Vol 3 Issue 9 Oct 2013

Impact Factor : 0.2105(GISI)

ISSN No : 2230-7850

Monthly Multidisciplinary Research Journal

Indian Streams Research Journal

IMPACT FACTOR : 0.2105

Welcome to ISRJ

RNI MAHMUL/2011/38595 **ISSN No.2230-7850**

Indian Streams Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial Board readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

International Advisory Board

Editorial Board

Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.net

Indian Streams Research Journal
Volume-3, Issue-9, Oct-2013
ISSN 2230-7850

Available online at www.isrj.net

Water Quality Monitoring- Study Of Seasonal Variation Of Rotifer And Their Correlation With Physicochemical Parameters Of High Altitude Lotus Lake, Toranmal (M.S.) India.

Patil J. V. , Ekhande A. P. And Padate G. S.
SVS's Dadasaheb Rawal College, Dondaicha. Dist. Dhule (M.S.) India.
SVS's Dadasaheb Rawal College, Dondaicha. Dist. Dhule (M.S.) India.
Dept. of Zoology, Faculty of Science, M. S. University of Baroda, Vadodara

Abstract: Seasonal variation of rotifers density and species richness was studied of Lotus Lake. This revealed that the density of rotifers was maximum in summer, while it was minimum in post- monsoon. Maximum species richness of rotifers was recorded in summer while minimum species richness was recorded in winter. The data subjected to ANOVA, the results given in the form of Mean and Standard Error of Mean. The rotifer community structure depends on a variety of environmental factors that include biological parameters, such as predation or competition, as well as various physico-chemical factors.

Keywords:correlation, Seasonal variation, rotifers, Toranmal.

INTRODUCTION

Zooplanktons, like phytoplankton, have also been used recently as indicators to observe and understand changes in ecosystem because they also seem to be strongly influenced by climatic features (Beaugarand and Reid, 2000; Li et al., 2000). The variability observed in the distribution of zooplankton is due to abiotic parameters (e.g. climatic or hydrobiological parameters like temperature, stratification and advection) or to a combination of both (Beyst et al., 2001). The use of zooplankton for environmental characterization of a water body is potentially advantageous. The individual generation time of zooplankton is short enough for them to quickly respond to acute stress but long enough for them to integrate the effects of chronic situations, making them favourable candidates/tools as community indicators of health of any ecosystem (Cairns et al., 1974). Thus, the use of zooplankton for ecological biomonitoring of water bodies also helps in the analysis of water quality trends and judgement of adequacy of water quality for various uses. Hence, in present study of Lotus Lake both Phytoplankton and Zooplankton are considered.

Thus, Zooplankton being in the centre of aquatic food web, and influenced strongly by bottom-up and top-down processes, have often been used as models for ecological paradigms (Wetzel, 2001). Rate of Lake change (eutrophication) may best be determined through long term monitoring programmes which can assess the trophic conditions and also provide a baseline for present as well as future comparisons. Since zooplanktons are potentially valuable indicators of environmental changes, investigations on zooplankton are expected to be an integral part of such programmes. Quantitative information on actual and relative abundance (community composition) is expected to yield more indicator value than simply presence or absence of certain species (Gannon and Stemberger, 1978). Hence, in the present study of Lotus Lake, to establish a food chain/web and condition of the lake, zooplankton are also considered and their qualitative and quantitative seasonal variations and correlation with other biotic and abiotic parameters are evaluated in the present chapter.

Zooplankton communities of freshwater belong to four main taxonomic groups the Rotifera, the Cladocera, the Copepoda and the Ostracoda. Most rotifers are not free floating, but are sessile and associated with littoral substrata. Population of rotifers is highest in association with submerged macrophytes, especially plants with richly divided leaves. In such conditions the densities may reach upto 25,000 per litre (Edmondson, 1946) and vise a versa with reduced sites of attachment and presumably less protection from predation, their density is low (Wetzel, 2001). Even though most rotifers commonly exhibit maximal densities in early summer, in temperate regions they show wide range of temperature tolerance (Berzens and Pejler, 1989). Various rotifer taxa serve as useful bioindicators of water quality of environments within the limits of Limnosaprobity. Their ability to colonize diversified aquatic and semi-aquatic biotopes and inherent quality to build up substantial densities within short time-

intervals make them ideal for ecological considerations as well as valuable tool for population dynamic studies. Hence, while studying hydrobiology of the Lotus Lake it is important to evaluate status of rotifers. The present work deals with density and diversity of rotifers at Lotus Lake.

MATERIAL AND METHODS

Study Area-Lotus Lake: Toranmal plateau is a quantum part of Satpura Mountain forming the cultural transition between Gujarat, Madhya Pradesh and Maharashtra with its high altitudinal (1155 mAMSL) trijunctional location between the three states. It had remained as an isolated ecosystem for longtime. However, in recent days it is gaining considerable attention of Environmentalist, Naturalist, Geographers, Ecologists, Geomorphologists and of course Biologist. It lies in western Satpura Mountain which is a horst block between Narmada graban on north and Tapi in the south.

Lotus Lake is a shallow perennial water body, located on Toranmal Plateau at 21o 53′ 20′′ N latitude, 24o 28′ 01′′ E longitude and 900 mAMSL with 1.17 Km perimeter. It spreads in 3.5 hectare. Its North-South linear length is 154 m while East-West is 419 m. It receives water through streams from higher altitudes of Toranmal Plateau. It has a gravel embankment on North side which arrests the main flow of the streams. Water of the Lotus Lake is utilized by the local people for domestic purpose like washing, bathing and also to some extent for agriculture. It is covered with Lotus flowers hence centre of attraction at Toranmal tourist station.

Google Sat-Image of Lotus Lake

The study site was visited at an interval of fifteen days from December 2006 to November 2008. Surface water samples were collected from three stations of Lotus Lake (LL) namely LL-A, LL-B and LL-C between 8 a.m. to 10 a.m. For each parameter studied the average of these stations are taken. Standard method was used for qualitative and quantitative analysis of rotifers (Edmonson, 1963). Qualitative study of rotifers was carried out up to the genus/species level using the standard keys given by Edmondson (1963) and Battish (1992). The physico-chemical parameters were analyzed by using standard methods of analysis as per APHA (1998).

STATISTICAL ANALYSIS

The data of the two year study (from December-2006 to November-2008) was pooled for three months and four seasons and analyzed for seasonal variations, with respect to winter (December, January, February), Summer (March, April, May), Monsoon (June, July, August) and Post monsoon (September, October, November). Further, the Mean, Standard Error of Mean (SEM) were calculated for each season and One-Way ANOVA with no post test for various parameters for four seasons was performed. The correlation between the abiotic factors and the plankton density was calculated. The Pearson Correlation was calculated by keeping plankton as dependent variable and other abiotic and biotic factors as independent variables.

RESULTS

Rotifera

In the Lotus Lake total 20 species of Rotifera were recorded. Rotifers exhibited significant seasonal variations ($P < 0.0001$, F3 44 97.05). Maximum density of rotifers (Table:1, Fig.1) was recorded in summer (1218 ± 34.83 /l) which started decreased in monsoon (880.3 ± 49.21 /l,) through post monsoon (508.8 ± 23.06 /l) and reached to minimum density in winter (449.8 ± 33.19 /l).

The Rotifers, registered significant variation across the seasons ($P < 0.0001$, F3 44 149.3). Maximum species richness of Rotifers (Table:1,Fig.2) were recorded in summer (13 ± 0.25) with decreasing trend in the following seasons with 10.92 ± 0.23 and 7.08 ± 0.58 in monsoon and post-monsoon respectively and minimum 2.75 ± 0.30 in winter.

Table: 1 Seasonal Variations in Density and species richness (no. of species) of Rotifers at Lotus Lake during December 2006 to November 2008

Parameters	F value	Winter	Summer	Monsoon	Postmonsoon
Rotifer Density	$F_{3\ 44}$ 97.05	449 ± 33.19	1218 ± 34.83	880 ± 49.21	508 ± 23
Rotifer Sp.Richness.	$F_{3\ 44}$ 149.3	2.75 ± 0.3	13 ± 0.24	10.92 ± 0.23	7.08 ± 0.58

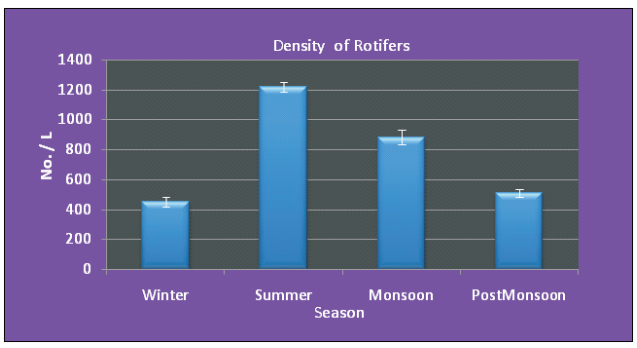

Fig.: 1 Seasonal Variations in density of rotifers (No. / l) at Lotus Lake

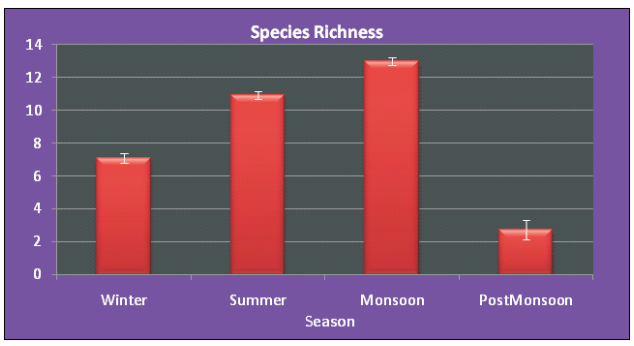

Fig.: 2 Seasonal Variations in species richness of rotifers at Lotus Lake

Table: 2 Pearson correlation of rotifers density with abiotic parameters of Lotus Lake

Sr. No.	Parameter	Rotifers.
1	Atmospheric Temperature AT)	.830**
2	Water Temperature (WT)	.876**
3	Water Cover (WC)	-.760**
4	Total Solids (TS)	.731**
5	Total Suspended Solids (TSS)	.021
6	Total Dissolved Solids (TDS)	.875**
7	Transparency	-.241
8	Carbon Dioxide (CO_2)	.888**
9	Dissolved Oxygen (DO)	-.566**
10	Chloride	.839**
11	Total Hardness (TH)	.551**
12	pH	.889**
13	NO_2^-	.034
14	NO_3^-	-.258
15	PO_4^{-3}	.520**

** The pearson correlation is significant at the 0.01 level (two tailed)

*The pearson correlation is significant at the 0.05 level (two tailed)

DISCUSSION

The zooplankton community composition in shallow lakes is influenced in addition to water chemistry and hydrobiology (Moss, 1994; Hampton and Gilbert, 2001) also by predation. A growing data of water body documents seasonal variations in the abundance of tropical zooplankton (Robinson and Robinson, 1971; Hulyal and Kaliwal, 2009). The proximal physical factors that regulate population of zooplankton in tropical lakes are affected by seasonal fluctuations and by short term, unpredictable climate changes (Lewis, 1983), while the limnological features of tropical lakes are strongly affected by rain and wind which cause mixing as well as stratification in water. Strong winds and intense rainfall following episodes of hot weather lead to the formation of multiple thermoclines, while heavy precipitation promotes nutrient runoff from the watershed. Together with high average temperatures and intense solar radiation, these factors are reported to support high productivity in tropical lakes (Talling and Lemoalle, 1998).

Rotifera is a group of primary freshwater invertebrates that plays a pivotal role in many freshwater ecosystems (Wallace et al., 2006). They are ubiquitous, occurring in almost all types of freshwater habitats, from large permanent lakes to small temporary puddles. Their ubiquity and abundance advocate their importance as one of the three main groups of freshwater zooplankton in limnological studies together with the Cladocera and Copepod, and as organisms used in mass aquaculture (Segers, 2007). Rotiferans because of their less specialized feeding habits, parthenogenic reproduction and high fecundity (Sampaio et al., 2002), form a prominent group among the zooplankton of a water body irrespective of the trophic status. They respond more quickly to the environmental changes and hence are frequently used as indicator of changes in water quality (Gannon and Stemberger, 1978).

In the present study of Lotus Lake rotifer density administered significant seasonal variations (F3 44 97.05) with maximum density in summer while minimum in winter. The survival and reproductive rate of Rotifers are related strongly to the quality and abundance of food (Edmondson, 1946; Baker, 1979). Temperature, in addition to its effects on the rate of development of egg also influences the rates of biochemical reactions, feeding, movement, longevity and fecundity of Rotifers (Edmondson, 1946). It has been identified as one of the main environmental gradients that structure the Rotifer assemblages is the temporal gradient (Bruno et al. 2005). At Lotus Lake surface water temperature in summer was 22.16 ± 0.21 which probably favours the reproductive rate of Rotifers and results in its higher density.

Phytoplankton is important food resource for Rotifers (Devetter and Sed'a, 2003). Hujare (2005) reported that high temperature, photoperiod and intensity of sunlight during summer accelerated growth of phytoplankton which are some of the limiting factors that have been correlated with the growth and abundance of Rotifers. The macrophytes and the littoral vegetation exposed during summer, create ideal habitat for the Rotifers and hence Rotifer composition, abundance and frequency may be expected to be high (Basinska and Kuczynska-Kippen, 2009). Due to low water cover in summer the Rotifers get concentrated and hence high density. Contrary to this higher water cover in winter distributed the Rotifers and lowered their density. In addition, Rotifers are also known to undergo diapause in unfavourable conditions such as lower temperature of winter (Schroder, 2005) extending over a period of several weeks or months, this can further decrease their density. Dormant eggs accumulate in the sediments and hatch when their

environment becomes favourable, generally from cold, dark and anaerobic to relatively warm, light and aerobic conditions (Gilbert, 1995). At Lotus Lake, located at higher altitude in Satpura range of North Maharashtra, temperature fall in winter with simultaneous decline in photoperiod creating an unfavourable environment for the Rotifers. Moderate density of Rotifers recorded in the monsoon and post-monsoon coincides with the influx of rain water that disturbs the equilibrium of the water body. The main food of herbivorous Rotifers is phytoplankton, of which population is disturbed by the incoming rain water that increases TS and TSS simultaneously with low light conditions caused because of cloudy skies. Probably a shortage of food is created. High water inflow has been associated with reductions in the zooplankton density and biomass along with a consequent decrease in chlorophyll concentration, mainly because of the high input of suspended solids (Hart, 2004).

Although, both the internal and the external variables determine the structure of plankton communities in reservoirs, physical variables generally show predominant influence (Wilk-Wozniak and Pociecha, 2007). The greater stability of these physical variables allows biotic variables to become the principal factors in the regulation of structure of a community (Naselli-Flores and Barone, 1997). Results based on Principal component analysis (Jorge et al., 2009) have shown that temperature, DO and pH have strong effects on the Rotifer species and has explained that about 70 % of the variations occur in zooplankton communities. Temperature increase has been related to an increase in the Rotifer diversity.

In the present investigation of Lotus Lake twenty species of Rotifers belonging to nine genera were recorded. Maximum fourteen species of Rotifers were found to co-occur in summer. Studies have been carried out on the ability of certain groups of closely related species to coexist in the same area utilizing the same pool of resources (Maria, 1974; Culver, 1972). Among various genera of Rotifers, the Brachinous was found to be dominant followed by Keratella. Most common species of Rotifers observed in the Lotus Lake were B. caudatus, B. qudridentatus, B. fulcatus, B. caliciflorus. K. tropica and Filinia longiseta, but other genera such as Lacana, Monostyla and Trichocera were not rare. The genus Lacane and Trichocera both noted at Lotus Lake have been shown to provide large contribution in terms of abundance and richness in macrophyte associated littoral habitat (Green, 2003). Rotifers are typically littoral but few species are purely pelagic (Kuczynska-Kippen, 2000). This is probably a consequence of the spatial heterogeneity of littoral habitats, which allows them to sustain themselves as a greater diversity of forms (Pennak, 1966; Basinska and Kuczynska-Kippen, 2009).

The Rotifers exhibit high population turnover rate in nature. Hilbricht-Ilkowska (1967) reported an average turnover for K. cochlearis to be 38 times in 200 days. Rotifers respond more quickly to the environmental changes than crustaceans and appear to be more sensitive indicators of changes in water quality (Gannon and Stemberger, 1978). Brachinous and Keratella are the species observed in both eutrophic and mesotrophic lakes (Dadhich and Saxena 1999), while Trichocera and Filina are likely to occur in eutrophic environment (Rutner – Kolisko, 1974).

CONCLUSION

Spatial variation in diversity and species composition cannot be solely driven by local environmental conditions but is also determined by habitat availability, in other words potential habitat is available at Lotus Lake. When comparing the species composition of the rotifer coenosis of Lotus Lake with that of other high altitude tropical Lakes, no true cold-water species are found, while quite a few warm water taxa occur. Clearly, the altitude (1000 m AMSL) at which Lotus lake is located does not support cold water fauna.

REFERENCES

I.APHA, 1998. Standard methods for the examination of water and wastewater 20th eds. American Public Health Association. American water works Association Water Environment Federation. Washington, D.C.

II.Basinska, A. and Kuczynska-Kippen, K. 2009. Differentiated macrophyte types as a habitat for rotifers in small mid forest water bodies. J. Biologia. Biomedic. Life Sci., 1100-1107.

III.Battish, S. K. 1992. Freshwater Zooplankton of India. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

IV.Beaugarand, G. F. I. and Reid, P. C. 2000. Spatial, seasonal and long term fluctuations of plankton in relation to hydroclimatic features in the English channel. Celtic Sea and Bay of Biscay. Marine Ecology Progress series, 200: 1813-1819.

V.Berzens, B. and Pejler, B. 1989. Rotifer occurrences and tropical degree. Hydrobiologia, 27: 171-180.

VI.Beyst, B. D., Buysse, A., Dewicke and Mees, J. 2001. Surf zone hyperbenthos of Belgian sandy beaches: seasonal patterns. Estuarine, Coastal and Shelf Science, 53: 877-895.

VII.Bruno, B. C., Sara, C., Antunes, R. P., Amadeu, M. V. M., Soares, P. and Fernando, G. 2005. Rotifer community structure in three shallow lakes: Seasonal fluctuations and explanatory factors. Hydrobiologia, 543: 221-232.

VIII.Cairns, J. 1974. Indicator species vs the concept of community structure as an index of pollution. Water Resources Bulletin, 10(2): 338-347.

IX.Culver, D. C. 1972. A niche analysis of Colorado. Ecology, 53: 126-136.

X.Dadhich, N. and Saxena, M. M. 1999. Zooplankton as indicators of trophic status of some desert waters of Bikaner (N-W Rajasthan). J. Environ. Poll., 6(4): 251-254.

XI.Devetter, M. and Sed'a, J. 2003. Rotifer fecundity in relation to components of microbial food web in a eutrophic reservoir. Hydrobiologia, 504 : 167-175.

XII.Edmondson, W. T. 1946. Factors in the dynamics of rotifer populations. Ecol.Monogr., 16: 357 372.

XIII.Edmonson, W. T. 1963. Freshwater biology, 2nd edn. John Wiley and sons. New York, USA.

XIV.Gannon, J. E. and Stemberger, R. S. 1978. Zooplankton (Especially crustaceans and Rotifers) as indicators of water quality. Trans. Amer. Micros. Soc., 97 (1): 16 – 35.

XV.Gannon, J. E. and Stemberger, R. S. 1978. Zooplankton (Especially crustaceans and Rotifers) as indicators of water

quality. Trans. Amer. Micros. Soc., 97 (1): 16 – 35.
XVI.Gilbert, J. J. 1995. Structure, development and induction of a new diapauses stage in rotifers. Freshwat. Biol., 34: 263-270.
XVII.Green, J. 2003. Associations of planktonic and periphytic rotifers in a tropical swamp, the Okavango Delta, Southern Africa. Hydrobiologia, 490: 197-209.
XVIII.Hampton, S. E. and Gilbert, J. J. 2001. Observations on insect predation on rotifers. Hydrobiologia, 446/447: 115-121.
XIX.Hart, R. C. 2004. Cladoceran periodicity patterns in relation to selected environmental factors in two cascading warm-water reservoirs over a decade. Hydrobiologia, 526:99-117.
XX.Hilbricht-Ilkowska, A. 1967. Attempt at evaluation of the production and turnover of plankton rotifers on the example of Keratella cochlearis (Gosse). Bull. Akad. Pol. Sci., 25: 35 -40.
XXI.Hujare, M. S. 2005. Hydrobiological studies of some water reservoirs of Hatkanangale Tahsil (Maharashtra). PhD thesis submitted to Shivaji University, Kolhapur, India.
XXII.Hulyal, S. B. and Kaliwal, B. B. 2009. Dynamics of phytoplankton in relation to physic chemical factors of Almatti reservoir of Bijapur District, Karnataka State. Environ. Monit. Assess., 153: 45-59.
XXIII.Jorge, J. C., Sarma, S. S., Martin, M. and Nandini, S. 2009. Seasonal changes in the rotifer (Rotifera) diversity from a tropical high altitude reservoir (Valle de Bravo, Mexico). J. Environ. Biol., 30(2): 191-195.
XXIV.Kuczynska-Kippen, N. 2000. Seasonal changes of the rotifer community in the littoral zone of a polymictic lake. Verh. Internat. Verein. Limnol., 27: 2964-2967.
XXV.Lewis, W. M. 1983. Temperature, heat and mixing in Lake Valencia, Venezuela. Limnol. Ocenogr., 28: 273-286.
XXVI.Li, M., Gargett, A. and Denman, K. 2000. What determines seasonal and interannual variability of phytoplankton and zooplankton in strongly estuarine system? Application to the semi-enclosed estuary of Strait of Georgia and Juan de Fuca Strait, Estuarine. Coastal and Shelf Science, 50: 467-488.
XXVII.Maria, R. M. 1974. Niche structure in freshwater zooplankton: A principal component approach. Ecology, 55: 1306-1316.
XXVIII. Moss, B. 1994. Brackish and freshwater shallow wetlands- different systems or variations on the same theme. Hydrobiologia, 275/276: 1-14.
XXIX.Naselli-Flores, L. and Barone, L. 1997. Importance of water level fluctuation on population dynamics of cladocerans in a hypertrophic reservoir, Italy. Hydrobiol., 360: 223-232.
XXX.Pennak, R. W. 1966. Structure of zooplankton populations in the littoral macrophyte zone of some Colorado lakes. Trans. Amer. Microsc. Soc., 85 (3): 329 - 349.
XXXI.Robinson, A. H. and Robinson, P. K. 1971. Seasonal distribution of zooplankton in the northern basin of Lake Chad. J. Zool. Lond., 163: 25-61.
XXXII. Rutner-Kolisko, A. 1974. Plankton rotifers Biology and taxonomy. Suppl. Die Binnengewasser. Schweizerbart'sch Verlagsbuchlandlung, Stuttgart, Germany.
XXXIII. Sampaio, E. V., Rocha, O., Matsumura, T. T. and Tundisi, J. G. 2002. Composition and abundance of zooplankton in the limnetic zone of seven reservoirs of the Parana Panema river Brazil. Brazilian J. Biol., 62: 525-545.
XXXIV. Schroder, T. 2005. Diapauses in monogonont rotifers. Hydrobiologia, 546: 291-306.
XXXV.Segers, H. 2007. A global checklist of the rotifers (phylum Rotifera). Zootaxa, 1564: 1-104.
XXXVI. Talling, J. F. and Lemoalle, J. 1998. Ecological dynamics of tropical inland waters. Cambridge University Press, London.
XXXVII. Wallace, R. L., Snell, T. W., Ricci, C. and Nogrady, T. 2006. Rotifer: Biology, Ecology and Systematic (2nd edition). In: Segers H., and Dumont, H. J. (eds). Guides to the identification of the Microinvertebrates of the Continental waters of the world, 23(1). Kenobi Productions. Gent, Belgium and Backhuys, Academic Publishing BV. The Hague, The Netherlands.
XXXVIII. Wetzel, R. G. 2001. Limnology: Lakes and Reservoir Ecosystem (p. 1006, 3rd edn.) Academic Press, Burlington
XXXIX. Wilk-Wozniak, E. and Pociecha, A. 2007. Dynamics of choosen species of phyto and zooplankton in a deep submontane dam reservoir in light of differing life strategies. Hydrobiol. Stud., 36: 35-48.