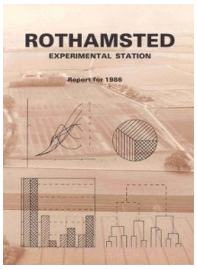
ROTHAMSTED RESEARCH

Rothamsted Experimental Station Report for 1986

Full Table of Content



Synoptic Monitoring for Migrant Insect Pests in Great Britain and Western Europe. VII. Annual Population Fluctuations of Macrolepidoptera over Great Britain for 17 Years

I. P. Woiwod and K. J. Dancy

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Synoptic monitoring for migrant insect pests in Great Britain and Western Europe. VII. Annual population fluctuations of macrolepidoptera over Great Britain for 17 years.

I. P. WOIWOD and KATHRYN J. DANCY*

Abstract

Annual estimates of the relative population sizes over Britain for all species of macrolepidoptera sampled by the light trap network of the Rothamsted Insect Survey have been made for the 17 years from 1968–1984. Plots are presented of these annual estimates for the 375 species which have occurred in every year during the period. These plots provide important information on large scale trends against which regional changes and local population fluctuations can be assessed.

Introduction

Since 1960 light traps of standard Rothamsted design have been operated as part of the Rothamsted Insect Survey for monitoring aerial insect populations of moths (Taylor, 1974, 1986). All macrolepidoptera have been identified routinely from the samples obtained by this network of light traps which have mainly been operated and the catches often identified by volunteers (Taylor, French & Woiwod, 1978). With the aid of such help a large database has been developed containing information on over 600 species of macrolepidoptera from over 300 sites throughout Britain and amounting to more than 1600 site-years of data.

In number of species, sites, geographical coverage and timescale this quantitative database is unique for any large group of terrestrial invertebrates anywhere in the world. Although such data has many ecological applications they were originally collected for two principle purposes. The first was to provide comparative information for the study of spatial population dynamics. The data has already been used extensively for this purpose resulting in a series of publications containing and analysing spatial population parameters of moths as well as other groups of organisms (e.g. Taylor, Woiwod & Perry, 1980; Taylor & Woiwod, 1982; Woiwod & Taylor, 1984).

The second original objective was to monitor long-term changes in moth populations throughout Great Britain so that significant changes could be detected as they occurred and then related to known environmental factors such as agricultural practice, pollution and urbanization. Because of the annual variability and cyclic nature of some insect populations long series of data are required to detect such significant changes with any statistical validity and these data are only now becoming available. However, some preliminary results have already been published (Taylor, French & Woiwod, 1978; Woiwod, 1981; Taylor, 1986) and analytical methodology developed (Taylor, Kempton & Woiwod, 1976; Taylor, 1978).

The use of the database for long-term environmental monitoring is currently being developed in more detail. For the analysis of changes in single species at long running sites or over limited areas it is necessary to know of any widespread population changes so that the relevance and scale of local changes can be assessed. For this purpose annual estimates of total relative population size over Great Britain have been made by the integration of mapping grids for all species sampled by the Survey. In this paper plots of such estimates are given for the 17 years from 1968 to 1984 for the 375 species which have occurred in samples in every year and whose taxonomic separation has been adequate over the 17 years. Because of the large number of species and the consideration which needs to be given to the biology of

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individual species, detailed statistical evaluation of large scale trends will be published elsewhere. However, visual inspection of the plots will often enable preliminary assessment of significant changes which have occurred and provide an important source for future analysis. It should be noted that because of differential attraction of moth species to light such estimates are of relative population size only and should not be used for comparison between species without care.

Integrated totals of macrolepidoptera populations

Annual relative total populations of macrolepidoptera over Great Britain have been estimated by integrating the mapping matrix produced by the SURFACE II program (Sampson, 1975). In effect the program interpolates logged sample values on to a regular grid using a standard distance weighted mean alogorithm, the inverse distance squared has been found to give reasonable values in a large number of studies and has been used here. Such interpolation is necessary for irregularly spaced samples where there is some change in sample sites between occasions (Woiwod, 1982, 1986; Woiwod & Tatchell, 1984). Examples of maps produced by this method are shown in colour in Taylor (1986, Plate 1) for three moth species over a ten year period. The total population estimates are thus the integrated area of such maps over a 17 year period. The actual size of each element in the map matrix was chosen to be 10 kms square, there were 2291 of these elements for each map so the mean number per trap of a particular species per 10 km square could be calculated from the estimated total population, assuming the particular species occurred throughout Britain. Because absolute correction factors are not available to turn light trap catches into actual densities and different species are known to be attracted to light with differing efficiencies, all estimates of density or population size are only relative. This will be no problem for the intra-species annual comparisons presented here but inter-species comparisons should not be made uncritically.

Not until 1968 were sufficient sites in operation (51) to make mapping a feasible proposition. The annual distribution and number of trapping sites are given in Taylor *et al.* (1985, Fig. 1) from 1968 to 1981 ranging from 51 sites to a maximum of 126 in 1976. Comparable maps have not been published for 1982, 1983 or 1984 but the number of sites are 81, 73 and 61 respectively.

Figures 1 to 25 show these annual relative total population estimates for Britain for 375 species of macrolepidoptera. These include all species which occurred in all 17 years and for which identification was consistent throughout the period. It will be noted that populations of less than two on the logarithmic axis often exhibit greater annual variability than values over two. This mainly results from the low numbers of individuals in samples for these years and therefore often reflects a particular sensitivity to catches from a few sample sites. The numbers and names of species in the figures are those given in Taylor *et al.* (1981) and Taylor *et al.* (1985). The Kloet and Hincks' Latin name has been used throughout.

Acknowledgements

We wish to thank the numerous voluntary workers who have enabled us to obtain the data, Dr. L. R. Taylor who initiated the Survey, Mrs. J. Nicklen and Adrian Riley for organising the collection and identification of the samples and the Nature Conservancy Council for supporting the analysis of the data.

FIGS 1–25. Relative log total populations of 375 macrolepidoptera species over Great Britain estimated from light trap catches of the Rothamsted Insect Survey by integration of Surface II mapping grids. The relative total population is plotted on a $\log_{10}$ scale. Annual estimates are plotted for the 17 years 1968–1984.

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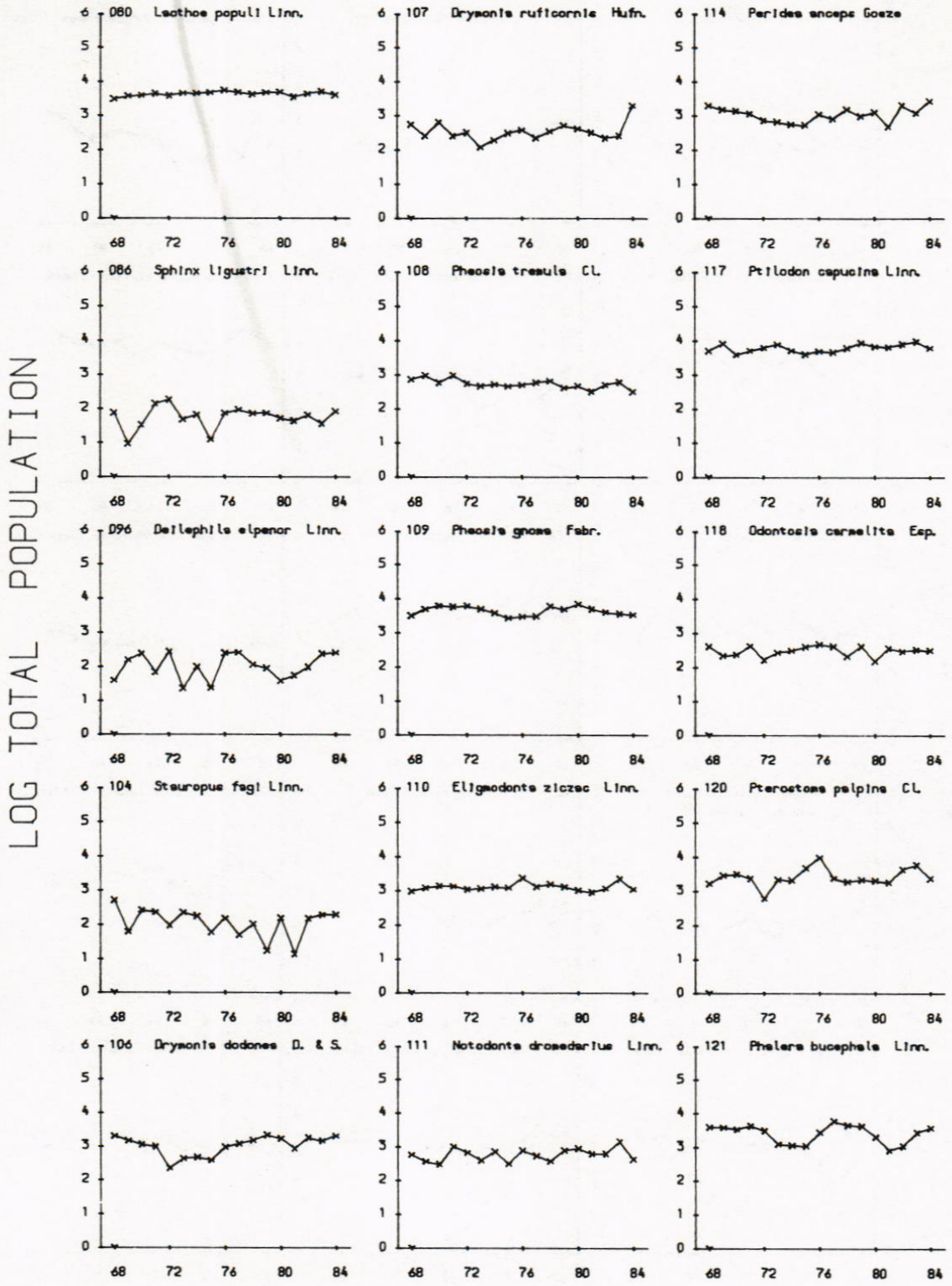

FIG. 1.

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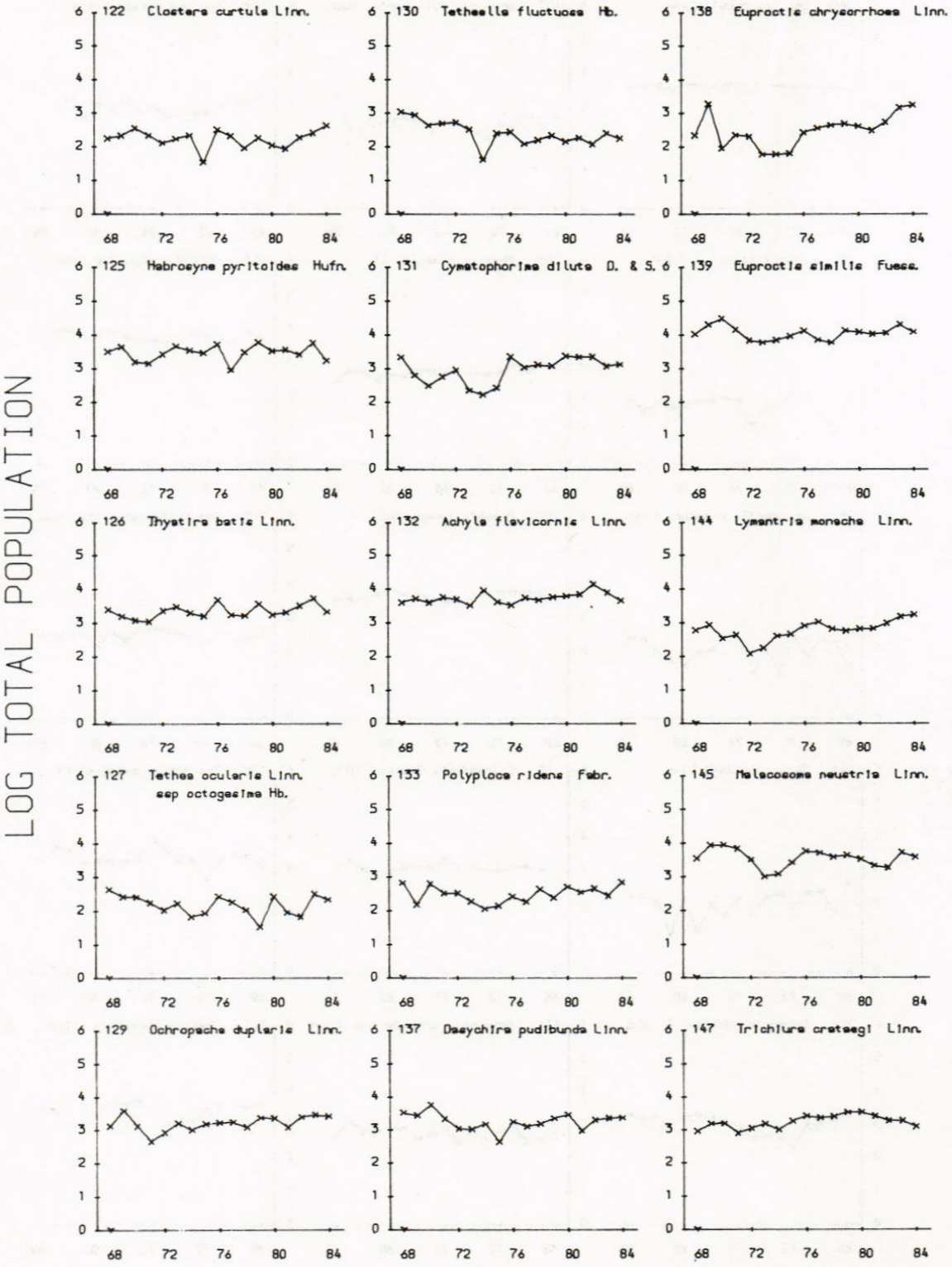

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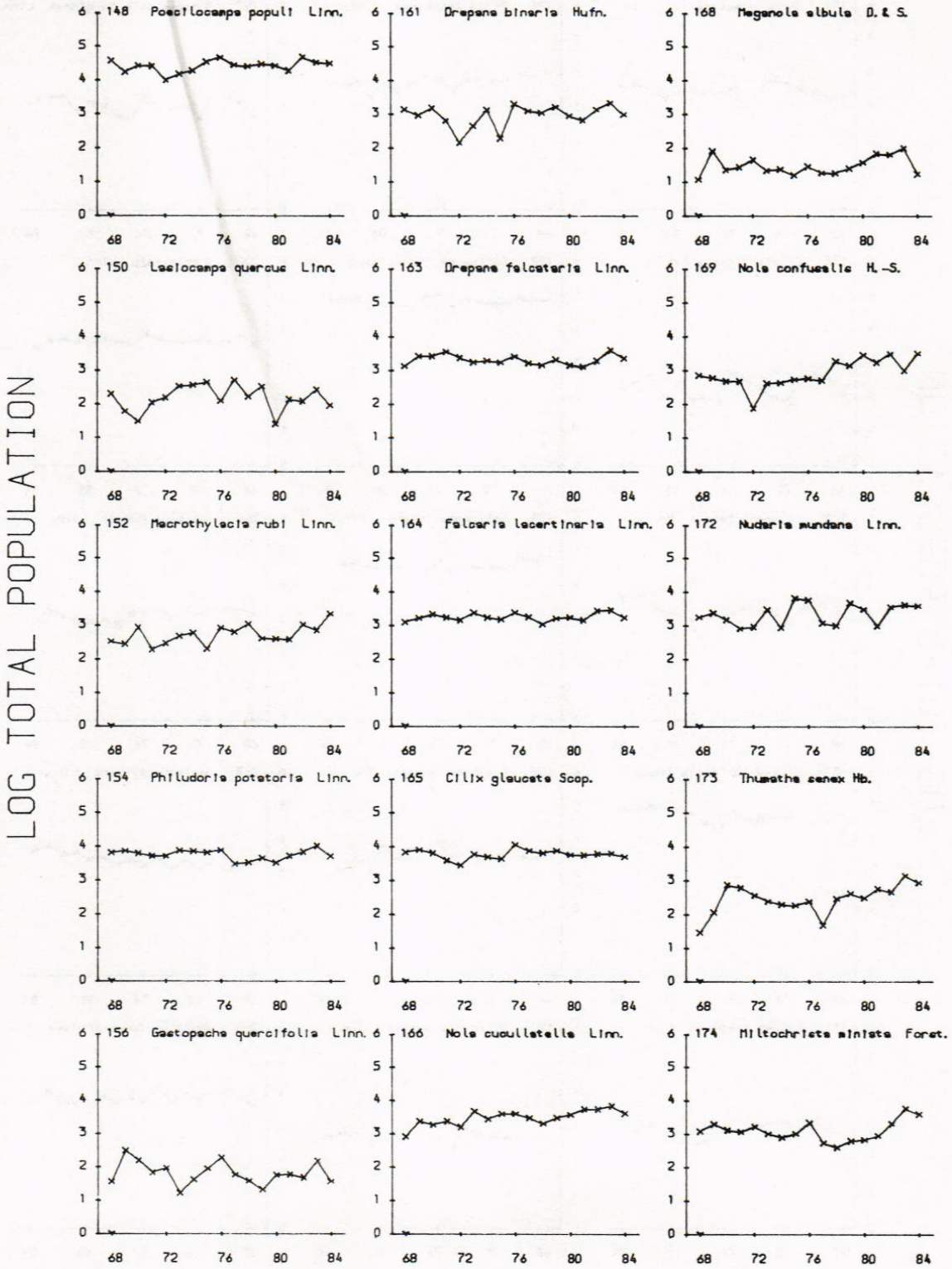

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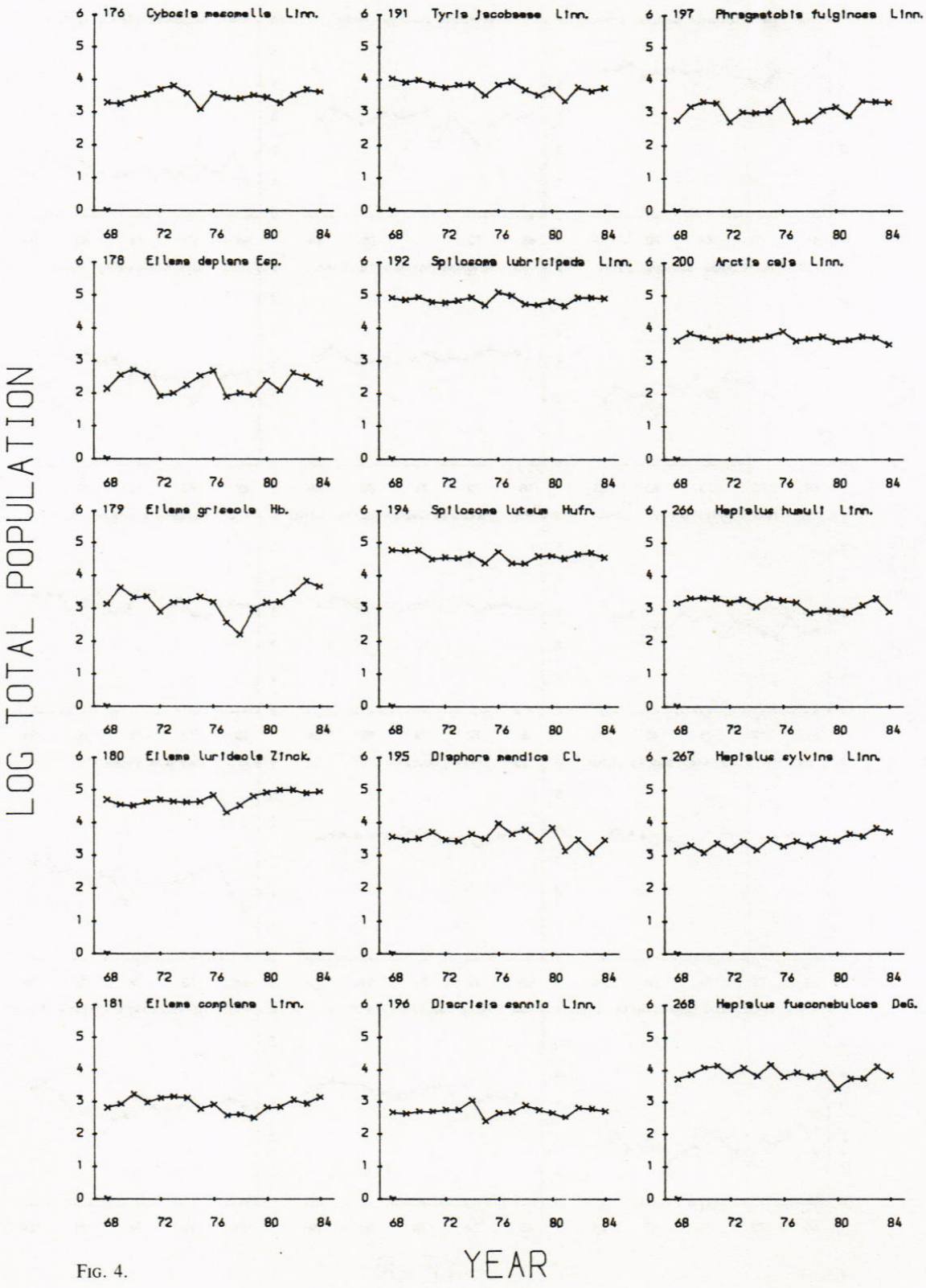

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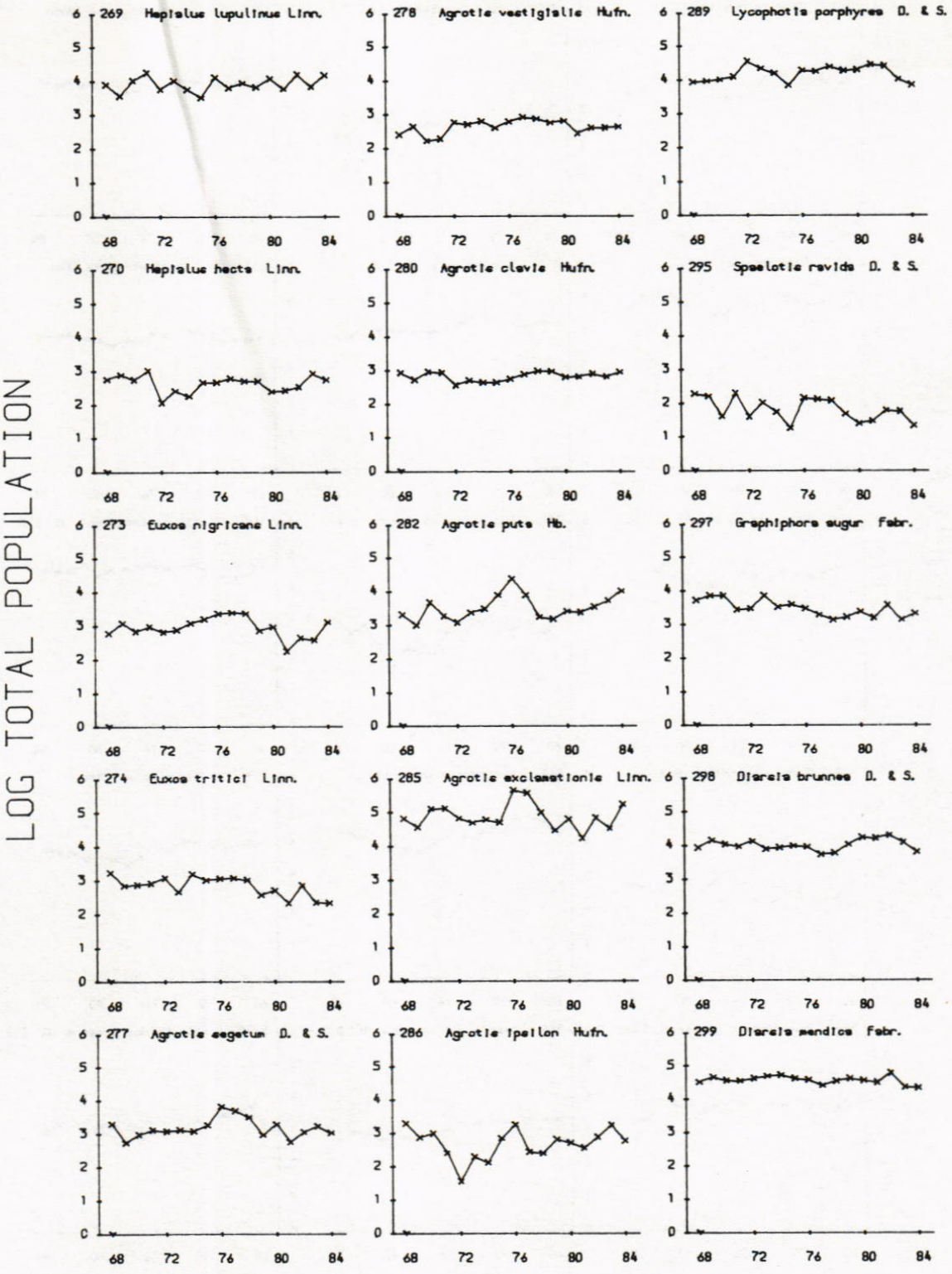

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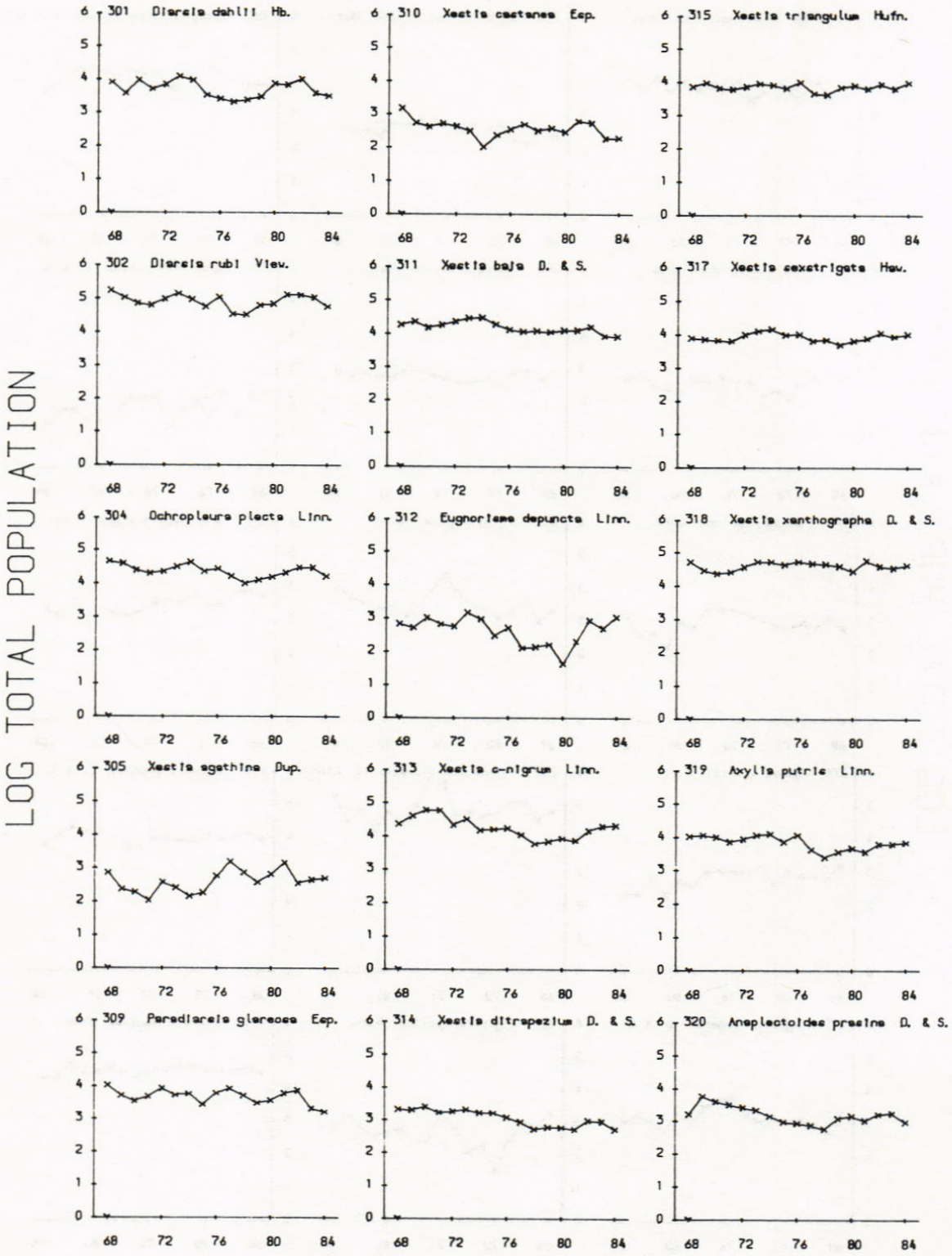

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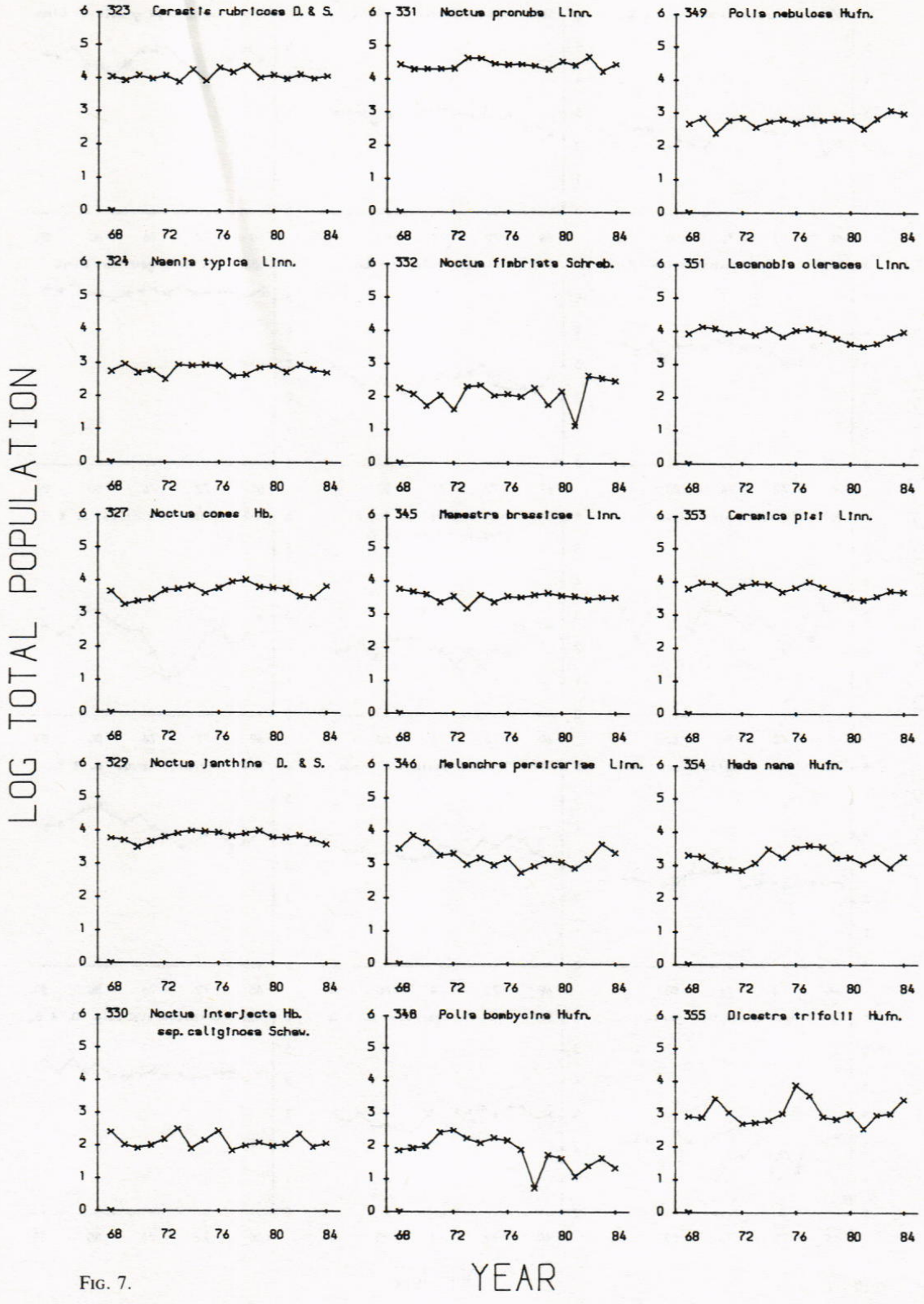

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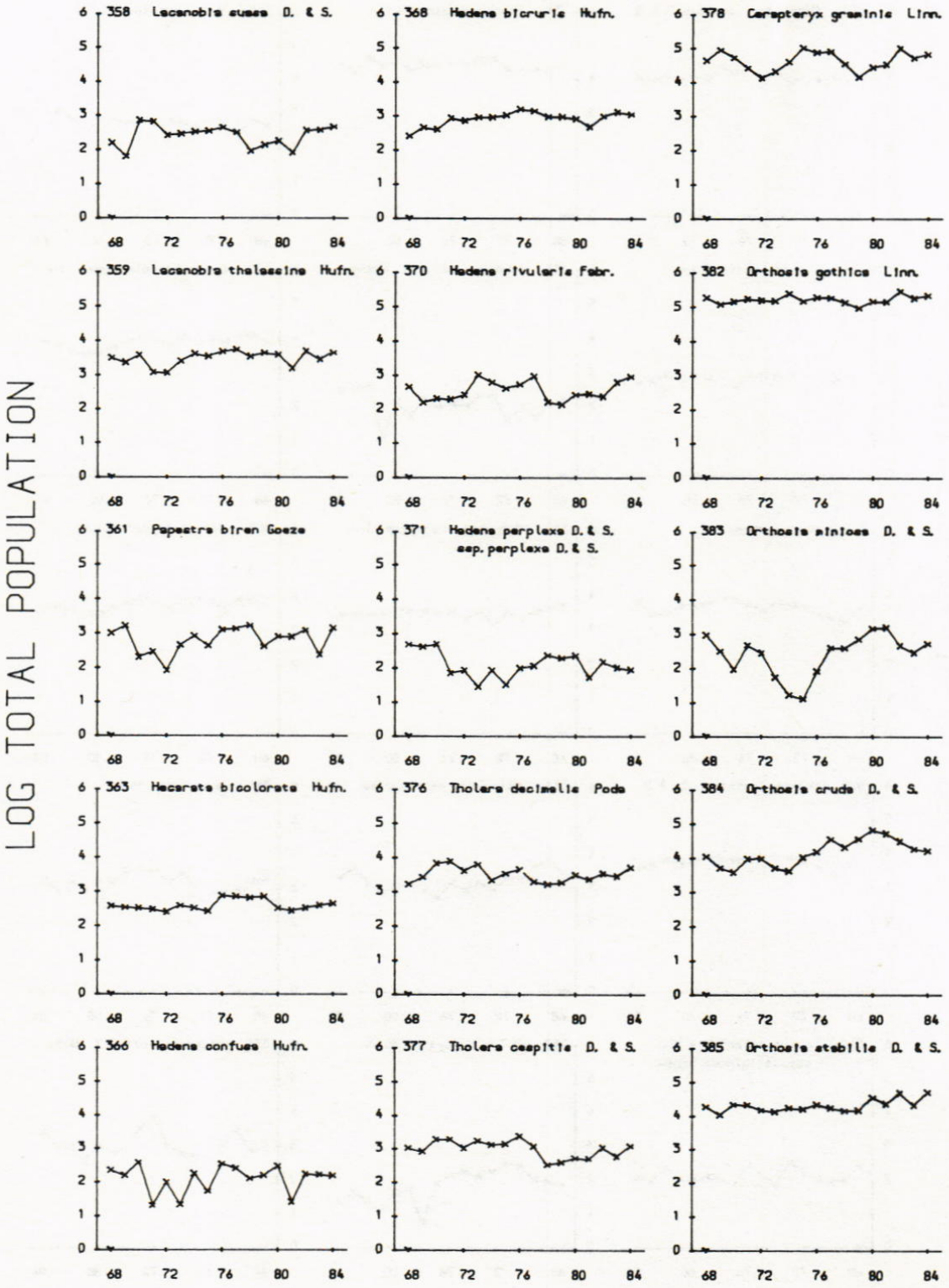

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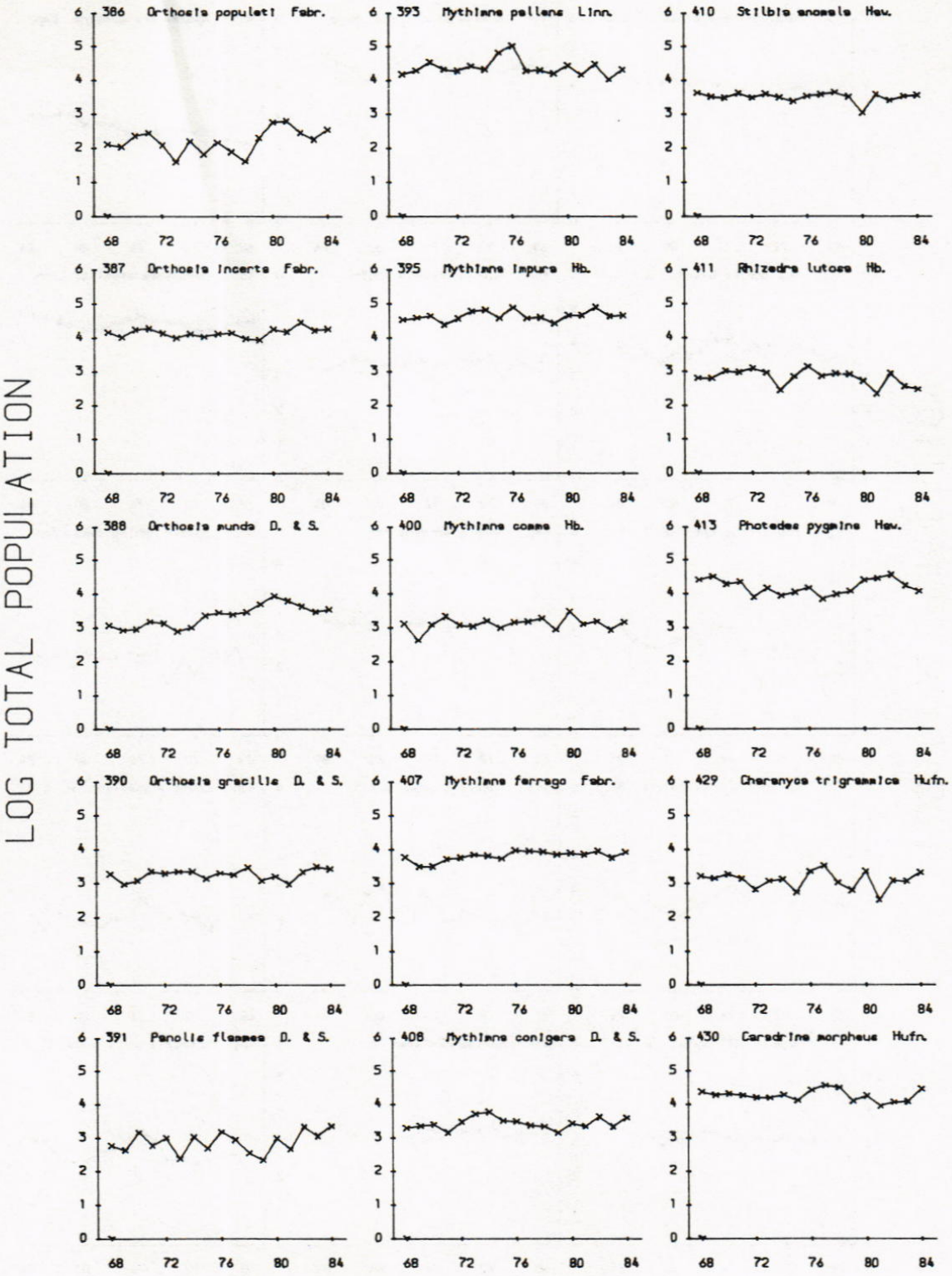

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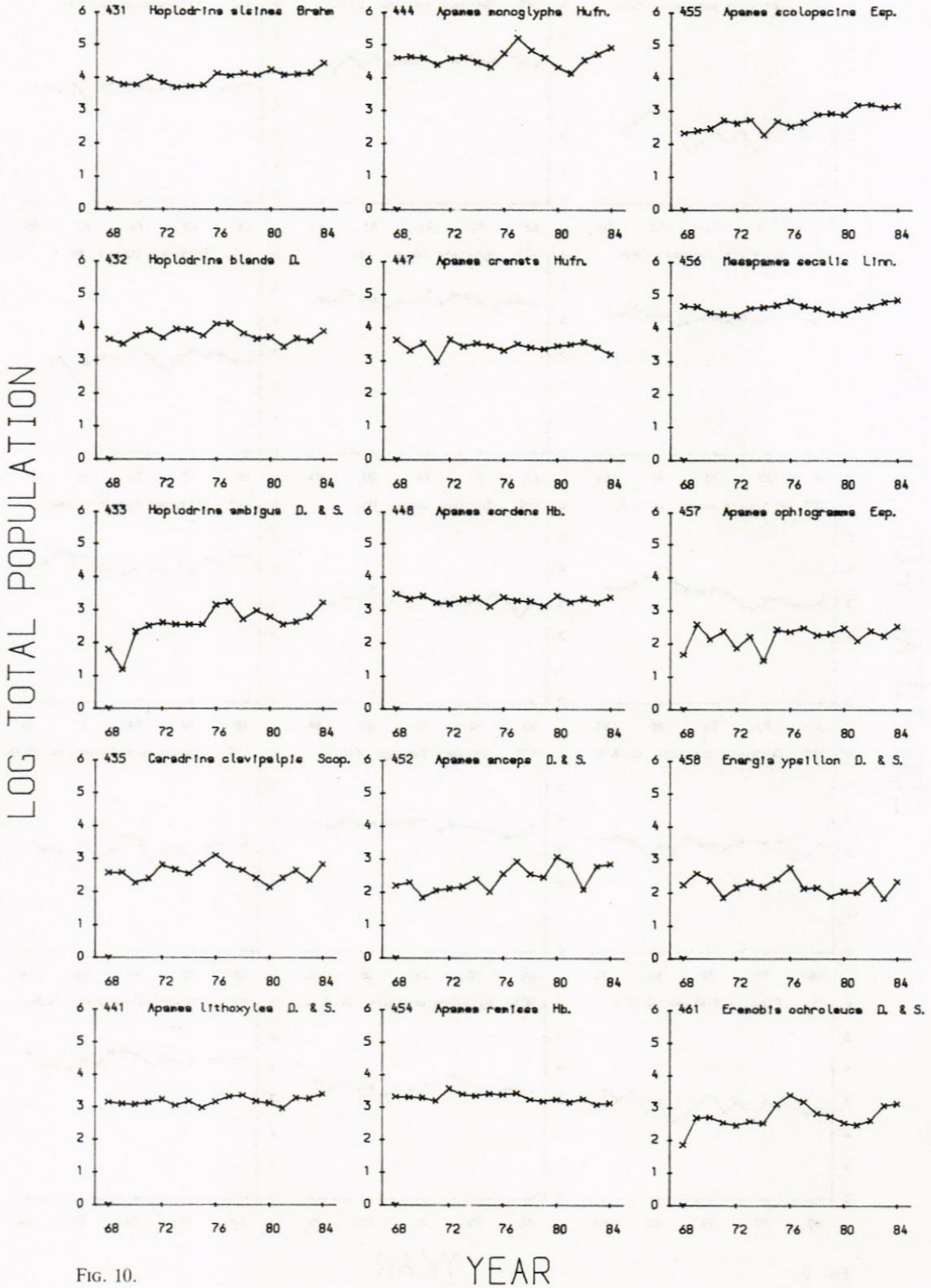

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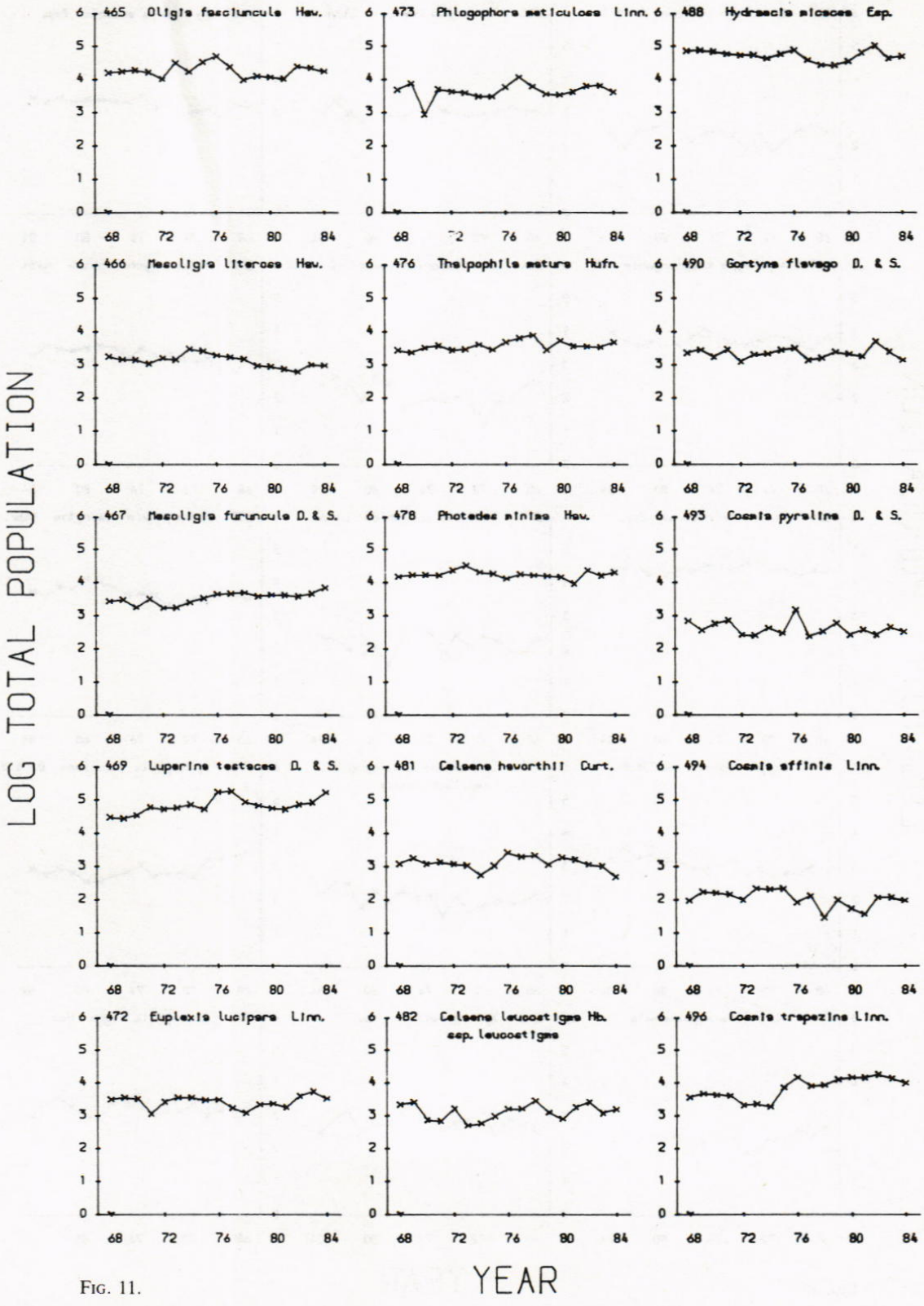

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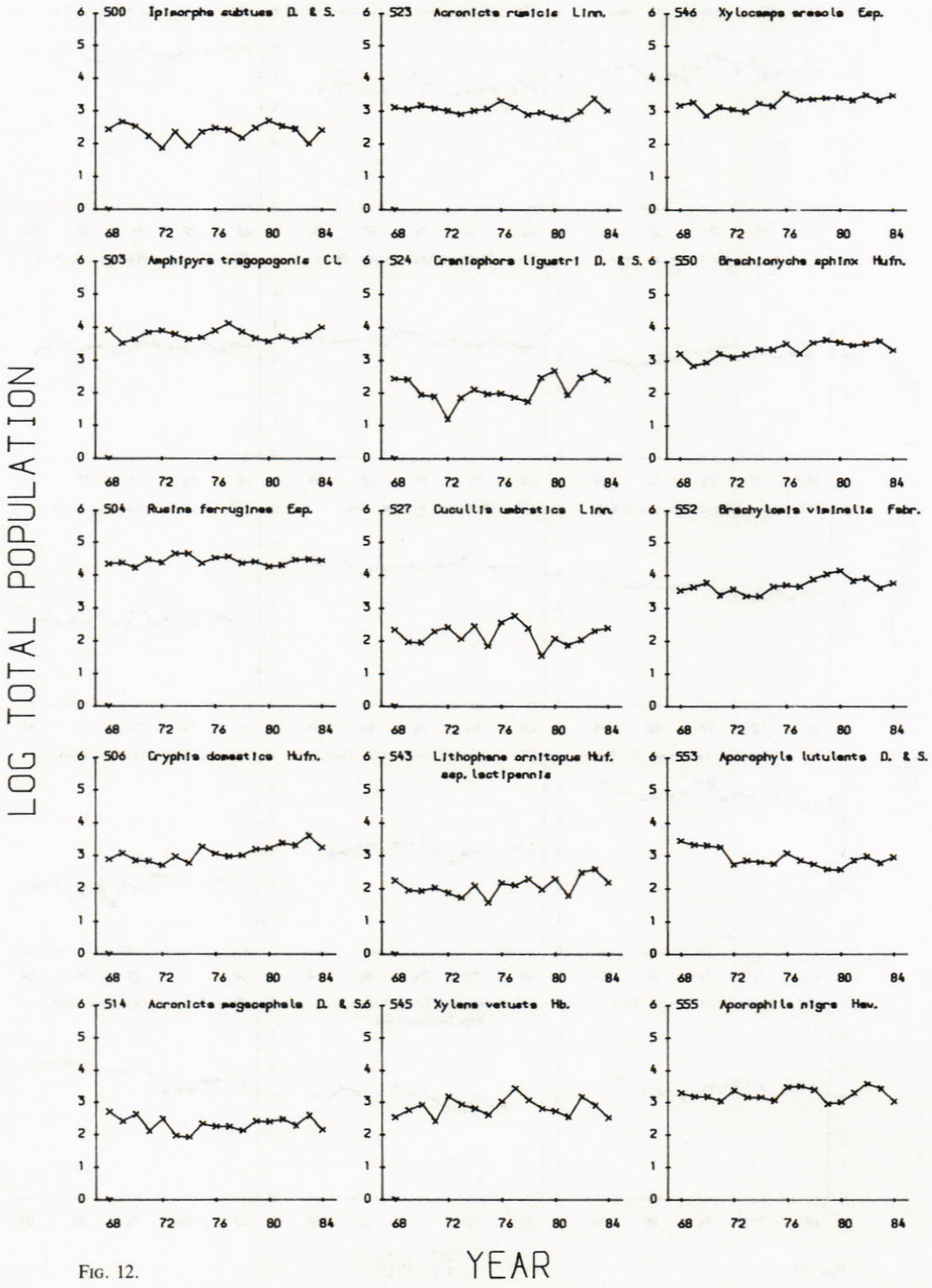

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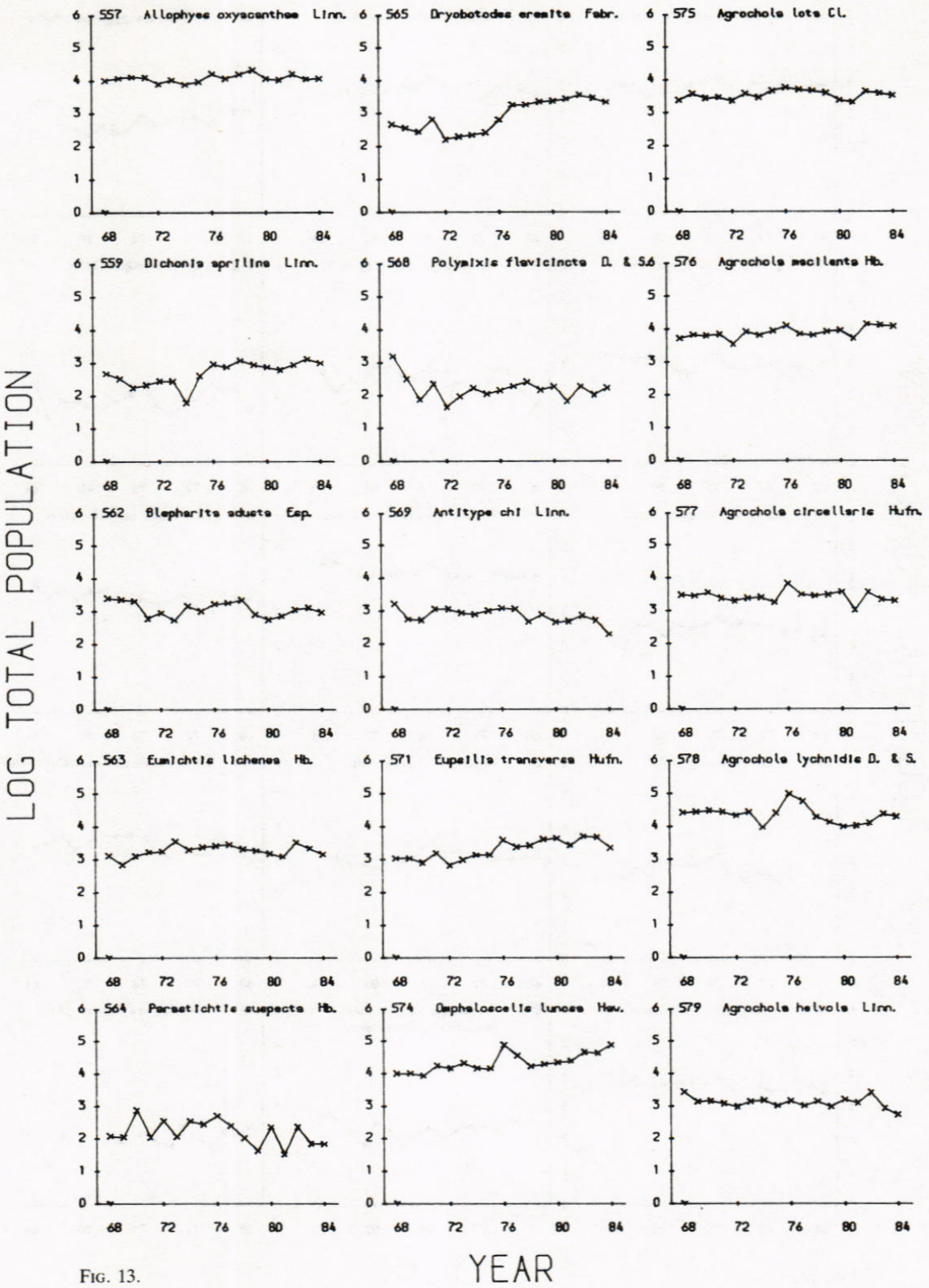

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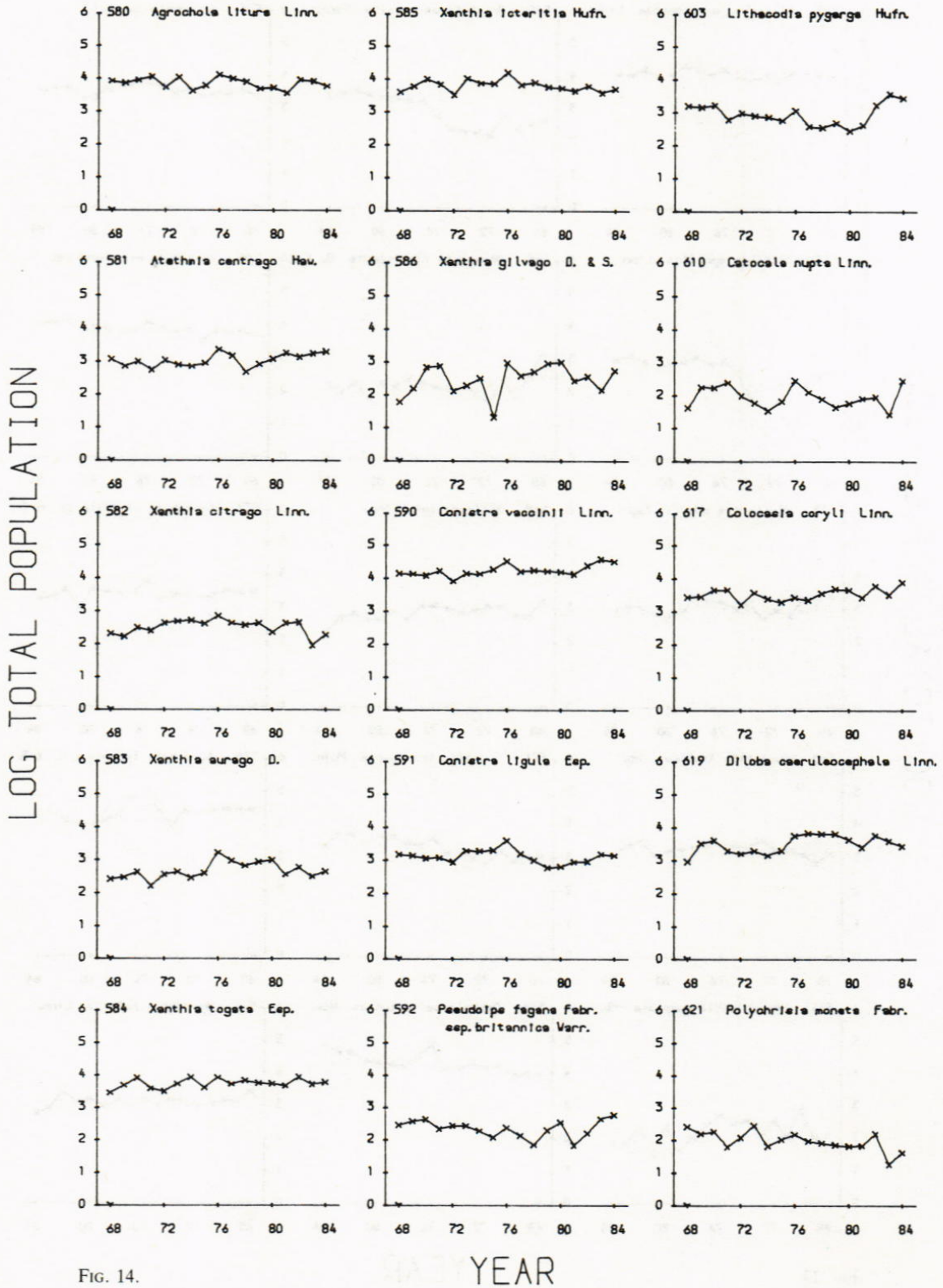

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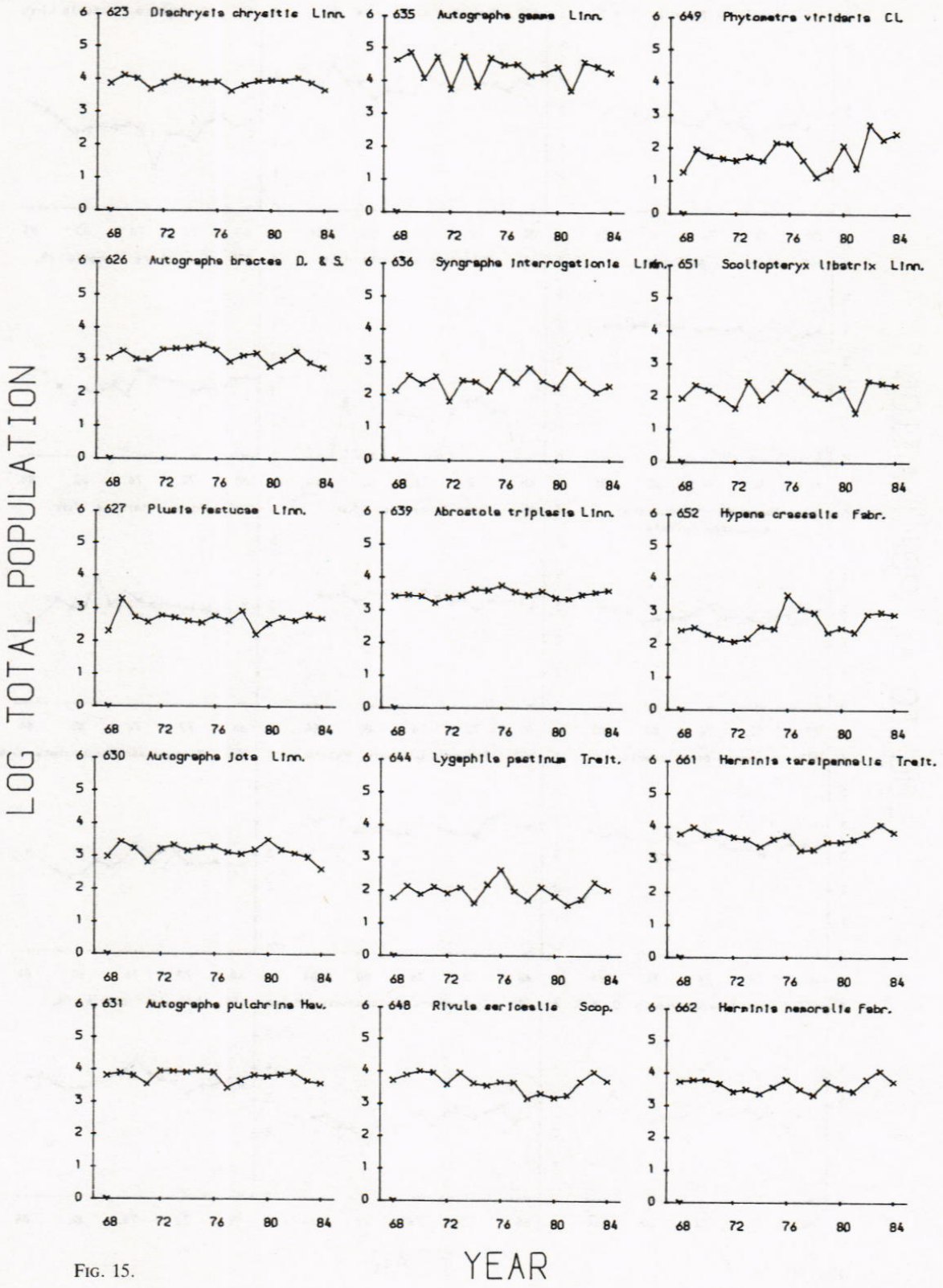

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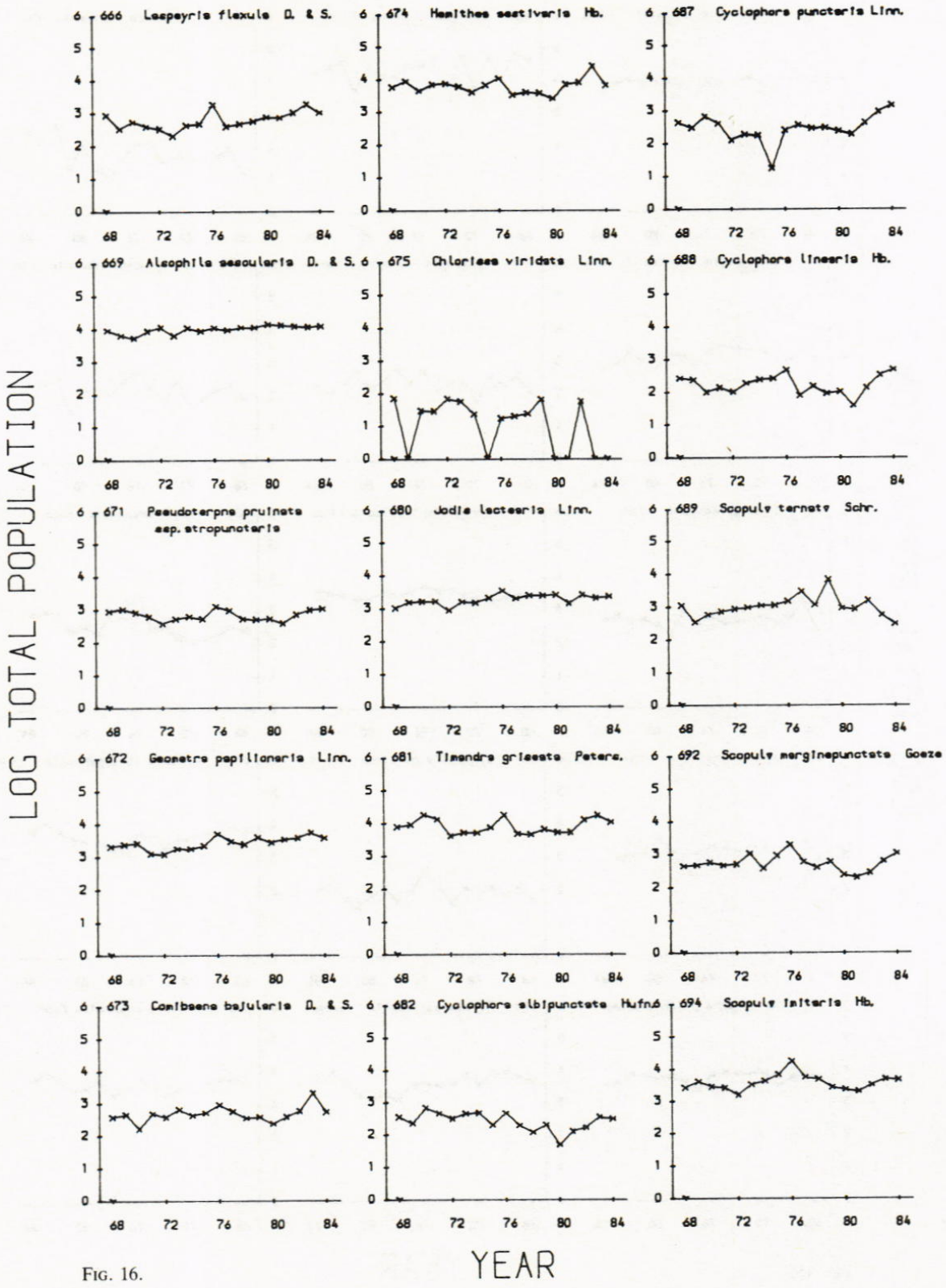

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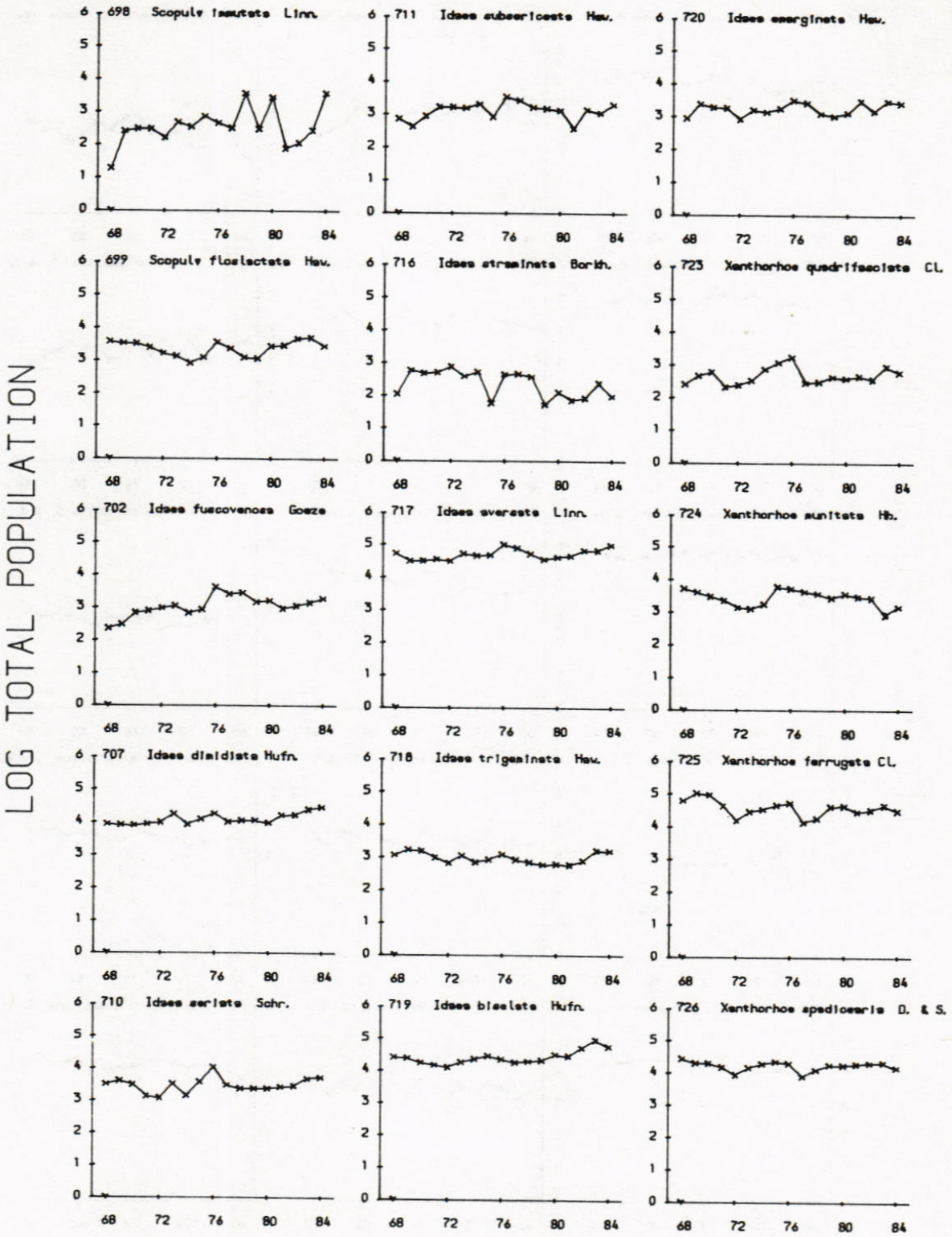

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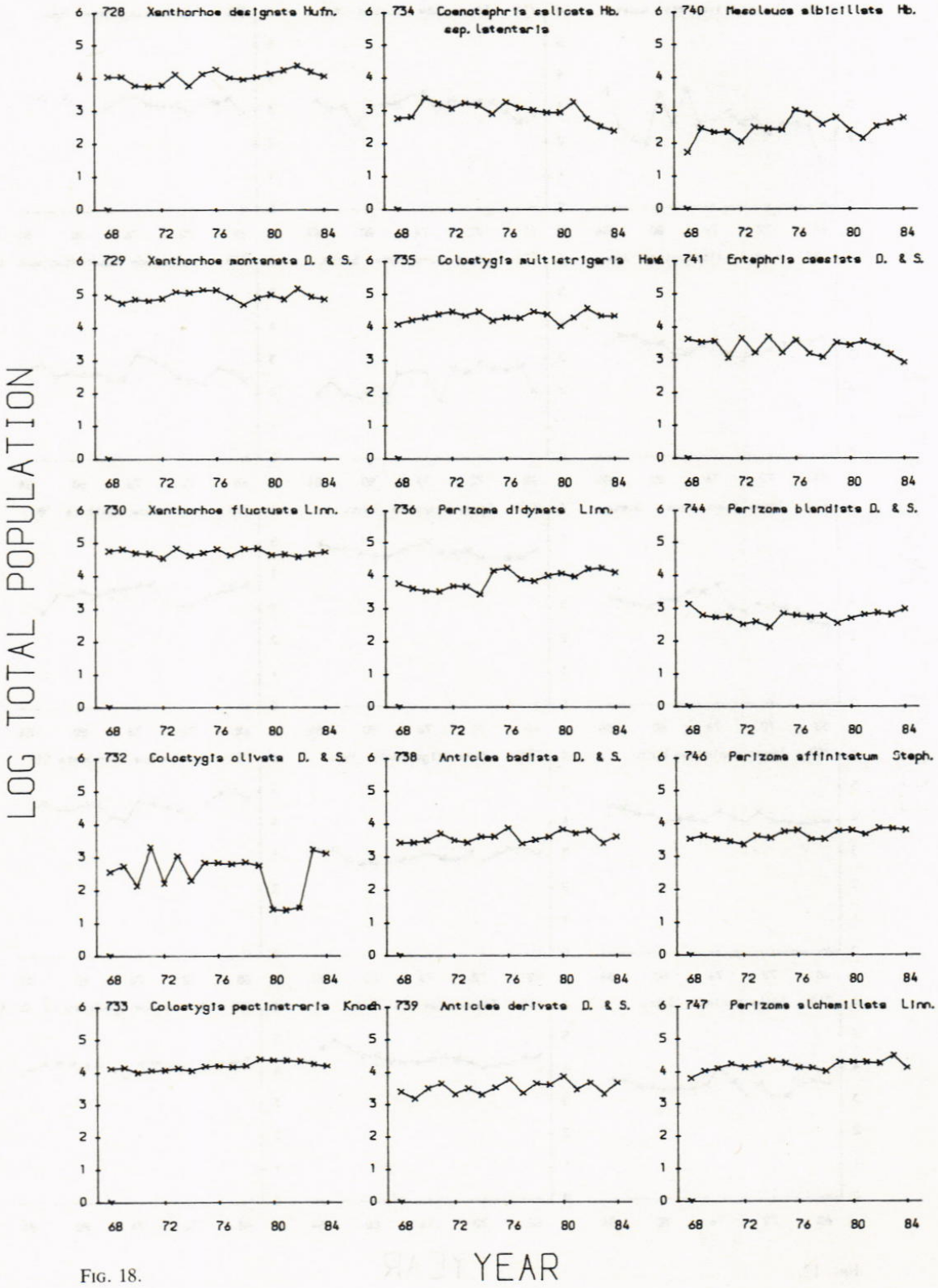

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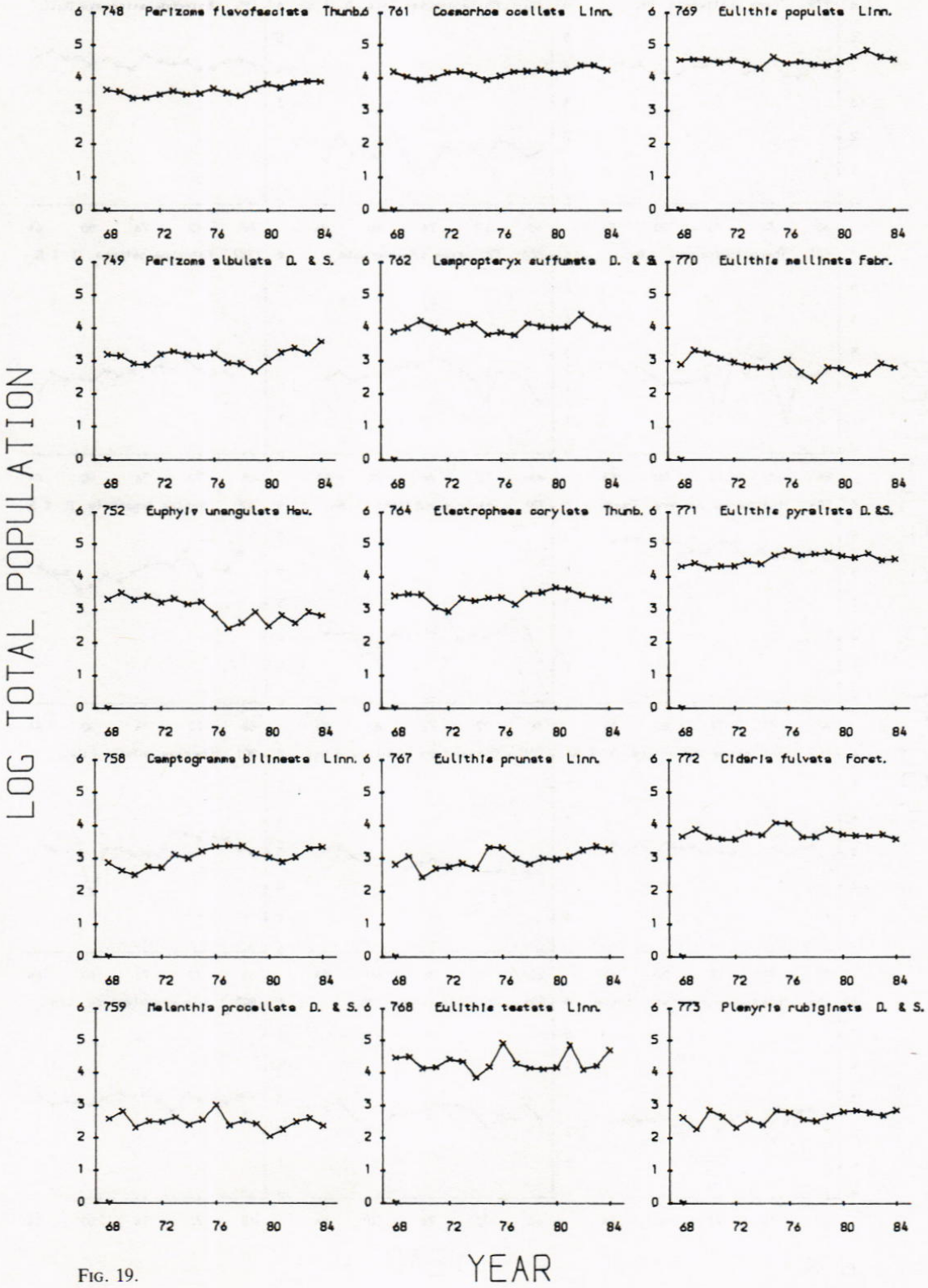

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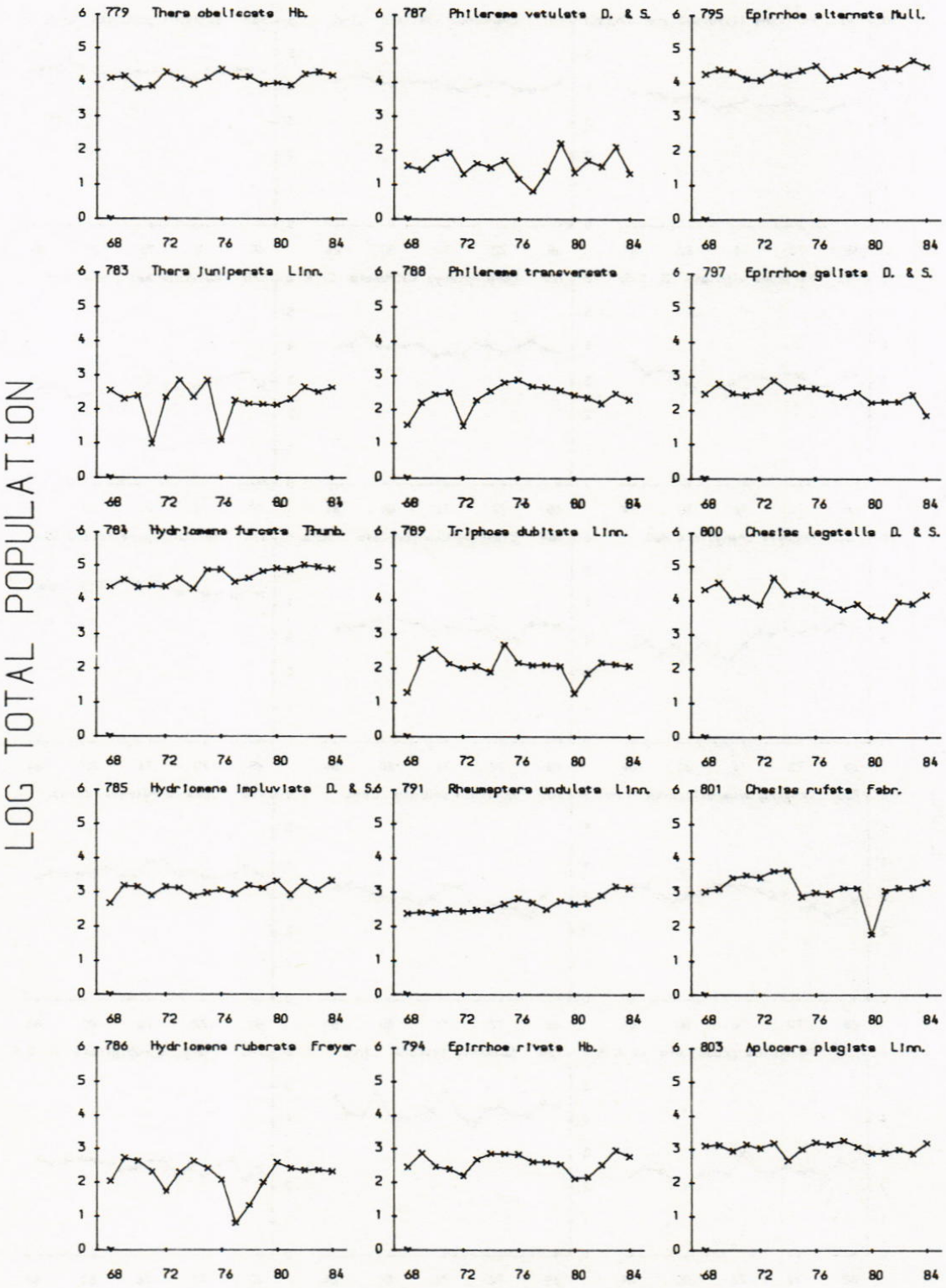

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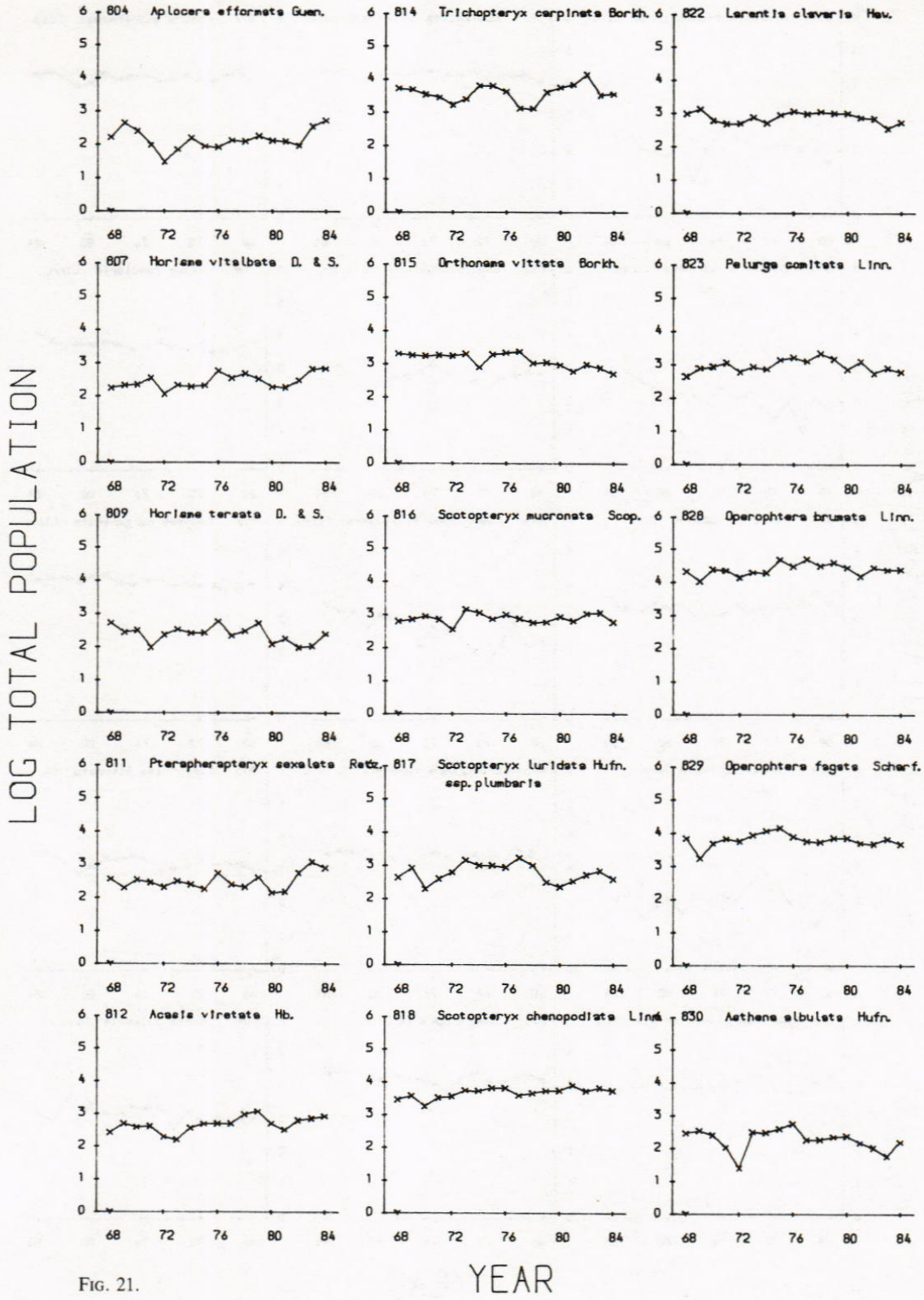

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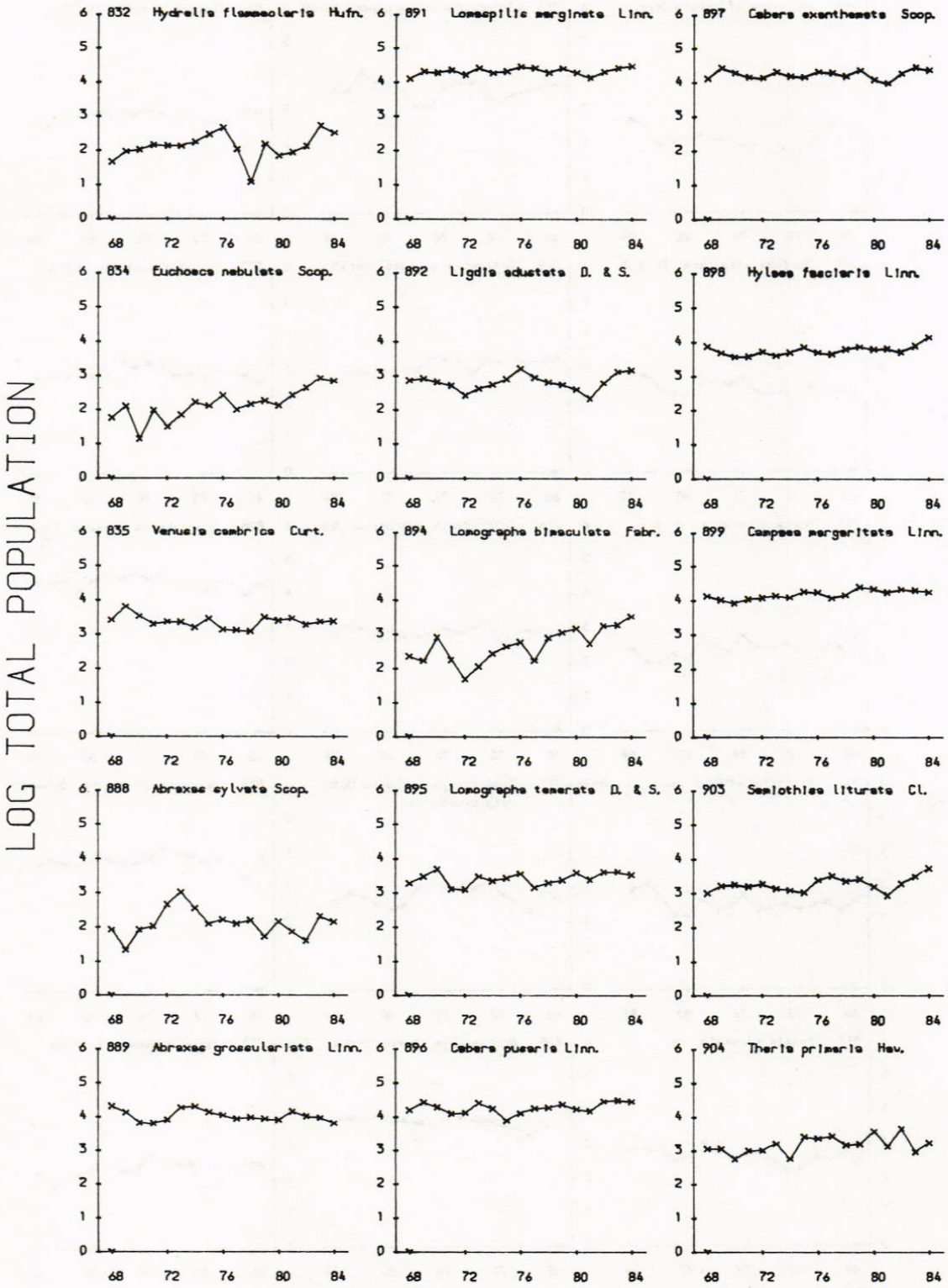

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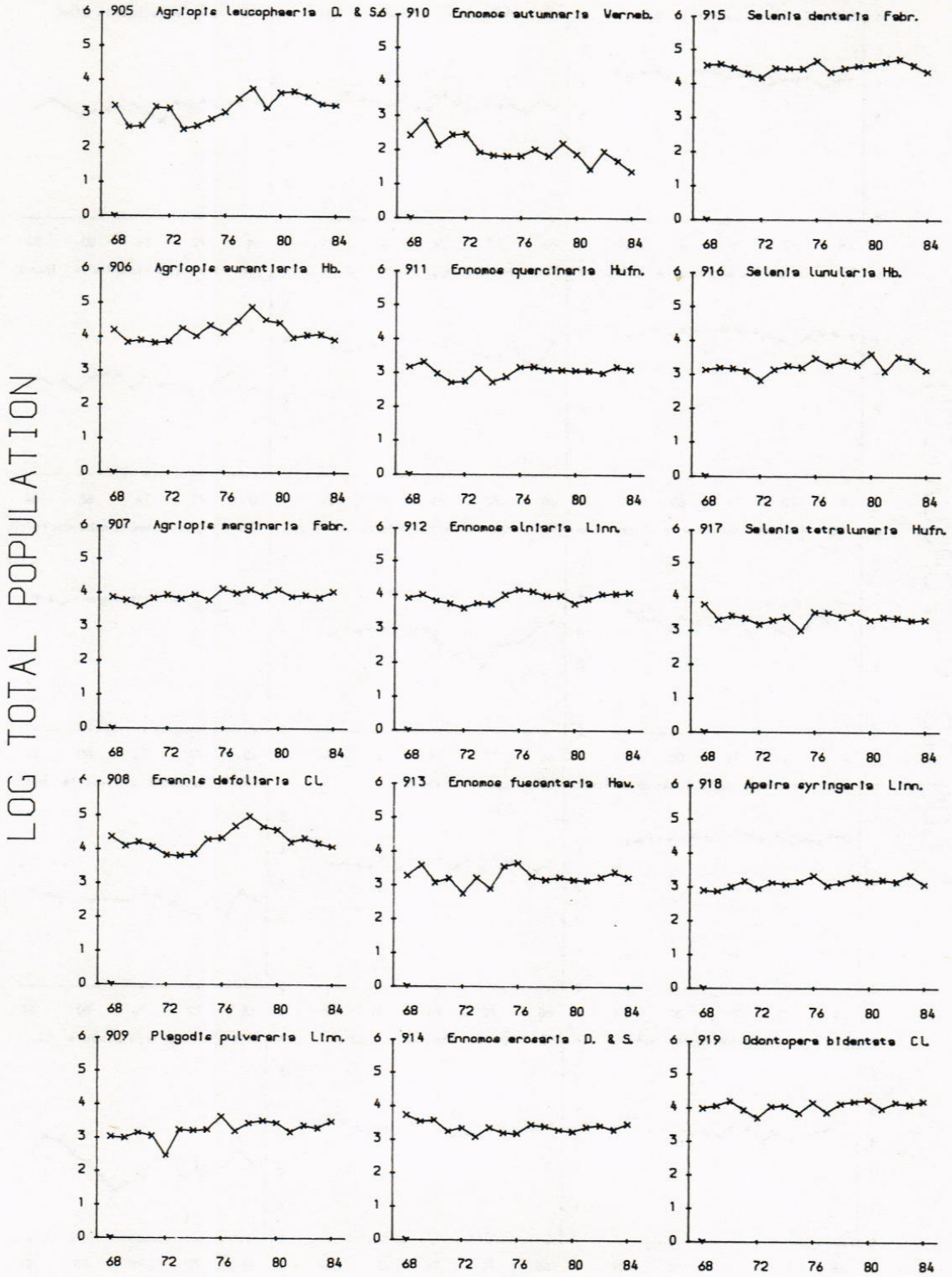

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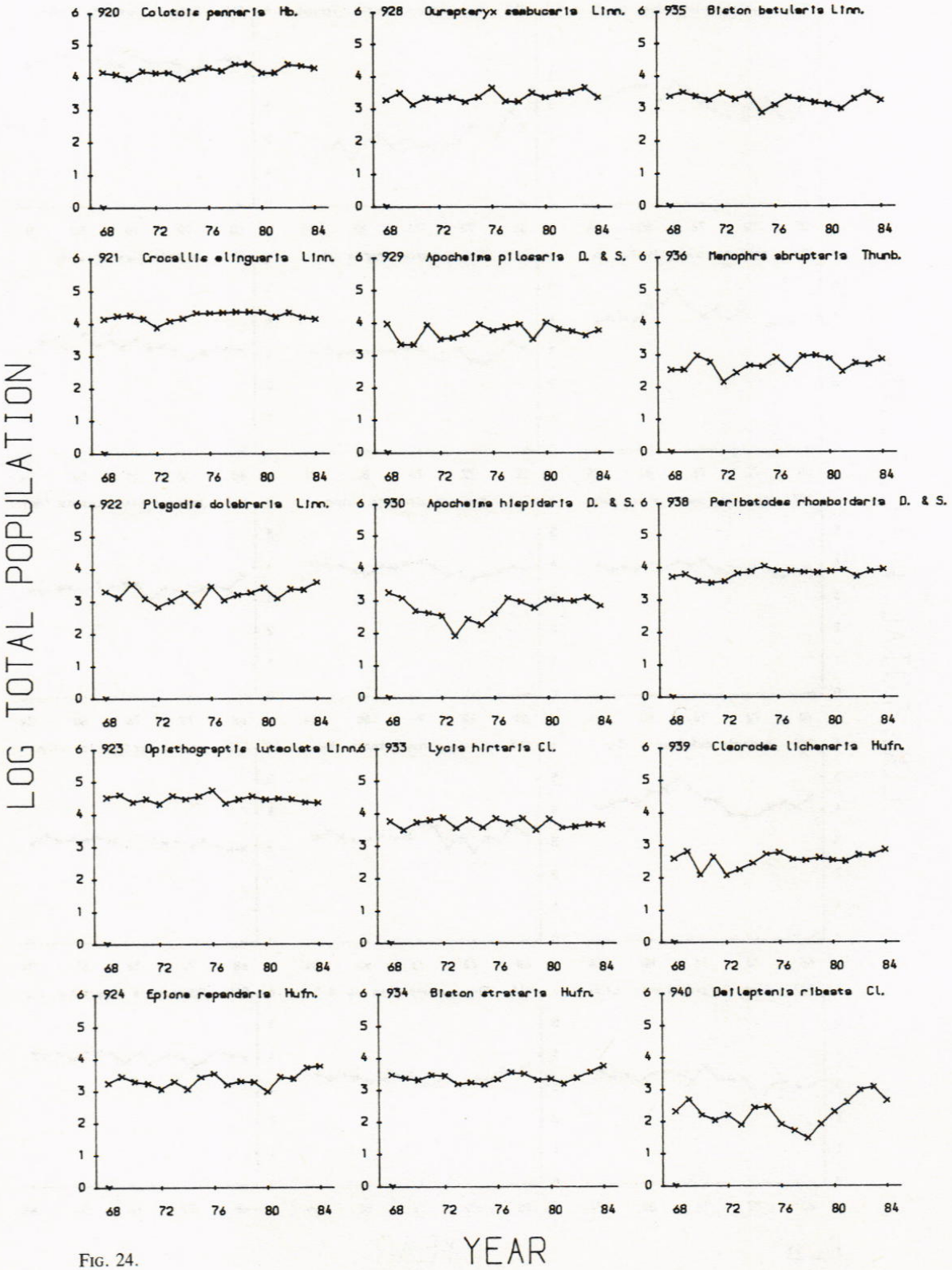

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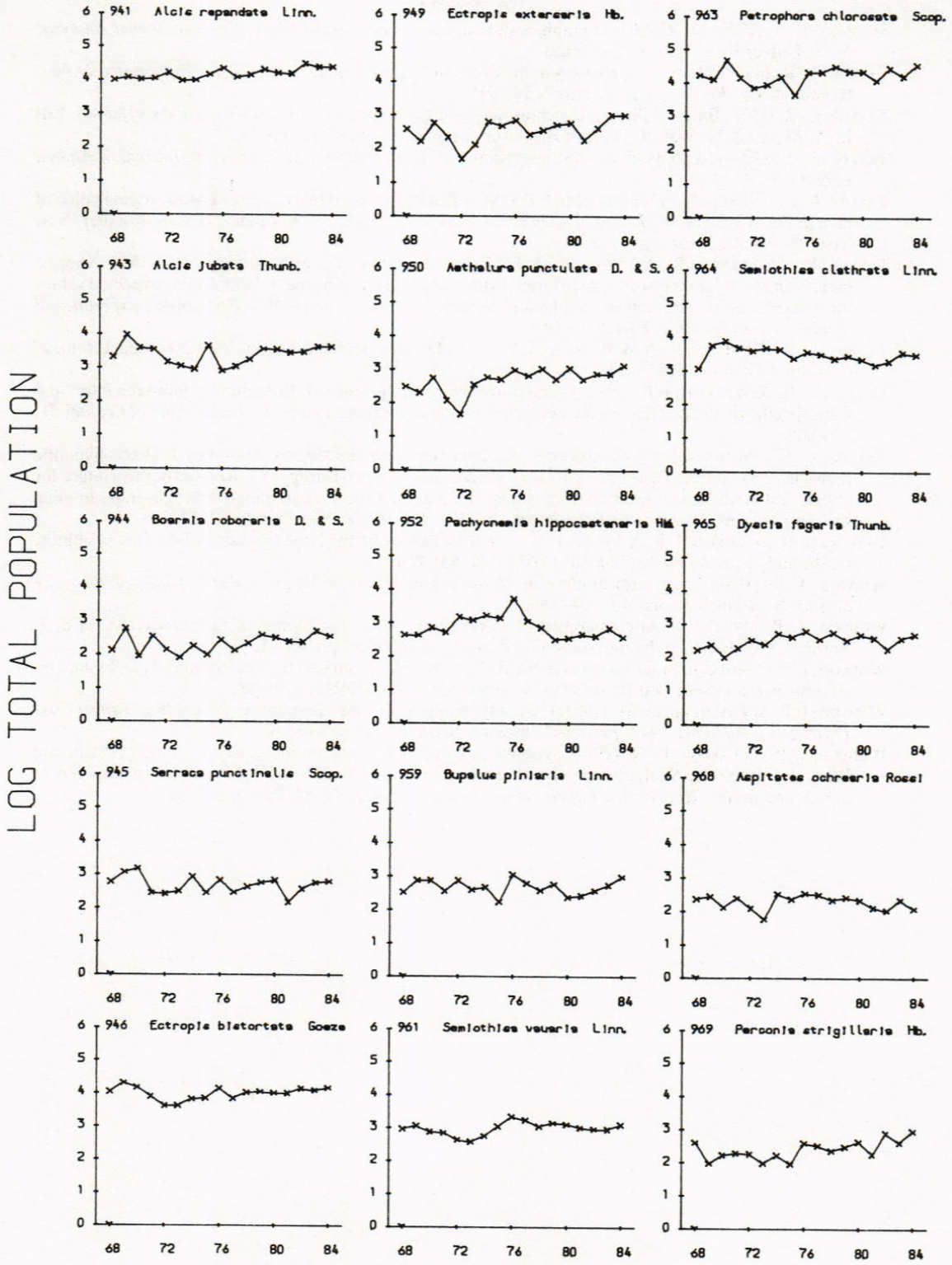

FIG. 25.

https://doi.org/10.23637/ERADOC-1-27

REFERENCES

SAMPSON, R. J. (1975) SURFACE II graphics system. *Kansas Geological Survey Series in Spatial Analysis, No.1,* University of Kansas, Lawrence.

TAYLOR, L. R. (1974) Monitoring changes in the distribution and abundance of insects. *Rothamsted Experimental Station. Report for 1973,* Part 2, 202–239.

TAYLOR, L. R. (1978) Bates, Williams, Hutchinson—a variety of diversities. In: *Diversity of insect faunas*. Eds L. A. Mount & N. Waloff. Oxford: Blackwell Scientific Publications, pp. 1–18.

TAYLOR, L. R. (1986) Synoptic dynamics, migration and the Rothamsted Insect Survey. *Journal of Animal Ecology* **55,** 1–38.

TAYLOR, L. R., FRENCH, R. A. & WOIWOD, I. P. (1978) The Rothamsted Insect Survey and the urbanization of land in Great Britain. In: *Perspectives in urban entomology*. Eds. G. W. Frankie & C. S. Koehler. New York: Academic Press, pp. 31–65.

TAYLOR, L. R., FRENCH, R. A., WOIWOD, I. P., DUPUCH, MAUREEN J. & NICKLEN, JOAN (1981) Synoptic monitoring for migrant insect pests in Great Britain and Western Europe. I. Establishing expected values for species content, population stability and phenology of aphids and moths. *Rothamsted Experimental Station. Report for 1980,* Part 2, 41–104.

TAYLOR, L. R., KEMPTON, R. A. & WOIWOD, I. P. (1976) Diversity statistics and the log-series model. *Journal of Animal Ecology* **45,** 255–272.

TAYLOR, L. R. & WOIWOD, I. P. (1982) Comparative synoptic dynamics. I. Relationships between inter- and intra-specific spatial and temporal variance/mean population parameters. *Journal of Animal Ecology* **51,** 879–906.

TAYLOR, L. R., WOIWOD, I. P., HARRINGTON, R., NICKLEN, JOAN & DUPUCH, MAUREEN J. (1985) Synoptic monitoring for migrant insect pests in Great Britain and Western Europe. VI. Revised nomenclature for aphids and moths, analytical tables for spatial and temporal species parameters and light trap sampling site distributions. *Rothamsted Experimental Station. Report for 1984,* Part 2, 251–275.

TAYLOR, L. R., WOIWOD, I. P. & PERRY, J. N. (1980) Variance and the large scale spatial stability of aphids, moths and birds. *Journal of Animal Ecology* **49,** 831–854.

WOIWOD, I. P. (1981) Long term monitoring of moth populations at Broom's Barn. *Transactions of the Suffolk Naturalist's Society* **18,** 204–209.

WOIWOD, I. P. (1982) Computer mapping of insect survey data. In: *Euraphid, Gembloux 1982*. Ed. J. Bernard. Gembloux, Belgium: Station de Zoologie Appliquee, pp. 83–91.

WOIWOD, I. P. (1986) Computer mapping in the Rothamsted Insect Survey. In: *Proceedings of the Seminar on Agrometeorology and Pest Forecasting,* Wageningen: CTA/TDRI, pp. 89–98.

WOIWOD, I. P. & TATCHELL, G. M. (1984) Computer mapping of aphid abundance. *Proceedings British Crop Protection Conference 1984, Pests and Diseases, Brighton,* pp. 675–683.

WOIWOD, I. P. & TAYLOR, L. R. (1984) Synoptic monitoring for migrant insect pests in Great Britain and Western Europe. V. Analytical tables and figures for the spatial and temporal population parameters of aphids and moths. *Rothamsted Experimental Station. Report for 1983,* Part 2, 261–293.

https://doi.org/10.23637/ERADOC-1-27