communal removal, the impact of weevils that feed only on the plant and the establishment of the boom across the lake are all factors that have contributed to this declining trend.

INTRODUTION

Kainji lake which is located between latitude 9°50' and 10°55'N and between longitude 4°32' and 4°45'E has a surface area of about 1250Km^2, a maximum depth of 54.9m and extends for 136.8Km upstream beyond Yelwa. It is 24.1Km at the widest part (Niger Dam Authority, 1972) .The Kainji dam itself is located 1030Km from the Atlantic 0cean in the south. The dam wall is 8.3 Km long and 65.5m high (Imevbore, 1971).

The lake is home to wide variety of aquatic plants and animals. The lake was free of water hyacinth (*Eichhornia crassipes*) until 1989, it came with the floods from the neighboring Niger Republic. Since then the weed has multiplied and spread across the lake causing serious obstruction to transportation and fishing activities. Ayeni *et al* (1994) found out that water hyacinth alone accounted for 16% of the total area of the Lake. In the pre-water hyacinth times, all the vascular plants on the Lake accounted for only 0.5% (Imevbore, 1971) while Chachu (1977), attributed the entire cover to be 8.9%.

To continue monitoring the spread of water hyacinth on the lake with the aim of proffering management strategies for its control, vigorous field surveys were embarked upon twice a year, at high-water and low water from 1994 to date. This paper presents the findings of the field surveys and discusses the annual cyclical pattern of the hydrology of Kainji Lake and how it regulates the annual spread of water hyacinth across the entire lake

MATERIAL AND METHODS

Circum-navigation of the lake was done twice a year: in August; period of low water and in December / January; period of high water. Two 45 horse power engines were used to power a fibre glass Almarine boat. At a speed of 20Km/hr, a survey team comprising weed scientist, range ecologist, geographer and technologists circum-navigated the entire shores of the lake making stoppages where necessary to collect data. Each trip took an average of seven days. Other parts of the lake were also checked for presence or absence of the weed.

Geo-referencing of the Lake

Using the natural co-ordinates of the lake, the entire lake surface was divided into about 1250 cells or grids coinciding with the actual lake area. These grids were printed on a hard copy map from a digitized computer map. All the cells were numbered 1-1250 representing $1Km^2$ on ground. Data on the level of occurrence of water hyacinth as collected on the field were entered against the relevant cell.

Obtaining Water Hyacinth Cover For Grids

To locate the position of a given cell on ground, geo-position system (GPS) (Magellan 12 Blazer[R] or Germain[R] GPS) linked to orbiting satellites was used as guide, which are capable of linking up to 12 satellites. The GPS tells the position on ground where data is to be collected corresponding to a known cell on paper. Data are taken only on grids with water hyacinth. Since a grid may have many mats of water hyacinths, an average measurement of the largest and smallest mat (not less than 1m across) is taken and multiplied by the total number of mats (larger than 1m across) in the cell to form the value to be entered for the cell. Measurements were done with a 30m-fibre tape.

Calculating Water Hyacinth Cover

A data base using Micro-soft Excel[R] was set up for the collected data . All the numbered cells were assigned collected data, which sum up to the total cover for the lake. The lake was partitioned into six strata, corresponding to different co-ordinates. When this database is linked to Geographical Information Systems (GIS) package, a spatial spread of the cover of water hyacinth across the lake is obtained.

GIS packages used during the course of this study include Resource Information Systems –5, developed at IITA Ibadan, Mapmaker, developed in Europe and ArcView.

RESULTS AND DISCUSSION

Table 1 shows the total cover of water hyacinth in Km^2 between 1994 and 1999 in all strata of Kainji Lake. Table 2 shows the same information in Table 1 in percentages. The table shows that by August 1996 total coverage of water hyacinth on the lake was 23.75 Km^2 or 1.9%. December of the same year had 165 Km^2 or 13.20%. In 1997 January the cover stood at 199Km^2 or 15.92% and 25Km^2 or 2.00% in August. In March 1999, the cover of water hyacinth was 129.11Km^2 or 10.36% and 10.49 Km^2 0.74% in August.

Table 1 further shows that Strata 3 (NW) of the lake had the highest concentration of the water hyacinth all the year put together with 329.69Km^2. Strata 3(NE) had 357.88 Km^2. Strata 2(CW) had 179.50Km^2, Strata 2 (CE) 130.50 Km^2, Strata 1 (SW) 59.375 Km^2 and Strata 1 (SE) had 47.375 Km^2. Figure 1 shows a water hyacinth cover map of the lake in 1999 and the various strata of the lake. Figure 2 is a line graph showing the distributions of % cover of water hyacinth of the lake at high and low water during the study period. The tables show that at low water peroids the level of occurrence of water hyacinth is lower than during high water levels.

Field observations show that the perculiar hydrological behavior of the lake is responsible for this cyclical high and low water density. At high water, the in-coming floods move the floating weeds far into the adjourning shorelines. As the water begins to recede, the floating weed is left stranded at the shorelines. By August when the water has reached the lowest level, over 90% of the weed, which came in with the flood, would have been left on the shores. On the shores the weed eventually dry up. The extent of drawdown between the high and low water can be very wide apart. At Shagunu for instance, a shoreline draw down of 300 meters has been recorded between high water and low water mark. In other low land areas like Warra, over 3.5Km has been recorded. At the periods when the weed is left stranded at the shores many communities gather and burn the weeds.

Many reasons for the high proliferation of the weed at the northern section of the lake compared to the other parts as shown in the tables and figure 1 can be given. The first being that this section serves as the entrance of the weed into the lake such that the area is quickly saturated with the weed compared to other parts. Secondly, as the weed migrate into the lake through the northern section the numerous islands and grasses trap the weed. A third reason is that the

Table 1. Total Coverage of Water Hyacinth (in Km^2) Between 1994 and 1999 in all Strata of Kainji Lake

	January 1994	August 1996	December 1996	January 1997	August 1997	December 1997	January 1998	August 1998	March 1999	August 1999	Total Cover (km)
Stratum 3 (NW)	51.25	10.00	55.00	51.13	15.88	47.75	41.63	12.75	40.23	3.88	329.49
Stratum 3 (NE)	63.75	13.75	48.75	50.13	9.13	67.13	51.50	13.25	37.62	2.88	357.88
Stratum 2 (CW)	27.50	0.00	15.00	39.25	0.00	40.13	46.38	11.25	18.88	1.23	179.50
Stratum 2 (CE)	37.50	0.00	22.50	27.63	0.00	20.00	19.00	3.88	3.13	1.00	130.50
Stratum 1 (SW)	16.25	0.00	12.50	13.63	0.00	10.00	6.75	0.25	11.75	0.25	59.375
Stratum 1 (SE)	3.75	0.00	11.25	17.25	0.00	8.00	6.00	1.13	17.50	1.25	47.375
Total Coverage	200.00	23.75	165.00	199.00	25.00	193.00	171.25	42.50	129.11	10.49	1019.50

Table 2. Occurrence (%) of Water Hyacinth Between 1994 and 1999 in all Strata of Kainji Lake

	January 1994	August 1996	December 1996	January 1997	August 1997	December 1997	January 1998	August 1998	March 1999	August 1999
Stratum 3 (NW)	4.10	0.80	4.40	4.09	1.27	3.82	3.33	1.02	3.25	0.31
Stratum 3 (NE)	5.10	1.10	3.90	4.01	0.73	5.37	4.12	1.06	3.01	0.23
Stratum 2 (CW)	2.20	0.00	1.20	3.14	0.00	3.21	3.71	0.90	1.51	0.09
Stratum 2 (CE)	3.00	0.00	1.80	2.21	0.00	1.60	1.52	0.31	0.25	0.08
Stratum 1 (SW)	1.30	0.00	1.00	1.09	0.00	0.80	0.54	0.02	0.94	0.02
Stratum 1 (SE)	0.30	0.00	0.90	1.38	0.00	0.64	0.48	0.09	1.40	0.01
Total % Occurrence	16.00	1.90	13.20	15.92	2.00	15.44	13.70	3.40	10.36	0.74

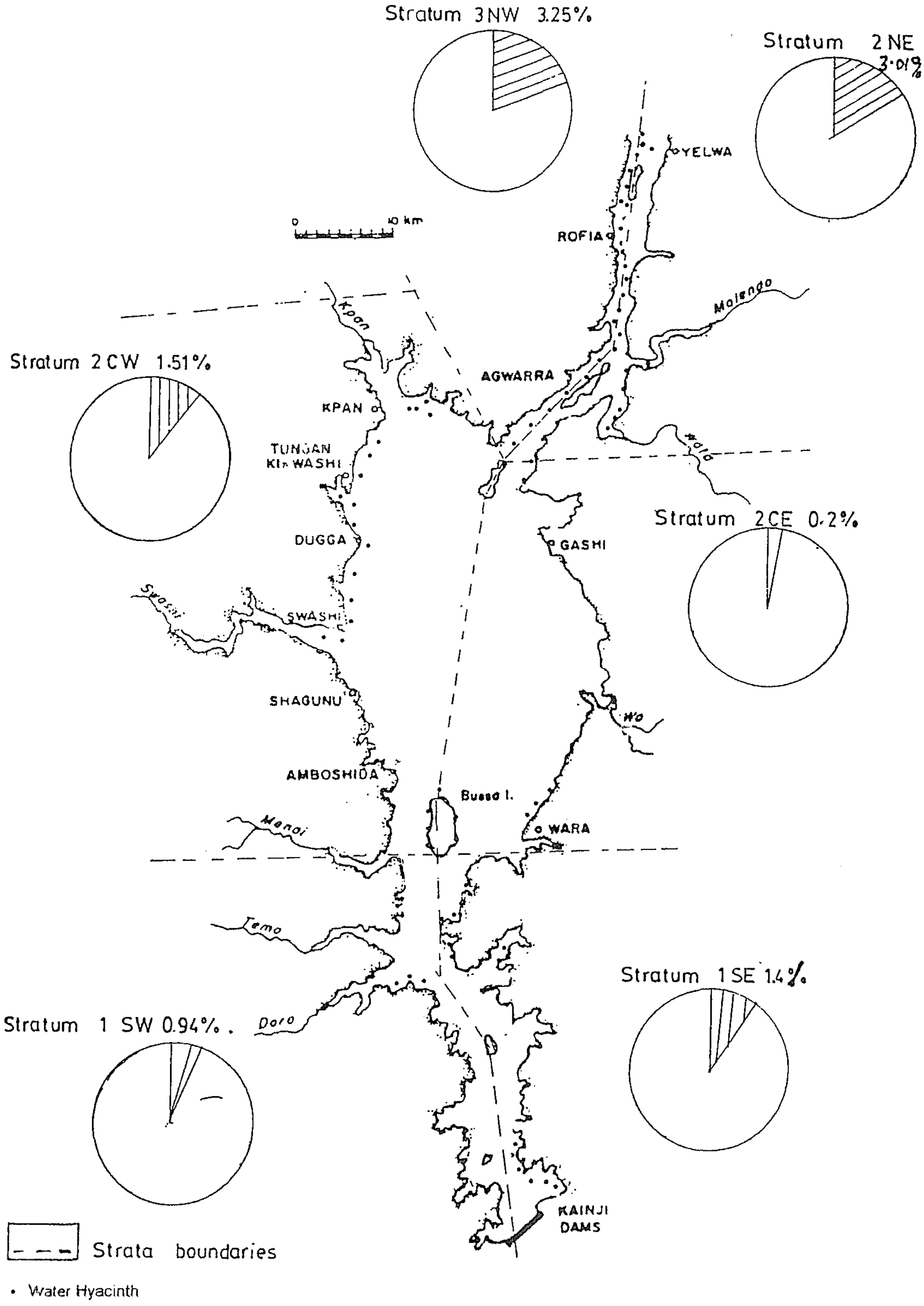

Fig. 1 Occurrence of water hyacinth on Kainji Lake in February, 1999.

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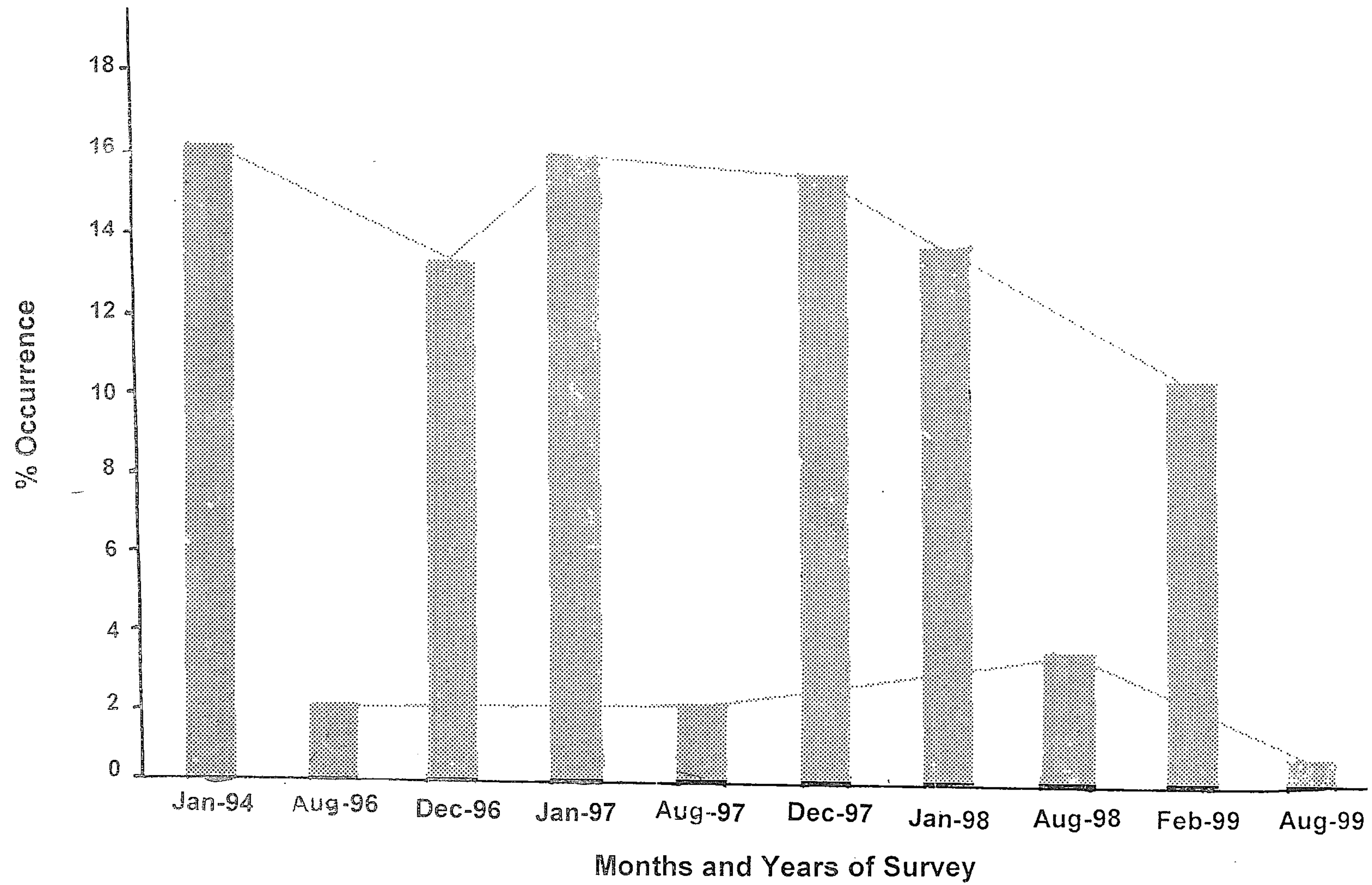
Fig. 2. Trends of High and Low Water Percentage Occurrence of Water Hyacinth on Lake Kainji between 1994 and 1999.



down stream parts of the lake have larger water expanse thus causing stronger waves generated by the strong impact of prevailing winds whose impact cause the weeds to be dislodged and broken into tiny bits.

The variation of water hyacinth cover over the years can also be attributed to patterns of flood and rainfall. The level of in-coming flood has been observed to be a factor that determines the load of water hyacinth to be brought into the lake. Rainfall directly influences flood levels. In recent years rainfall has been increasing across the West Africa sub-region thereby leading to unprecedented floods reaching the lake. At Kainji the highest rainfall in thirty years was recorded in 1999. Olokor, (1999) has indicated that the years of heavy rainfalls will record lower coverage of water hyacinth compared to those of lesser rainfall because of the stronger impacts of floods on the weeds at such times. Thus the very low water hyacinth coverage for August, 1999 was due in part to the heavy rainfalls and floods, which swept the weeds far inland. However, the report indicated that as rains decline due to the impact of the 10-year drought cycle that affect the lake at the beginning of every decade, population of the weeds will increase between 2000-2003 and there after drop sharply. Community mobilisation and other control measures are however necessary to put the weeds at minimal level.

CONCLUSION

For more than half a decade, NIFFR research team has been monitoring and studying the spatial cover of water hyacinth on Lake Kainji. Because of the obnoxious characteristics of the weed, it was worthwhile exercise to ascertain the risk level of the lake being colonized by the weed. This study has found that the peculiar hydrological pattern of the lake which at high-water moves the floating weed to high ground and leaves them stranded to die out, is a strong factor that controls the ability of the weed to colonise the Lake. With the combined impact of other control measures, the Kaniji Lake is likely not to be colonised by the weed.

It is hoped that with the establishment of the floating boom, the total area covered by the weed in years to come will be less than the present. Olokor (1995), in analyzing the cycles of the flood and drought forecasted the year 2000/2003 to be dry (although it may not be as dry as the years 1970/1973). Subsequently, at this time, the hydrological pattern of the lake will be less enhanced, creating a more riverine condition, with less waves and tidal movement which annually move the weed on-shore leading to a rise in the population and concentration of the weed. Increased effort at communal removal will help mitigate the impact.

REFERENCE:

Akinyemiju, O.A (1995). An Inventorial Tour of Lake Kainji. A report submitted to National Institute for Freshwater Fisheries Research Institute, New Bussa. 30pp.

Ayeni, J.S.O., F. Daddy, M. Mdaihli and E.A. Obot (1994). Control and utilization of aquatic weeds: Water hyacinth and Niger grass on Lake Kainji. *NIFFR Annual Report*. ISSN 0331-9296. Pp 20 24

Chachu, R.E.O. (1977). The Vascular Flora of Kainji Lake. *Proceedings of the International Conference on Kainji Lake and River Development in Africa*. Vol. 2 Kainji Lake Research Institute Nigeria.

Imevbore, A.M.A.(1971). Floating Vegetation of Lake Kainji. *Nature* 230.599-60

Kusemiju, K (1994). Control of Water Hyacinth on the River Niger. Report submitted to National Institute for Freshwater Fisheries Research. New Bussa.23pp.

Obot, E.A (1984). Studies in the productivity of *Echinochloa stagnina* (Retz) P. Beauty in the Kainji Lake Basin of Northern Nigeria. Ph.D thesis, University of Ife, Nigeria.

Olokor, J.O (1995). Climate of the Kainji Lake Basin.1925-1993.Consultancy report for the Nigerian- German Kaniji Lake Fisheries Promotion Project. New Bussa.

Olokor, J.O., F. Daddy. Adesina G.O. and H.A. Adeniji (1996). Mapping Water Hyacinth Coverage of Kainji Lake (Progress Report on Control of water Hyacinth). *National Institute for Freshwater Fisheries Research, New Bussa. 1996 Annual Report*. ISSN 0331-9296.

Olokor, J.O (1999). Status of Water Hyacinth (*Eichhornia crassipes*) on Kainji Lake, 1994-1999. Consultancy report for the Nigerian-German Kaniji Lake Fisheries Promotion Project, New Bussa.

W.B. (1990). World Bank Report (1990)