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Thirty-five years of Tropical biology: a quantitative history

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Abstract: Citation indices are unappropriate measures of scientific output and impact. For that reason, nonparametric statistics were preferred to analize 35 years of publication on Tropical biology in the Revista de Biología Tropical. The most frequent subjects are animal taxonomy, human biology -including medicine- ecology and animal behavior. Botany papers are less frequent and mainly deal with morphology and taxonomy. Applied studies are not predominant. In that period, only one case of unethical experimentation with humans was discovered in a paper of Mexican origin. The proportion of foreign institutions publishing in the journal has increased from 23% (1953-1963) to 50% in the last decade; similarly, the number of studies done in the Neotropics is on the rise. English and Spanish are equally frequent, although English is the basic language of ethology and evolution and Spanish predominantes in papers on animal morphology and parasitology. Most Costa Rican authors publish in Spanish, in contrast with many of their Latin American colleages. In recent years, there is a tendency to publish shorter papers written by more than one author. The Revista de Biología Tropical, covered by 18 data bases, accounts for most exchanges and sales in the Universidad de Costa Rica and has worldwide distribution.

Good advise for field biologists who venture beyond the research stations is to stop regularly and to look back, which allows them to assess their advance and correct the route. Similarly, as the Revista de Biología Tropical -colloquially known as the "Revista"- reached 35 years of publication, we considered that it was also necessary to look back. A quantitative analysis was proposed as an adecuate complement to the anecdotal account by De Girolami (l988a), but a review of several papers by Garfield (1955, 1972, 1984) and in "Scientometrics" (vols. 6-12) showed that current bibliometric methods are generally at the unsatisfactory level of descriptive statistics. As their ecological counterparts to measure diversity, indices are normally unfit for inferential statistical analysis, and should often be regarded as apparent rather than as significant values. Our impression is that most information scientistis have failed to identify this important problem. Furthermore, Perez (1984) has shown that the Science Citation Index is not only unreliable but also strongly misleading in some cases (e.g. to eval uate the impact of scientific work), despite its value for bibliographic purposes (Weinstock 1971). For these reasons, we analized the "Revista" with descriptive and inferential statistics by using distribution free tests to avoid unjustified assumptions (Siegel 1956).

MATERIAL AND METHODS

All the papers published from 1953 through 1987 were classified according to the variables in tables 1-10. We considered as missing the few cases in which there were several values to a variable (e.g. more than one country was included in the study). "Subject" refers to the main topic. We selected a classical division of subjects, rather than UNESCO's categories in the Spines Thesaurus, which were either too broad or too detailed for our purposes. Papers under three pages were considered short communications, even if not specifically marked as "Comunicaciones". Geographical data for institutions refer to the senior author's address. Categorical data were analized with cross tabulations; those categories that were not statistically different (Kendall Tau-B and Chi-square tests) were pooled for discussion and in the figures, but appear in detail in the tables.

RESULTS AND DISCUSSION

Subject:

The most frequent subjects have been animal taxonomy (N = 228 papers), medicine and hu-man biology (N = 123), ecology of particular animal species (synecology, N = 66), community ecology (N = 63) and animal behavior (ethology, N = 49).

Botanists have been most productive in the more classical areas of morphology, taxonomy, autecology and physiology. Plant pathology has been less frequent, followed by few papers on paleontology, evolution, embryology, genetics and parasitology (Fig. la).

Most zoology papers deal with taxonomy, while there is a medium level productivity for autecology, ethology, physiology, morphology and parasitology. Few zoological papers have appeared on evolution, genetics, embryology, pathology and paleontology (Fig. 1b). The contribution of the journal to Neotropical taxonomy is particularly meaningful consid-· ering current problems in the field (Wilson 1985).

The "Revista" is a general journal, and there are publications in fields other than botany and zoology as well. Much has been published on medicine and human biology, followed by community ecology and a few studies on biochemistry, chemistry, biogeography, natural history, history of science and geology (Fig. 1c). Chemistry and geology are no longer considered acceptable subjects and are published elsewhere, while the small importance of biogeography and natural history might reflect that few authors work in those fields. In contrast with most Third World journals (Gorbitz 1964, Vessuri 1987), applied studies are not predominant. Very specialized journals such as "Systematic Zoology" sometimes accept thematically unappropriate papers to keep the publication up to size (Hull 1983), a problem unknown in the more general "Revista". Its rejection rate has varied from 20 to 60% in the last three years (in "Acta Cientifica Venezolana" and "Systematic Zoology" these values are 15% and 60% respectively, Hull 1983, Vessuri 1987).

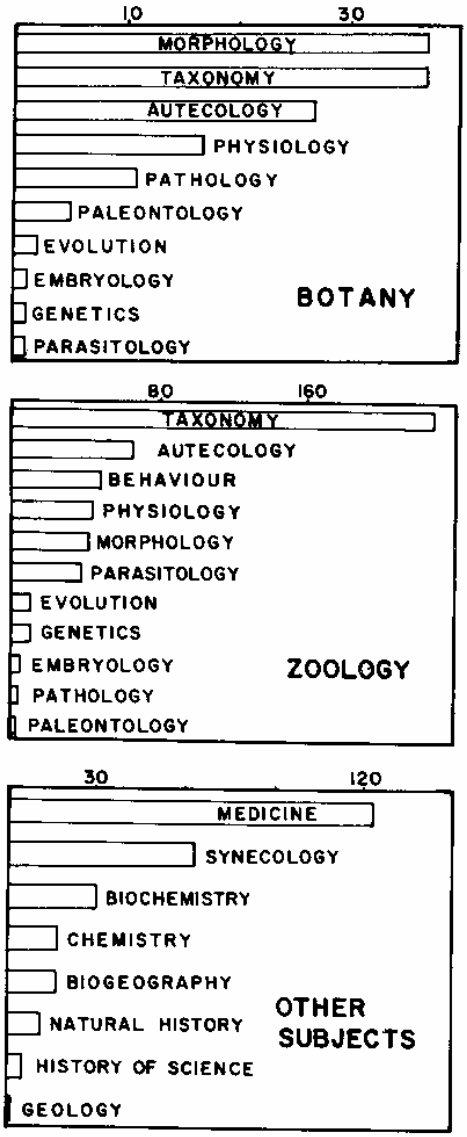


Fig. 1. Number of papers per subject published from 1953 through 1987.

Theoretically oriented papers:

From 1953 through 1988, 18 theoretical and review papers have been published, begining with Archie Carr's quest for the reproduction localities of some marine turtles (Carr 1957, Carr and Caldwell 1958). Posterior reviews dealt with immunology of parasitic nematodes' (Valdivieso and Tamsitt 1970), medically important viruses (Hilleman 1971), hemoflagellates (Zeledón 1971), distribution and migration of marine decapods (Murillo 1972), abnormal hemoglobines (Saenz 1976), fossil bees (Wille 1977), hematozoa of Neotropical birds (White *et al.* 1978), lampbrush chromosomes (Espinoza et al. 1980), taxonomy of *Bactris* palms (Mora and Clement 1981), insect guilds (Fowler 1982), snake venom myotoxins (Gutierrez and Cerdas 1984), biogeography of ants (Fowler 1983), physiology of honey bee mites (Ramirez 1986), analogies in the evolution of fig wasps and certain mites (Ramirez 1987) and critical eutrophication in the marine environment (Mee 1988).

TABLE 1

Characteristics of botany papers

	X	SD	Minimum	Maximum
Figures	6.52	7.83	0.00	47.00
Tables	1.16	2.68	0.00	14.00
References	14.35	10.83	0.00	60.00
Pages	9.95	7.03	1.00	38.00

TABLE 2

Characteristics of Zoology papers

	X	SD	Minimum	Maximum
Figures	5.45	8.32	0.00	3.00
Tables	1.53	2.50	0.00	25.00
References	13.84	13.90	0.00	122.00
Pages	11.01	11.00	1.00	127.00

TABLE 3

Characteristics of papers in fields other than botany and zoology

	X	SD	Minimum	Maximum
Figures	4.10	6.31	0.0	48.00
Tables	2.60	4.30	0.0	37.00
References	16.00	15.15	0.0	175.00
Pages	10.46	8.26	1.0	56.00

Ethics

Since the begining of the journal, a peer re–view system was established for all papers, in–cluding those from members of the editorial board. In contrast with most journals (Hull 1983); the board has the final decision on ac–ceptance, not the editor.

It is unethical to publish a paper or its slight modification in several journals. Two claims of this practice have been received but none was substantiated; interestingly, in both cases the problem began when related papers appeared in European journals after publication in the "Revista". Perez (1961) experimentally inoculated 82 mental patients with *Plasmodium vivax* in Mexico, and 79 developed blood infection. The parasite can severely affect blood, liver and in some cases the brain. This sort of experiment is unethical and currently prohibited by law worldwide (in Costa Rica, the goverment has formed a commission to evaluate ethical aspects of any research program that uses human subjects). We hereby officially regret its publication, in the name of all per–sonnel and advisors of the "Revista". No

other ethical problems have been identified in almost a thousand papers published since 1953. Strin–gent ethical codes have been applied for many years and all reviewers are specifically asked to check for ethical treatment of human and non human organisms.

Supplements:

Five supplements have appeared since 1973, dealing with nest architecture of bees (Wille & Michener 1973), conservation and development in Central America (Chavarria 1976), marine science (Chavarria 1978), marine isopod Crustacea (Brusca & Iverson 1985), and plant ecophysiology in the Mesoamerican forests (Clarck, Dirzo & Fetcher 1987). Another on *Sechium edule.* written by E.M. Flores is currently in press and two more on entomology have been proposed. Thus, the supplements have been balanced between botany, zoology and conservation and, particularly, the volume on forest ecophysiology is outstanding for its clear double purpose: it is both an updated review prepared by foremost authorities, and a textbook for technical and scientific trainees, which is currently used throughout Latin America.

Obituaries and hommages:

A total of twelve obituaries of microbiologists have been published, which reflects the early influence of parasitology oriented members of the editorial board. In 1961 (Vol. 9), obituaries were published for Rodrigo Facio and Fabio Baudrit, university officials who had supported establishment of the "Revista". Volume 35 (1987) included four invited papers commemorating the birth centennial of Costa Rican biologist Clodomiro Picado Twight, whose early elaboration of the Inmunologic Theory of Aging (Picado 1937) has been largely overlooked. The "Revista" also lost two editors in this period, Rafael L. Rodriguez and Manuel Chavarria; their obituaries appeared in 1981 (Vol. 29) and 1987 (Vol.35).

Geographic distribution of institutions:

Throughout the years, there has been no significant trend in the distribution of countries where research institution is located (Table 4, Kendall Tau-B $p < 0.01$) . In the first ten years of publication, 197 papers were published, of which 77% were of national origin (editorial for the year 1962). To date, slightly less than 50 % of articles are of foreign origin, which reflects the growing internationality of the "Revista" if compared, for example, with "Acta Cientifica Venezolana" (23% foreign). There are no very frequent or unfrequent subjects in studies supported by institutions from the United States, West Indies and Central and South America (Table 5, fig. 2. Chi-square tests, $p > 0.05$), but Costa Rican entities less frequently host work on some categories of animal biology and particularly animal taxonomy (Chi-square test, $p < 0.01$) according to classification in Table 5. In Mexico and Europe, animal taxonomy is the main subject supported (Table 5, fig. 2. Chi-square test, $p < 0.01$).

Geographic areas studied:

Although the great majority of research has been done in the Neotropical region, there are occasional reports from subtropical areas in places like the United States and Chile. The studied area is related to the year (Table 6, Fig. 3. Kendall Tau-B, $p < 0.01$). The number of studies has steadely increased since 1953 in Meso and South America (Chi-square test, $p < 0.01$), has not changed significantly in the United States (Chi-square test, $p > 0.05$) and has decreased in Chile (Chi-square test, < 0.01), which reached a peak around 1960 (Table 6, fig. 3). This may be related to more stringent exclusion of studies not dealing directly with Tropical —and particularly Neotropical— subjects. The reason for this is simply space limitation.

There is an association between geographic area and subject of study (Table 7, fig.4. Ken–dall Tau-B, $p < 0.01$). The greatest number of papers on Costa Rican (Chi-square test, $p < 0.05$), Central American and the West Indian nature deals with subjects that are not strictly zoological (Chi-square test $p < 0.01$); in the other countries animal taxonomy led (Chisquare test, $p < 0.01$).

TABLE 4

Geographic distribution of Institutions publishing research form 1953 through 1987

	1953 - 1957	1958 -1962	1963 -1967	1968 -1972	1973 -1977	1978 -1982	1983 -1987
Sou th America	0	3	7	3	2	8	24
Central Emerica	1	5	6	8	4	7	14
Mexico	3	12	11	7	9	5	34
Brazil	2	2	3	3	1	11	10
Costa Rica	72	75	28	29	52	87	196
Asia	0	1	10	5	1	1	2
United States	0	12	24	23	34	21	24
Europe	1	1	1	0	1	1	5

Note: Africa published only 3 papers in this period.

Language:

In its first years, the journal published some .'" papers in Italian, German and French, probably by influence of Italian cofounder Ettore de Girolame and German trained coeditor Alfonso Ruiz. Nevertheless, almost the totality of papers have been in Spanish and English. English was more frequent from 1968 through 1972 (Table 8. Binomial test, $p < 0.05$), but Spanish prevailed by a small margin from 1953 through 1962 and again after 1983 to present (Table 8. Binomial tests, $p < 0.05$). In entomology, the use of German, French and Italian has strongly declined in this century, as English became the dominant vehicle for communication. Russian and Spanish are making a slow increase (Steyskal 1988), but Spanish is not yet a viable system for scientific communication in general (Price 1983). The relative importance of Spanish in the Revista probably results from the growth of the Costa Rican scientific community and the desire of some foreign authors to reach a wider audience in Latin America.

The language of publication is associated to research subject in some cases (Kendall Tau-B tests). There are no language trends in several subjects (Table 9. Binomial tests, $p > 0.05$), but English is the most frequent lailguage of animal behavior and evolution, and plant embryology and paleontology (Table 9. Binomial tests, $p < 0.05$). Spanish is the main language of animal morphology and parasitology, plant morphology, autecology, taxonomy and genetics, and synecology, natural history, medicine and human biology, and history of science (Table 9. Binomial tests, $p < 0.05$). Spanish is the main language of animal morphology and parasitology, plant morphology, autecology, taxonomy and genetics, and synecology, natural history, medicine and human biology, and history of science (Table 9. Binomial tests, $p<0.05$).

The area where the research is done relates to the language of publication (Table 10. Kendall Tau-B, $p < 0.01$). Studies done in Costa Rica are chiefly in Spanish, those from Brazil, the United States and Asia are more often in English (Table 10) (binomial tests, $p < 0.05$). There is no language predominance in other areas (Table 10. Binomial tests, $p > 0.05$). The papers from Costa Rica contrast with the general Latin American pattern in which 81 % of publications are in English (Garfield 1984 a).

TABLE 5

Geographic distribution of institutions and subject of papers published by them from 1953 through 1987

Institute \ Tema	Zoomorphology	Zoophysiology	Zooembryology	Ethology	Zooevolution	Zooautecology	Zootaxonomy	Geology	Sinecology	Zoopaleontology	Zoopathology	Zooparasitology	Phytomorphology	Phytophysiology	Phytoembryology	Phytoevolution	Autecology	Phytotaxonomy	Phytopaleontology	phytopathology	phytoparasitology	Natural History	zoogenetics	Phytogenetics	Medicine and human biology	Biochemistry and cell biology	Chemistry	Biogeography	History of Science
Costa Rica	28	25	4	22	7	34	81	0	37	2	2	23	28	10	1	1	17	29	5	6	0	5	8	1	104	20	13	4	4
Central America and West Indies	1	1	0	0	4	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	1	0	0
Unites States	7	12	1	14	1	16	36	0	6	0	1	7	4	12	0	0	2	5	0	0	0	2	1	0	5	6	8	3	1
Mexico	2	0	0	4	0	6	44	0	6	0	1	0	1	0	0	0	1	0	0	1	0	1	0	0	5	0	1	5	0
South America	2	4	0	3	1	7	28	1	5	1	0	3	4	3	0	1	5	1	0	1	1	1	0	0	3	0	0	1	0
Europe	1	0	0	1	0	0	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Others	0	3	0	0	1	0	15	0	0	0	0	2	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0

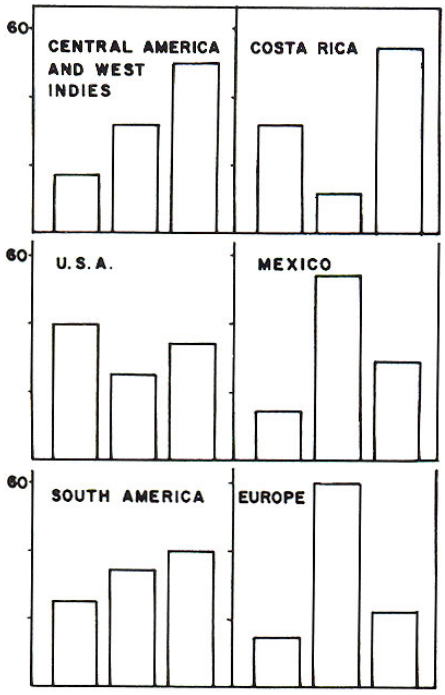


Fig. 2. Geographic distribution of institutions and subject of papers published by them. Key to bars, left: ethology and animal morphology, physiology, embriology, evolution and autecology; center: animal taxonomy; right: other topics according to Fig 1.

TABLE 6

Numbers of papers from six regions according to location of study sites, from 1953 through 1987

	1953-1957	1958-1962	1963-1967	1968-1972	1973-1977	1978-1982	1983-1987
Costa Rica	67	77	44	38	56	85	208
United States	0	8	5	6	6	8	7
Mexico	1	6	8	7	13	4	31
Chile	0	1	11	5	1	1	3
Central America	2	2	7	5	2	8	24
Brazil and others areas					10	24	29

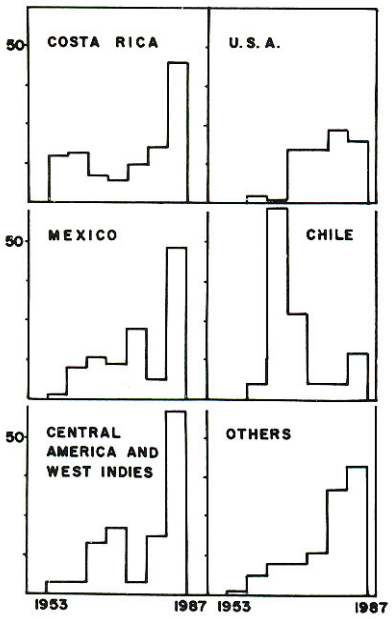


Fig. 3. Number of papers according to location of study sites.

Format:

The frequency of papers with few to many figures, tables and references, as well as the length of the papers, basically conform to skewed distributions in all subjects (Table 1·3, Figs. 5·7). There is a small tendency of larger papers to have more figures (Correlation Coefficient = 0.54), tables (Correlation Coefficient = 47%). In recent years, the size of figures and tables has been reduced, similar to most international journals, and usually to an aesthetic advantage. After 1972, it became economically impossible to use "couche" paper for illustrations, a disadvantage that is partially overcome by the use of fine quality printing screens. Color has been used in highly justified cases through–out the years, to illustrate tissues (Cespedes & Morera 1955), a complex phylogenetic diagram (Rodriguez 1956), pathological states (De Girolami & Faerron 1958), effects of element deficiencies in coffee leaves (Carvajal 1960), a new species of tree frog (Duellman 1963), the famous "golden frog" of Monteverde (Savage 1966), a venomous spider (Trejos, Trejos & Zeledon 1971), a new species of hemipteran (Zeledon & Ponce 1972), a fungus (Sáenz 1976), for graphs (Wille and Orozco 1975, Wille 1976), and again for tissues (De Girolami 1988b). The cover of the 35th. anniversary issue is also in color.

The length of each volume varies sharply from around 100 to more than 400 pages, short issues being more common in recent times as a result of improvements in style and format (Fig. 8). The number of feature articles has doubled from 20 in 1953 to reach 40 in 1987 (Fig. 9). For comparison: in "Acta Cientifica Venezolana" the total number of papers —including notes— increased from 22 in 1950 to 75 in 1984. The number of authors per paper (Figs. 9 and 10) has almost doubled (1.20 authors/paper in 1953, 1.79 in 1987). This increase parallels a general trend (e.g. in Spain, Mendez & Gomez 1986) that has been explained as a negative result of pressure to "inflate" the number of publications per author (Berry 1981, Perry 1987). The most productive authors have worked in parasitology and other health relatived subjects, entomology, plant morphology, phytochemistry, forest ecology, systematic botany, fish biology and several aspects of snake venoms. The list of the most prolific writers includes many well known names: R. Zeledon (34 papers), A. Wille (25), R.R. Brenes (20), A.Ruiz (20), G. Arroyo (180, EM. Flores (18), A. Saenz (198), L. A. Fournier (I8), W.A. Bussing (I 6), Q.O. Jimenez (I6), R. Bolanos (15), C.E. Caballero (15), L. Mata (14), A. Trejos (I4), L.D. Gomez (13), M. Lopez (12), J .M. Gutierrez (11), M. Nassar (11) and C. Villalobos (11).

Short communications have also increased in numbers (Fig. 10). Five were published from 1959 through 1963. They did not reappear until 1981 (four) and reached 22 in 1987. The same

TABLE 7

Subject of papers from six regions according to location of study sites

	Zoomorphology	Zoophysiology	Zooembryology	Ethology	Zooevolution	Zooautecology	Zootaxonomy	Geology	Sinecology	Zoopaleontology	Zoopathology	Zooparasitology	Phytomorphology	Phytophysiology	Phytoembryology	Phytoevolution	Autecology	Phytotaxonomy	Phytopaleontology	phytopathology	phytoparasitology	Natural History	zoogenetics	Phytogenetics	Medicine and human biology	Biochemistry and cell biology	Chemistry	Biogeography	History of Science
Costa Rica	29	25	4	29	5	39	106	0	42	1	2	25	25	11	1	0	18	25	5	8	0	5	7	1	106	21	14	4	4
Unites States	0	8	1	2	0	4	8	0	0	0	0	3	2	1	0	0	0	3	0	0	0	0	0	0	1	4	2	0	0
Mexico	3	2	0	5	0	7	25	0	8	0	1	0	4	0	0	0	2	0	0	1	0	0	1	0	5	1	5	0	1
Central America and West Indies	2	0	0	3	0	4	14	0	7	0	0	3	0	0	0	0	2	2	0	0	0	3	1	0	2	0	3	0	0
South America	3	5	0	8	3	7	43	1	3	0	0	5	4	3	0	1	5	6	0	2	1	1	0	0	3	0	0	0	0
Others	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

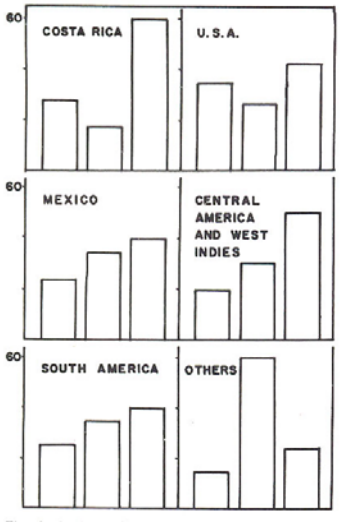


Fig. 4. Subject of papers according to location of study sites. Key to bars, left: ethology and animal morphology, physiology, embriology, evolution and autecology; center: animal taxonomy; right: other topics according to Fig. 1.

increasing trend is known in other international journals (Hull 1983). Readers often find book reviews interesting (Hull 1983) and the "Revista" needs to increase their number. To date, no systematic book reviewing policy has been established. Invited theoretical reviews will begin with a paper from Daniel M. Alongi of the Australian Institute of Marine Science (Alongi 1989).

A special format for range extensions was established recently, as a preferred option to the elimination of valuable data which are not fit for normal articles. The need for debate has also been felt and a forum section was first published as "Commentaries" (Monge-Nájera & Morera-Brenes 1987) at the suggestion of Editorial Board member C.E. Valerio. Ideally, all comments will appear with a reply, as in the case of Guzman (1988) and Prahl (1988).

TABLE 8

Number of papers in Spanish and English from 1953 *through 1987*

	1953- -1957	1958- -1962	1963· -1967	1968· -1972	1973· ·1977	1978- ·1982	1983· -1987
Spanish	71	86	39	27	60	74	197
English		20	53	51	46	67	116

Distribution:

Considering all the scholarly journals published by the Universidad de Costa Rica, the Revista de Biología Tropical is outstanding in distribution. A total of 1250 public and personal libraries receive the journal (Fig. 11). "Systematic Zoology", the publication of an important American society, has a circulation of nearly 2700 (Hull 1983). Considering the relative sizes of Costa Rica and the United States, this is a very good level for the "Revista". The subscription price has always been subsidied. It has changed only four times in 36 years, from US $2 (10) in 1953 to US$ 18 (Ç 360) begining in 1989. It is a general experience that ‘‘ scientific journals are not appropriate for self-financing and are published for their extrinsic value in society (Abelson 1981). The largest number of sales corresponds to the “Revista”, followed by journals on history and the social sciences (Fíg. 12. Chi-square test, $p < 0.01$); in the same descending order, the “Revista” leads on exchange, followed by the serials on social sciences and visual arts.literature (Fig. 12. Chi-square test, $p < 0.01$). There is a similar pattern for donations (Fig. 12. Chisquare test, $p < 0.0$ 1). The second place of social science material probably reflects current World interest in social and political events in Central America.

TABLE 9

Language and subject of papers published from 1953 through 1987

	Zoomorphology	Zoophysiology	Zooembryology	Ethology	Zooevolution	Zooautecology	Zootaxonomy	Geology	Sinecology	Zoopaleontology	Zoopathology	Zooparasitology	Phytomorphology	Phytophysiology	Phytoembryology	Phytoevolution	Autecology	Phytotaxonomy	Phytopaleontology	phytopathology	phytoparasitology	Natural History	zoogenetics	Phytogenetics	Medicine and human biology	Biochemistry and cell biology	Chemistry	Biogeography	History of Science
Spanish	29	25	3	17	2	32	101	6	40	1	2	28	30	8	1	0	20	27	3	6	1	8	1	108	20	9	7	4	9
English	13	20	2	31	8	33	123	1	23	2	2	2	10	7	7	0	2	6	10	2	5	0	4	2	0	12	10	8	0

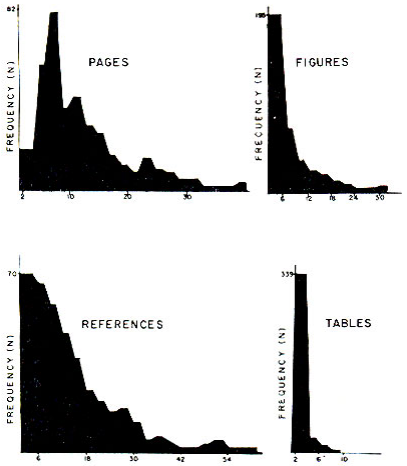


Fig. 5. Characteristics of botany papers (horizontal axis: numbers).

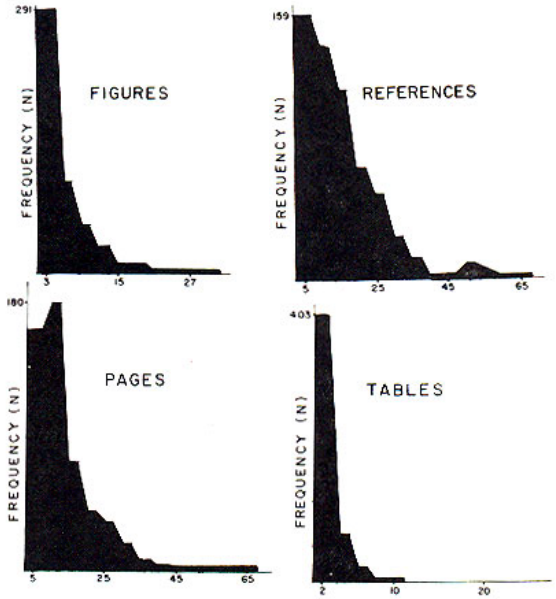


Fig. 6. Characteristics of zoology papers (horizontal axis: numbers).

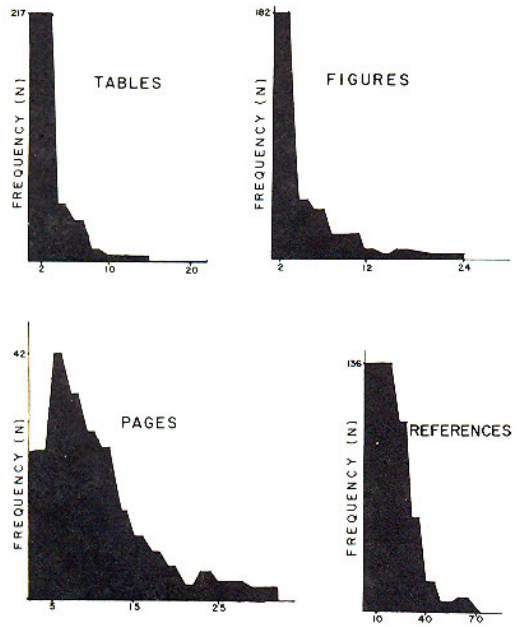


Fig. 7. Characteristics of papers in fields other than botany and zoology (horizontal axis: numbers)

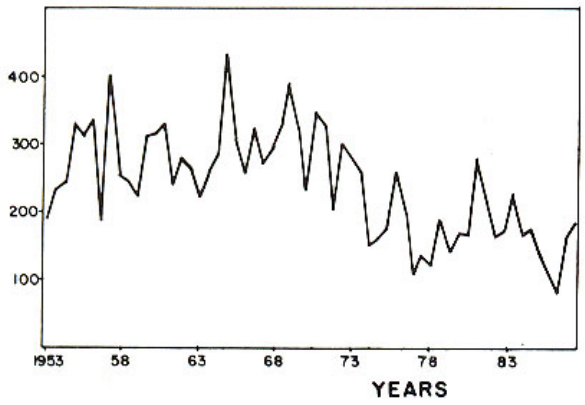


Fig. 8. Length (in pages) of issues

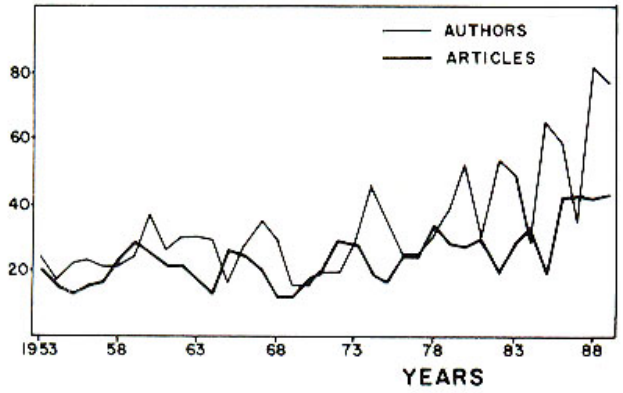


Fig. 9. Number of feature papers and authors.

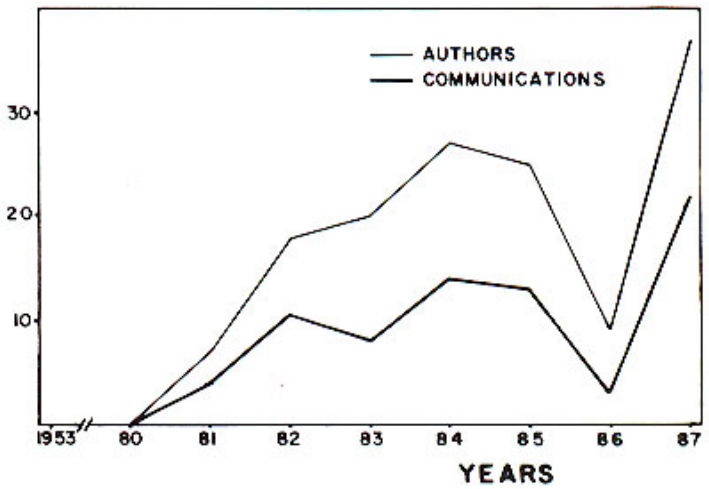


Fig. 10. Number of short papers and authors.

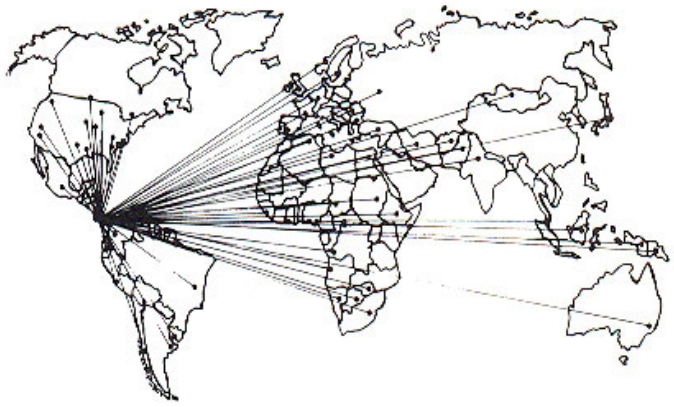
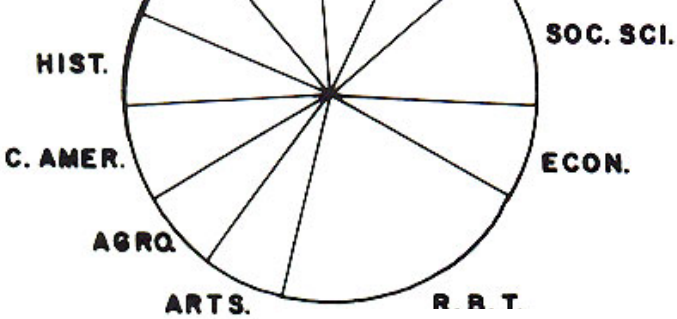


Fig. 11. Geographic distribution of the main libraries which keep collections of the Revista de Biología Tropical (only public libraries located in capital cities are shown).

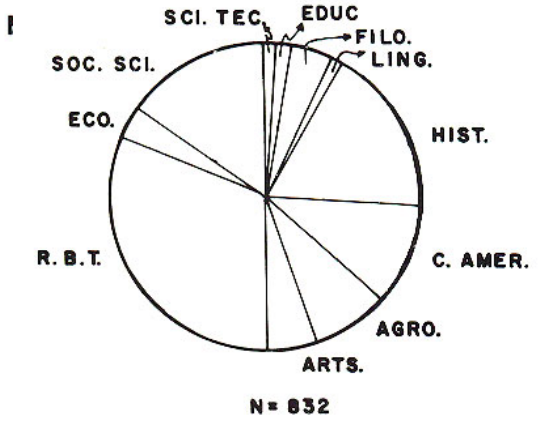
A final question regards geographic areas of distribution. Issues are donated to influential libraries as well as to those unable to pay a subscription or to return another serial in exchange (Fig. 12). Most donations correspond to Central America, and key libraries and data bases in the United States and Europe (Fig. 13. Chi-square test, $p < 0.01$); anual subscriptions are mainly paid by libraries and individuals from Central America, the United States and the West Indies (Fig. 13. Chi-square test, $p > 0.01$). The exorbitant prices of First World scientific serials (Abelson 1981) would keep them out of reach for the Universidad de Costa Rica; the problem is greatly solved by exchange. Exchange is by far the most important reason for the foundation of the journal, and a major means of distribution. From 225 exchange titles in 1956, the "Revista" has increased to 590 today, despite the lack of any active exchange initiation program. The most important destinations are Europe, Brazil and the United States (Chi-square test. $p<0.01$). The international success of the "Revista" is reflected in its coverage by 18 data bases and indexing serials: Aquatic Science and Fisheries Abstracts, Biological Abstracts (BIOSIS), Chemical Abstracts, Current Awareness in Biology, Current Contents (ISI), Index Medicus, Nutrition Abstracts, Abstracts of Hygiene, Field Crop Abstracts, Helminthological Abstracts, Herb. Abstracts, Horticulture Abstracts, Index Veterinarius, Review of Applied Entomology, Sel. Water Resources Abstracts, Soils and Fertilizers, Veterinary Bulletin and Tropical Diseases Bulletin.

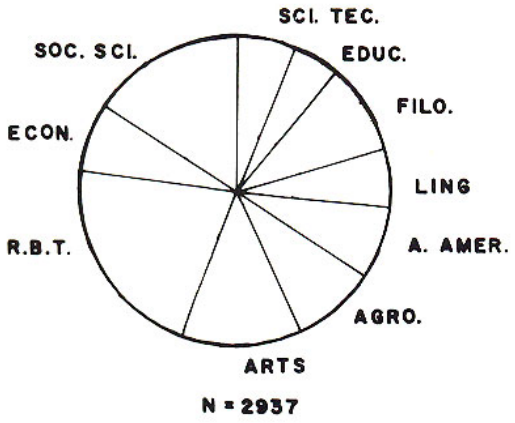
The value of inclusion in electronic memories -an important advantage for authors publishing in the "Revista"- includes its potential to discover "hidden" information. For example, historians of science probably wold never find by traditional methods, that a personal account by Stephen J. Gould on how the model of Punctuated Equilibria originated, is included in a paper on a Costa Rican biologist who lived in the first half of this century (Monge-Nájera 1987). An electronic search would retrieve that information (Weinstock 1971).

The contemporary increase in punctuality, as well as frequency of citation and priority shipment to



highly selective orga-nizations such as
er Third World serials (Gorbitz 1964,





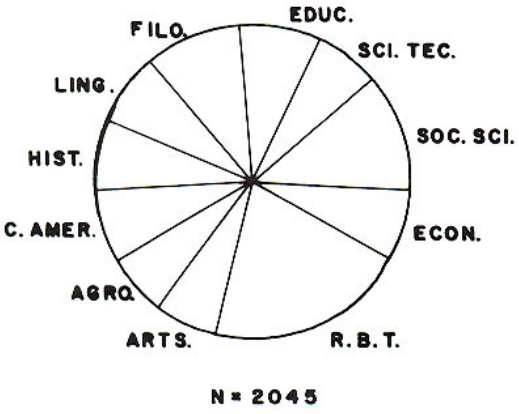


Fig. 12. Relative output of the periodical publications of the Universidad de Costa Rica, according to subject. Above: sales, center: exchange, below: donations. Key: Educ = education, Filo = phylology, Ling = linguistics, Hist = history. C. Amer. = Central American politics, Agro = agronomy, Arts=visual arts, RBT = Revista de Biologia Tropical, Eco = economy, Soc. Sci. = social sciences, Sci. Tec. = science and technology (general).

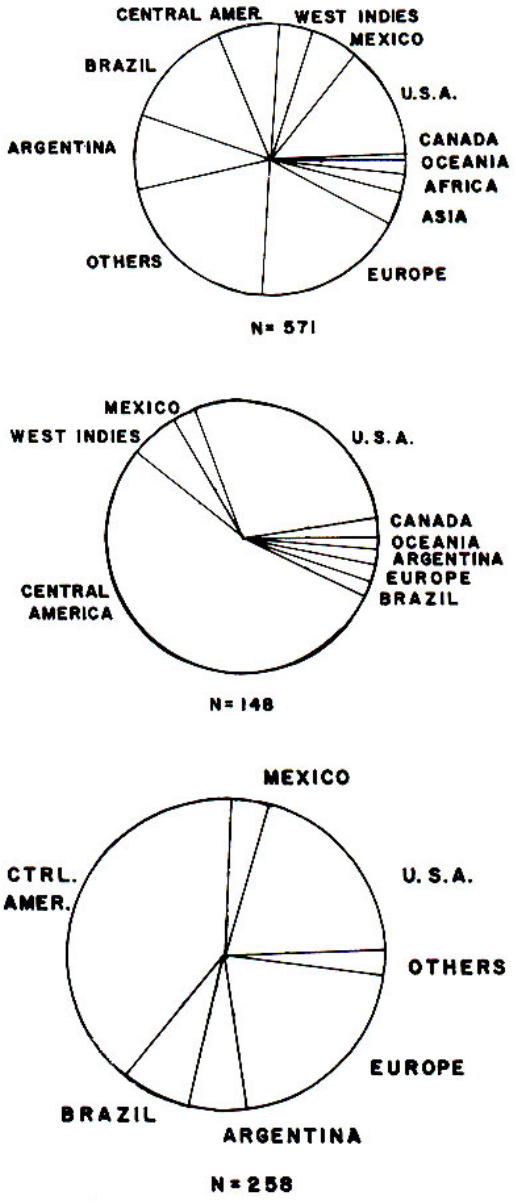


Fig. 13. Relative geographic distribution of the Revista. From above: exchange, subscriptions, donations.

The future:

In years to come, the most probable trends in the Revista de Biología Tropical are: 1) growth, both in number of pages per year and as host to other publications (e.g. the planned taxonomic series of the Zoology Museum, Universidad de Costa Rica) and 2) an increase in the use of electronic media for administration, editing and publishing.

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RESUMEN

Los índices de citas no son adecuados para medir la producción científica y el impacto de las publicaciones. Por ello, se prefirió usar estadística no parametrica para analizar las publicaciones de la Revista de Biología Tropical entre los años 1953 y 1987. Los temas mas frecuentes son la taxonomía animal, la biología humana -incluyendo medicina- la ecología y el comportamiento animal. Los artículos sobre botánica son menos frecuentes y principalmente se refieren a morfología y taxonomía. Los estudios aplicados no son los más comunes en la revista. En este periodo, solo se identifico una violación ética a las normas de experimentación con seres humanos, en un artículo proveniente de México. La proporción de instituciones extranjeras que publican en la revista aumento de un 23%(1953-1953) a un 50% en la Ultima década; similarmente ha crecido la cantidad de artículos sobre la Región Neotropical. Los artículos en ingles y en español son igualmente frecuentes, aunque el inglés es predominante en etología y evolución y el español en morfología y parasicología de animales. En contraste con la mayoría de sus colegas latinoamericanos, los costarricenses publican principalmente en español. En los últimos años, se ha dado una tendencia a publicar artículos cortos y con varios autores. La Revista de Biología Tropical, incluida en 18 bases de datos, produce la mayor cantidad de canjes y ventas para la Universidad de Costa Rica y tiene distribución mundial.

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