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An impact of Croatian journals measured by citation analysis from SCI-expanded database in time span 1975–2001

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The aim of this research is to gain an insight into international recognition of the STM (Science, Technology, and Medicine) Croatian journals measured by citations in SCI-expanded database. The sample for the research was a citation analysis of 142 journals in time span 1975–2001 for papers published in 1975–1998. More than 90% of those journals are not indexed by SCI-expanded. For the purpose of this research we introduced a new scientometric indicator *Normalized number of Citations per 100 Papers (NCP)* that allows us direct comparison of the journals from various categories ($NCP = 100C/P / IF_{1989}$). We chose the year 1989 as a mean value for time span 1975–2001.

By citation analysis we established the influence of errors on recognition of Croatian journals and their articles. Obtained results show that an article-to-article link is not found for 32% of cited items. The most frequent type of error is journal title, 37%, which indicates that approximately one third of Croatian journals can not be found when searching by journal title only.

Some Croatian journals, even not indexed by SCI-expanded, showed relatively high rank in an impact, i.e. their NCP is higher than 100, and number of citations per paper is higher than 1.

Introduction

Journal as a key conventional channel in science communication is an often used object in bibliometric research. The diversity of journal research aspects can be seen in example of two issues that celebrate the 50th anniversary of *The Journal of the*

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American Society for Information Science (JASIS), or in example of *Scientometrics* [SCHUBERT, 2002] and GLÄNZEL & AL. [2002]. Regarding the research approach, articles involved in journal research and evaluation can be divided into two groups, objective and subjective [TURBAN & AL., 2004]. The objective approach is based on citations and citation analyses (citation counts over a certain time period), “total cites”, “immediacy index”, “total articles”, “cited half-life” and “impact factor”. The subjective approach, also called perception analysis approach, solicits information from experts such as academic staff, deans, or departmental heads.

Citation-based ranking of journals, introduced by Gross & Gross, in far 1927 is frequently used as an objective method of journal evaluation. Determination of the status or of the position of a journal in its environment, either in comparison to the subject field or in contexts of scientific environment of a university or a country, especially in example of small countries, is important for many reasons. According to NISONGER [1999], it is important for scientists to know where to send manuscripts, in order to be more available to the auditorium to whom it is dedicated. From the aspect of faculty or university evaluation it is not all the same in which journals their scientists publish. For libraries, journal evaluation and ranking is important for the purpose of collection planning and development, as well as it is important for journal editors to improve the quality of their journals.

Citation database, indices, WoS (Web of Science: SCI expanded, SSCI and A&HCI) ISI /Thomson Scientific, and statistical databases originated from citation indices, JCR (Journal Citation Reports) and ESI (Essential Science Indicators), up to now, are recognized in whole scientific world as a main instrument in science evaluation. Considering that WoS is a very selective database and covers less than 10% of world scientific productivity, it is clear that most journals, especially from non-English speaking countries and small scientific communities, are not indexed in it. Consequently, they are not covered by JCR, and even less in ESI. An example of selectivity of mentioned databases can be seen in the sample of Croatian journals. At the moment 13 Croatian journals are indexed by WoS, 12 of them have an IF (indexed in SCI and SSCI). 13th journal, *International Journal of the Aesthetics and Sociology of Music*, is indexed by A&HCI, which has no instrument like JCR. According to the data from ESI database,¹ which gathers data from WoS, in the category of the most cited journals in time span 1995–2005, in all subject fields we found only one Croatian journal, *Croat Chem Acta*, ranked 273 among the 303 most cited journals in the field of chemistry.

If we used only mentioned indicators in scientometric research, more than 95% of scientific productivity in national journals of non-English speaking countries would be omitted. Due to this fact it is questionable how much are those journals generally internationally relevant. For small countries, with low scientific productivity or so

¹ <http://www.isinet.com/products/evaltools/esi/> (retrieved December 2005).

called “periphery countries”, it is important to continuously monitor the position of their journals in relevant scientific surrounding, even when they are not indexed by ISI/Thomson Scientific sources.

One of the opportunities for these countries is scientometric instrument development and monitoring of availability and impact of those journals in relevant conventional and less conventional sources: from the availability and accessibility in electronic format and indexing in relevant bibliographic databases, monitoring the usage via log analysis (reading, downloading etc.) to the measuring citations in conventional citation databases, as ISI/Thomson or in the national citation indices etc. [BROWN, 2003]. At the end of 2004 two new citation databases appeared; a commercial one Scopus,² and an open source Google Scholar,³ with a different concept about the corpus of covered sources in comparison with the concept of WoS. New citation sources offer a more comprehensive picture of the impact of specific publication, on an international level, given their concepts of selection of publications are not based on Bradford’s law of distribution, as in the case of WoS. Consequently, national journals covered by new citation sources have a better chance for international visibility and recognition.

One of the newest researches concerning the measurement to which extent is a journal internationally recognized, was conducted by BUELA-CASAL & AL. [2006]. They claimed that it should be made clear that internationality *per se* is not to be equated with quality. It is quite possible that a non-global, non-international journal may publish the best, most advanced and innovative research. In their research they focused on the identification of a complete set of factors necessary to accurately define and measure internationality in relation to academic journal publishing.

Croatian scientific journals

Croatian scientific community with 6017 FTE⁴ (Full Time Equivalent) or 0.14% FTE researchers in all scientific fields, compared to the total number of inhabitants, is a relatively small one. Their scientific productivity on international level is measurable by number of papers in the internationally recognized journals, indexed by WoS. However, one of the indicators of scientific productivity and scientific activity are journals and papers published in Croatia. At the moment, Croatia has approximately 220 journals in all scientific fields. It is difficult to establish the exact number of active national journals, as they have different periodicity, from once a year to twelve times yearly. It is not a rare occasion that a journal who predicted dynamic of two issues a year, appears as a double issue. The time span in appearance of a new issue for some journals can be

² <http://www.scopus.com/scopus/home.url> (retrieved 24 November 2006).

³ <http://scholar.google.com/> (retrieved 24 November 2006).

⁴ UNESCO Institut for Statistics. Statistical data FTE available on: <http://www.uis.unesco.org/TEMPLATE/html/Exceltables/science/R&DTables.xls> (retrieved 31 October 2006).

even two years. Publishers of almost all Croatian journals are academic institutions or professional associations, and all of them are financed by Croatian Ministry of Science, Education and Sport. There are exceptions of a few journals whose publishers are small private commercial companies, since the year 2000. Almost all of the journals still appear in a printed version, even though tendency to electronic versions is noticeable. National and University Library Zagreb started with a pilot project Full-text database of Croatian journals.⁵ The idea of the project is to organize and develop textual database for all Croatian scientific and professional journals to be available as an open source.

Given that we have a relatively big number of journals compared to relatively small scientific community, journal editors compete every year for the financing support of the Ministry of Science, Education and Sport to enable publishing. Ministry has its own criteria for journal evaluation, such as editorial board, peer-review, type of papers (original articles, review articles, short communication & notes, and professional papers), coverage by relevant international bibliographic databases, especially by ISI databases. In order to be covered by the relevant international bibliographic databases, it is important to be readable, which means that it is important to publish in English. We observed linear increase rates for Croatian STM journals during the second half of 1990s and later tendency to publish increasingly in English instead of Croatian, similarly to the results obtained by LEYERSDORFF & ZHOU [2005].

Croatian journals indexed by WoS

From the sample of 220 Croatian journals, with different frequency of publishing, from one to twelve issues yearly, and with the different starting years, currently 13 of them are indexed by WoS. More precisely, 10 Croatian journals are indexed by SCI-Expanded: *Chemical and Biochemical Engineering Quarterly*, *Croatian Medical Journal*, *Croatica Chemica Acta*, *Food Technology and Biotechnology*, *Mathematical Inequalities and Applications*, *Metalurgija*, *Neurologia Croatica*, *Periodicum biologorum*, *Strojarstvo* and *Tekstil*; in SSCI database are indexed 2 journals: *Collegium Antropologicum* and *Društvena istraživanja*, and in A&HC is indexed *The International Review of Music Aesthetics and Sociology*. If we presume that quoted journals represent the key Croatian journals, which is 5.9% of 220 journals, in that case this fact is basically in accordance to the selection policy of ISI that WoS represent the “core” of the world scientific journals. For a small, non-English speaking country as Croatia is, it is not reasonable to expect that it will be represented in WoS with more journals. In a comparison with Italian journals, according to UGOLINI & CASILLI [2003] 73 of Italian journals were indexed by SCI, all of which were English-language, among 10 Croatian journals which are indexed by SCI-expanded, only 8 are English-language.

⁵ <http://www.nsk.hr/DigitalLib2c.aspx?id=457> (retrieved 24 November 2006).

Given that the WoS is one of the most selective databases, for many journals even only to be indexed in it, is a matter of prestige, especially for “periphery countries”. However, indexing by itself does not represent much, if we do not take a step further by monitoring citations of journals and papers. ISI calculates IF (Impact Factor) by measuring citations of indexed journals. Just to show an example of position and ranking of national journals indexed by WoS (SCI and SSCI) for 14 countries which recently started as a new member of EC, (more precisely 12 of them, and 2 countries who are negotiated to be part of EC), 3 countries are not represented by any journals in WoS (Lithuania, Cyprus and Malta), countries which are represented in WoS, from 1 to 6 journals were: Latvia 1, Bulgaria 2, Slovenia 4, Turkey 4, and Romania with 6 journals. Countries following by increasing number of indexed journals are Croatia 12, Slovakia 14, Hungary 18, Czech Republic 27 and Poland 37. IF of quoted journals, only in the case of Poland and Czech Republic (3 journals), was equal to or higher than one, respectively the highest was 2.377, for the year 2001 [JOKIĆ, 2003].

A fact that majority of mentioned journals, including Croatian journals, have an IF less than one, taking in consideration specificity of scientific fields, indicates that those journals however are not appertain to the group of the most prestige journals. Even, taking in consideration all specificity of ISI categories, majority of those journals are ranked in the third group on the IF scale.

Compared to other Croatian journals, *Croatica Chemica Acta (CCA)* is a Croatian journal indexed by SCI database at the very beginning (1974), with a stabile IF that is the highest among Croatian journals. According to SOMBATSOMPOP & AL. [2002], average journal IF of the Thai academic journals in their work was 0.069, suggesting that each article had an opportunity to be cited of 6.9%. Journals with longer ages tended to have more opportunity to be cited, and had greater IF compared to those with shorter publishing period. According to ARAUJO RUIZ & AL. [2005] foreign journals have a higher impact than national non-English journals.

SCI-expanded in time span 1975–1998 indexed 10 Croatian journals, 6 of them were included from 1994 to 1998. This fact could speak in favour of DANELL [2000] that the establishment of new journals can be seen as an expression of both growth and differentiation of science. For a small scientific community, in particular way, it is recognition of their contribution to whole scientific community.

Objectives of the research

Except the research about indexing in relevant bibliographic databases and occasionally research for a particular journals [SOROKIN, 1990; JOKIĆ, 1998; MARIČIĆ & AL., 2000; JOKIĆ, 2001; JOKIĆ & AL., 2002; JOKIĆ & SIROTIĆ, 2002] and researches led by ANDREIS [1998], in Croatia, until now we have not had systematic researches concerning the scientific productivity and citation analysis of Croatian journals.

Therefore, in this research we tried to clarify questions concerning impact of STM Croatian journals by measuring citations which they received from journals indexed by SCI-expanded database for articles published in time span 1975–1998. More than 90% of journals from our sample are not indexed by SCI-expanded, but possibility for their citation in WoS indexed journals exists. This fact was the starting point of our research. We tried to establish the position of Croatian journals, comparing the number of received citations by each paper. We will discuss the differences in number of received citations concerning the established errors in citing, and potential position of some of the Croatian journals, which are not indexed by SCI-expanded, but according to obtained results they could be a part of that corpus.

Data and methods

Sample for this research were citation analysis data extracted from SCI-expanded database for 142 Croatian journals in the time span 1975–2001 for articles published in 1975–1998. In mentioned time span some journals ceased and some emerged, especially in 1990s (see Table 2).

For each journal we counted a number of papers published per year and we analysed obtained citations in detail. Cited items are identified with six parameters: author's surname and initials, journal's title, volume, page, and publication year, which define the article-to-article link, necessary to identify cited item. The SCI-expanded database consists of two types of citations: citations of papers, registered as source items (i.e. all cited parameters match citing paper and the abbreviated journal's title is unified) and citations of articles (books, patents, papers etc.) that are (i) beyond the time scale of a database, (ii) not included as source items or (iii) contain one or more errors in six parameters that define related source item. Our sample consisted of more than 90% of journals which could be counted in categories (ii) and (iii).

Whereas not all of the six parameters that connect citing with cited article are searchable, the data are collected with simultaneous author and journal search. Highly cited articles by authors with frequent name are additionally searched by name and year in order to discover errors in a journal name. Each new journal "title" found by searching by particular author is then searched to find misspellings of author's name/initials and the process is repeated until all of the data are double checked. Besides, for all the journals an additional search based on English translations of journal name, as well as expected errors is performed. This search covers usual errors based on handwriting in earlier period, for example $a \leftrightarrow o$, $n \leftrightarrow u$, $4 \leftrightarrow 9$, and typewriting in later period such as $a \leftrightarrow s$, $n \leftrightarrow b$, $4 \leftrightarrow 5$.

To get a more objective picture we compared our results with the number of citations per papers for same or similar categories/fields according to data for 22 fields obtained by Essential Science Indicators (ESI) Thomson/ISI, 1995–2005, as well with

IF's for 1989. The year 1989, which is approximately in the middle of the observed time span, is used for normalization of citations. Obtained ratio of 1995–2005 citations vs. 1989 IF data for most categories to which Croatian journals belong to, is about 6.4 (chemistry = 6.3, geosciences = 6.7, mathematics = 6.5, pharmacy and pharmacology = 6.1). This fact clearly shows that the category indicators do not change significantly during the time period and can be used simultaneously, to take into account large differences between various categories. Given that the ESI data contain citations per papers for only 22 fields and do not allow a more detailed classification of categories compared to JCR, the standard IF of categories are calculated from printed version of 1989 JCR (IF₁₉₈₉) [KLAJČ & ANDREIS, TO BE SUBMITTED]. In this research we classified 142 Croatian journals in 55 categories according to JCR Science Edition classification schema. The categories are listed in Table 1 with the number of journal titles, citations per 100 papers (100C/P), due to the relatively small numbers.

It is well known that ISI categories differ by an order of magnitude. However, some of these categories are too wide and others too narrow [LEYDESDORFF & ZHOU, 2005]. Also, field categories differ in IF values. For example biochemistry has IF between 3 and 4, while engineering's IF is only about 0.3, and journals are usually compared only within certain categories. In order to compare journals within different categories, a normalization of citation data to the IF of corresponding category is necessary. We introduced a new scientometric indicator *Normalized Number of Citations per 100 Papers* (NCP) that allows direct comparison of journals from various categories defined as:

$$\text{NCP} = \frac{100\text{C/P}}{\text{IF}_{1989}}$$

For example, mathematical journal *Glasnik Mat*, having only 77.4 citations per 100 papers, normalized by the IF₁₉₈₉ turns to be 237.3 (IF₁₉₈₉ for mathematics = 0.397). The value of 201.1 citations per 100 papers for journal *Acta Adriatica* corresponds to NCP = 0 207.2 due to the IF₁₉₈₉, close to 1.000 (0.971).

According to SOMBATSOMPOP & AL. [2002], journals with older ages tended to have more opportunity to be cited, and were greater in impact factor value compared to those with younger ages. However, our results (see Table 2) show that journals starting later are ranked highly (8 and 9), while some other journals that ceased earlier, like *Praxis Med* is ranked lowly (135).

Table 1. Classification of Croatian journals according to the JCR scientific categories (1989), with citations per 100 papers and calculated Impact Factor for 1989 (IF₁₉₈₉)

	Number of journals	Citation per 100 papers	IF ₁₉₈₉
AGRICULTURAL SCIENCES	18	5.4	0.501
1. agriculture	8	4.4	0.378
2. agriculture, dairy & animal science	2	5.2	0.668
3. fisheries	3	3.2	0.692
4. forestry	5	8.9	0.495
BIOLOGICAL SCIENCES	13	54.7	2.090
5. biology	3	52.1	1.797
6. entomology	1	47.6	0.529
7. marine & freshwater biology	2	189.6	0.971
8. ornithology	2	8.5	0.705
9. parasitology	1	58.6	1.051
10. plant sciences	4	30.8	1.090
CHEMISTRY	2	444.8	1.252
11. chemistry	1	557.3	1.359
12. polymer science	1	24.9	0.929
ENGINEERING	31	12.6	0.557
13. biotechnology & applied microbiology	1	142.8	1.114
14. computer science, interdisciplinary applications	3	13.7	0.553
15. construction & building technology	1	12.1	0.255
16. energy & fuels	4	1.5	0.429
17. engineering	4	0.4	0.285
18. engineering, chemical	3	20.8	0.595
19. engineering, civil	2	1.0	0.384
20. engineering, electrical & electronic	1	1.7	0.634
21. engineering, mechanical	2	10.2	0.199
22. food science & technology	3	24.1	0.648
23. medical laboratory technology	2	0.5	0.954
24. metallurgy & mining	5	18.3	0.502
GEOSCIENCES	12	25.3	1.122
25. geography	4	6.0	0.589
26. geology	3	31.6	1.144
27. geosciences, interdisciplinary	2	44.6	1.207
28. meteorology & atmospheric sciences	2	36.5	1.571
29. paleontology	1	196.6	0.680
MATHEMATICS	3	71.9	0.397
30. mathematics	2	71.9	0.326
31. mathematics, applied	1	71.4	0.462

Table 1. (cont.)

	Number of journals	Citation per 100 papers	IF ₁₉₈₉
MEDICAL SCIENCES	50	23.4	1.617
32. dentistry, oral surgery & medicine	1	11.8	0.718
33. endocrinology & metabolism	1	20.6	2.270
34. gastroenterology & hepatology	1	8.2	1.825
35. medicine, general & internal	8	21.8	1.613
36. medicine, miscellaneous	4	12.0	0.587
37. medicine, research & experimental	10	2.8	1.881
38. neurosciences	3	7.0	2.127
39. obstetrics & gynecology	3	12.7	1.156
40. oncology	1	7.5	2.205
41. ophthalmology	1	5.7	1.072
42. otorhinolaryngology	2	2.2	0.505
43. pediatrics	3	4.2	0.988
44. pharmacology & pharmacy	5	116.9	1.512
45. psychiatry	1	18.6	1.549
46. public, environmental & occupational health	1	59.8	1.136
47. rheumatology	1	6.2	1.800
48. substance abuse	1	19.2	1.202
49. veterinary sciences	3	24.9	0.429
MATERIAL SCIENCE	1	19.9	0.616
50. materials science	1	19.9	0.604
MULTIDISCIPLINARY SCIENCES	4	12.0	4.225
51. multidisciplinary sciences	4	12.0	4.225
PHYSICS	8	93.3	1.740
52. astronomy & astrophysics	1	177.1	2.068
53. crystallography	2	29.1	0.964
54. oceanography	2	330.1	0.821
55. physics	3	66.4	2.105

Results and discussion

The total of 72829 source items originating from 142 journals in the time span 1975–1998 were searched for citations in the time span 1975–2001. Three additional years, when an average paper reaches a maximum number of citations, are added to allow papers published in journals starting in the last observed years to be cited. The searches by journal title and author name resulted in 28412 citations of 10772 items that is about 0.4 citations per paper or about 2.6 citations per cited paper.

It should be mentioned that JCR classifies some journals in several categories, while SCI also includes four categories from social sciences (SSCI). The total of 4194 SCI

journals (1989) are classified in 125 categories as follows: 3284 journals (78%) are in one category, 814 journals in two categories and 96 journals in three categories. However, in this analysis each journal is classified only in a single category, according to the subject of its papers, while journals covering more than three categories are considered as multidisciplinary. This classification is generally acceptable for all of the journals, although some of them, such as *TRAVAUX ICSOBA (Travaux du Comité international pour l'étude des bauxites, de l'alumine et de l'aluminium)* which consists of papers related to various fields, such as metallurgy and mining, geosciences, inorganic chemistry and chemical engineering, but it can not be considered as a multidisciplinary journal for it does not cover biology, medicine, agriculture and mathematics.

According to JCR classification scheme of scientific fields, Croatian journals cover just determined number of fields (see Table 1). This is expectable, given that a country with a relatively low scientific potential is not able to keep pace within all fields equally.

The field represented with the highest number of journals is medicine with all of its subfields, altogether 51 (35.9%) journals. By decreasing number of journals follows engineering with all its subfields, from biotechnology and food technology to polymer science and chemical engineering, altogether 31 or 21.8%. In third place are journals engaged in agricultural science, 19 or 13.4%, followed by bioscience and geosciences, each of them by 13 or 9.1%. Physics is represented with 8 or 5.6% journals; multidisciplinary journals represented 4 or 2.8%; mathematics 3 or 2.1%; chemistry with 2 or 1.4% and material sciences with 1 or 0.7%.

Comparing just the quoted data with the results obtained by KOZŁOWSKI & AL. [1999] and MUST [2006] concerning the Central and East European Countries, scientific productivity and impact by citations for source items indexed by SCI-expanded, deviation is noticeable. Namely, there is a common understanding that CEEC countries are strong in fundamental research. Our further research concerning citation analysis and received average number of citations by fields, confirms that chemistry and physics are fields with the highest number of citations received (Table 1 and Table 2).

The category of agricultural science is represented with four fields, with approximately equally number of citations per paper (C/P). Although journal *Ann Forestales* (Table 2) is one of Croatian journals with the highest ratio C/P, its contribution of only 2.6% papers in the category, which received almost 58% of all citations in the category, does not influence essentially on the value of NCP.

If we compare results of average $C/P = 0.054$ for Croatian journals in agricultural science with the world mean value according the ESI 1995–2005, 4.81 citations per papers, the difference is noticeable. To understand the differences it is important to take into account that Croatian journals in this category are not indexed by SCI-expanded and papers are written in Croatian.

Table 2. Croatian journals in SCI-Expanded (1975-1998) ranked by NCP

Journal title (category from Table 1) ¹	NCP	Number of papers (P)	Number of citations (C)	100C/P	Publishing period
1. THALASSIA JUGOSL (54)	486.2	356	1421	399.2	1975-1991
2. CROAT CHEM ACTA (11)	410.1	1825	10170	557.3	1975—>
3. ANN FORESTALES (4)	390.1	58	112	193.1	1975—>
4. PALAEONTOLOGIA JUGOS (29)	289.0	29	57	196.6	1975-1991
5. GLASNIK MAT (30)	237.3	875	677	77.4	1975—>
6. ACTA ADRIATICA (7)	207.2	327	658	201.2	1975—>
7. ACTA PHARM JUGOSL (44)	206.8	650	2032	312.6	1975-1991 ²
8. FOOD TECHNOL BIOTECH (22)	206.7	109	146	133.9	1996—> ³
9. MATH INEQUAL APPL (31)	154.6	56	40	71.4	1998—>
10. VET ARHIV (49)	141.6	993	603	60.7	1975—> ⁴
11. CHEM BIOCHEM ENG Q (13)	128.2	306	437	142.8	1987—>
12. TRAVAUX ICSOBA (24)	128.0	333	214	64.3	1975-1996
13. ACTA GEOL (26)	100.1	69	79	114.5	1975—>
14. BILJESKE NOTES IOCE (7)	95.1	39	36	92.3	1975—>
15. ACTA ENTOMOL JUGOSL (6)	89.9	164	78	47.6	1975-1990
16. HVAR OBS B (52)	85.6	227	402	177.1	1977—>
17. KRS JUGOSLAVIJE (27)	77.3	15	14	93.3	1975-1991
18. KEM IND (18)	72.3	1046	450	43.0	1975—>
19. CROATIAN MED J (35)	63.6	497	510	102.6	1992—> ⁵
20. STROJARSTVO (21)	60.6	923	112	12.1	1975—>
21. IZV JUGOSL CENT KRIS (53)	60.4	237	138	58.2	1975-1978 ⁶
22. ACTA PARASITOL IUGOS (9)	55.8	87	51	58.6	1975-1980
23. ARH HIG RADA TOKSIKO (46)	52.6	995	595	59.8	1975—>
24. ACTA BOT CROAT (10)	47.9	506	264	52.2	1975—>
25. CEMENT (15)	47.6	107	13	12.2	1975-1988
26. ACTA PHARM (44)	47.2	356	254	71.3	1992—> ⁷
27. INT J ENG MODELLING (14)	47.0	77	20	26.0	1991—>
28. KINESIOLOGY (36)	45.4	60	16	26.7	1996—> ⁸
29. METALURGIJA (24)	45.3	536	122	22.8	1975—>
30. ACTA BIOL (5)	42.2	54	41	75.9	1975—>
31. POLJOPRIVREDNA ZNANS (1)	38.1	798	115	14.4	1975-1996 ⁹
32. HIDROGRAFSKI GODISNJ (54)	37.1	82	25	30.5	1975-1992
32. PREHRAM TEHNOL BIOT (22)	36.7	727	173	23.8	1975-1995 ¹⁰
34. GLASNIK SUMSKE POKUS (4)	36.2	223	40	17.9	1975—>
35. FIZIKA B (55)	33.6	154	109	70.8	1992—> ¹¹
36. TEKSTIL (50)	32.9	2422	481	19.9	1975—>
37. GEOFIZIKA (27)	32.1	124	48	38.7	1984—>
38. FIZIKA (55)	31.4	1920	1271	66.2	1975-1991 ¹²
39. FIZIKA A (55)	30.7	198	128	64.7	1992—> ¹³
40. PERIOD BIOL (5)	29.4	4853	2568	52.9	1975—>
41. ACTA MED IUGOSL (35)	28.4	640	293	45.8	1975-1991 ¹⁴
42. ZBORNIK RADOVA FAKUL (21)	27.7	362	20	5.5	1975—>
43. POLIMERI (12)	26.9	489	122	24.9	1980—>
44. RASPRAVE PAPERS (28)	26.3	109	45	41.3	1975-1990 ¹⁵
45. GEOL CROAT (26)	25.2	163	47	28.8	1992—> ¹⁶
46. ACTA MED CROATICA (35)	25.0	360	145	40.3	1991—> ¹⁷
47. POLJOPRIVREDA (1)	23.8	89	8	9.0	1995—> ¹⁸
48. J COMPUT INFORM TECH (14)	23.6	153	20	13.1	1993—>
49. KINEZIOLOGIJA (36)	22.7	361	48	13.3	1975-1995 ¹⁹
50. AUTOMATIKA (14)	22.4	647	80	12.4	1975—>

Table 2. (cont.)

Journal title (category from Table 1) ¹	NCP	Number of papers (P)	Number of citations (C)	100C/P	Publishing period
51. JUGOSL GINEKOL PERIN (39)	21.0	227	55	24.2	1985–1991 ²⁰
52. GOD JUGOSL CENT KRIS (53)	20.3	724	142	19.6	1979–1990 ²¹
53. LARUS (8)	19.7	137	19	13.9	1975—>
54. PRAXIS VET (49)	19.6	915	77	8.4	1975—>
55. HRVATSKI METEOROLOSK (28)	18.3	66	19	28.8	1991–1997 ²²
56. GEOL VJESNIK (26)	18.3	492	103	20.9	1975–1991 ²³
57. ACTA STOMATOL CROAT (32)	16.5	977	116	11.8	1975—>
58. ACTA GEOGRAPHICA CRO (25)	16.3	73	7	9.6	1992—>
59. ALCOHOLISM (48)	16.0	291	56	19.2	1975—>
60. NEUROPSIHIJARIJA (38)	15.7	57	19	33.3	1975–1976 ²⁴
61. GEOGRAPHICAL PAPERS (25)	14.9	91	8	8.8	1975–1991
62. B SCI A (51)	14.7	92	57	62.0	1975–1976
63. MLJEKARSTVO (22)	14.1	789	72	9.1	1975—>
64. ZNAN PRAK POLJOPR TE (1)	13.6	506	26	5.1	1982–1994 ²⁵
65. KOSARKASKI MED VJESN (36)	13.3	64	5	7.8	1986–1990 ²⁶
66. NAFTA ZAGREB (18)	12.4	1256	93	7.4	1975—>
67. FARM GLAS (44)	12.3	404	75	18.6	1975—>
68. PSYCHIAT DANUBINA (45)	12.0	344	64	18.6	1989—>
69. JUGOSL GINEKOL OPSTE (39)	11.4	494	65	13.1	1975–1984 ²⁷
70. GORIVA MAZIVA (18)	11.3	459	31	6.8	1975—>
71. TEHNICKI VJESNIK (17)	11.1	63	2	3.2	1994—>
72. VET STANICA (49)	10.4	1006	45	4.5	1975—>
73. GEOGRAFSKI GLASNIK (25)	10.2	283	17	6.0	1975—>
74. FRAGMENTA HERBOLOGIC (10)	9.8	310	33	10.7	1976–1991 ²⁸
75. DIAB CROAT (33)	9.1	976	201	20.6	1975—>
76. MATH COMMUN (30)	8.9	69	2	2.9	1996—>
77. NATURA CROATICA (5)	8.8	145	23	15.9	1992—>
78. LIJEC VJESN (35)	8.6	2860	395	13.8	1975—>
79. ANN I FRANCAIS ZAGRE (51)	8.3	63	22	34.9	1975–1987
80. KRMIVA (2)	8.0	987	53	5.4	1975—>
81. STOCARSTVO (2)	7.7	1073	55	5.1	1975—>
82. AGRONOMSKI GLASNIK (1)	7.4	1040	29	2.8	1975—>
83. GEOGRAFSKI HORIZONT (25)	7.2	285	12	4.2	1975–1997
84. RIBARSTVO (3)	6.7	86	4	4.7	1992—>
85. ACTA BLOKOVICA (10)	6.6	125	9	7.2	1981–1995
86. S OTORHINOL ZAGREB (42)	6.2	96	3	3.1	1992–1997
87. RAD MED FAK ZAGREB (35)	6.1	283	28	9.9	1975–1991 ²⁹
88. LJEVARSTVO (24)	5.7	175	5	2.9	1975—>
89. RADOVI (4)	5.7	389	11	2.8	1975—>
90. GYNAECOL PERINATOL (39)	5.6	463	30	6.5	1992—> ³⁰
91. OPHTHALMOL CROAT (41)	5.3	122	7	5.7	1992—>
92. SUMARSKI LIST (4)	5.2	848	22	2.6	1975—>
93. JUG PEDIJAT (43)	5.1	580	29	5.0	1975–1990
94. ENERGETICAR (16)	4.8	342	7	2.0	1975–1991
95. CROAT J GASTROENTERO (34)	4.5	159	13	8.2	1992—>
96. MORSKO RIBARSTVO (3)	4.5	737	23	3.1	1975–1995
97. RIBARSTVO JUGOSLAVIJ (3)	4.5	317	10	3.1	1975–1991
98. EGE (16)	4.5	674	13	1.9	1993—>
99. CROAT SPORTS MED J (36)	4.4	117	3	2.6	1991—>
100. PHARMACA (44)	4.4	407	27	6.6	1975—>

Table 2. (cont.)

Journal title (category from Table 1) ¹	NCP	Number of papers (P)	Number of citations (C)	100C/P	Publishing period
101. <u>SUNCEVA ENERGIJA</u> (16)	4.2	166	3	1.8	1979–1994
102. <u>S OTORHINOLARYNGOLOG</u> (42)	4.1	530	11	2.1	1975–1991
103. <u>NEUROL CROATICA</u> (38)	4.0	905	78	8.6	1991—> ³¹
104. <u>BRODOGRADNJA</u> (19)	4.0	462	7	1.5	1975—>
105. <u>ARHIV ZA ZASTITU MAJ</u> (43)	3.8	765	29	3.8	1975–1992 ³²
106. <u>PAEDIAT CROAT</u> (43)	3.7	303	11	3.6	1993—> ³³
107. <u>GLASNIK ZASTITE BILJ</u> (1)	3.6	806	11	1.4	1978—> ³⁴
108. <u>ACTA FAC MED FLUM</u> (35)	3.5	299	17	5.7	1975—>
109. <u>REUMATIZAM</u> (47)	3.5	707	44	6.2	1975—>
110. <u>LIBRI ONCOL</u> (40)	3.4	802	60	7.5	1975—>
111. <u>FRAGM PHYTOMHERBOL</u> (10)	3.2	58	2	3.5	1993—> ³⁵
112. <u>POLJOPRIVREDNE AKTUA</u> (1)	3.1	1108	13	1.2	1975–1994
113. <u>ZAVARIVANJE</u> (24)	3.0	587	9	1.5	1975—>
114. <u>MED AN</u> (37)	3.0	285	16	5.6	1985–1993 ³⁶
115. <u>AGR CONSPEC SCI</u> (1)	2.9	91	1	1.1	1997—> ³⁷
116. <u>DRVNA IND</u> (4)	2.7	673	9	1.3	1975—>
117. <u>ACTA GRAPH</u> (17)	2.7	130	1	0.8	1989—>
118. <u>ELEKTROTEHNIKA</u> (20)	2.7	924	16	1.7	1975—>
119. <u>GLASNIK HRVATSKOG DR</u> (23)	2.6	81	2	2.5	1991–1993 ³⁸
120. <u>TROGLODYTES</u> (8)	2.5	111	2	1.8	1987–1995
121. <u>MED JAD</u> (37)	2.3	854	37	4.3	1975—>
122. <u>ACTA CLIN CROAT</u> (37)	2.2	343	14	4.1	1991—> ³⁹
123. <u>NEUROLOGIJA</u> (38)	2.2	1215	56	4.6	1977–1990 ⁴⁰
124. <u>GRADEVINAR</u> (19)	2.1	1237	10	0.8	1975—>
125. <u>RUDARSKO GEOLOSKO NA</u> (24)	2.0	297	3	1.0	1989—>
126. <u>ENERGIJA</u> (16)	2.0	918	8	0.9	1975—>
127. <u>POMORSKI ZBORNIK</u> (51)	1.9	780	61	7.8	1975—>
128. <u>KLIN MED</u> (37)	1.8	88	3	3.4	1992—>
129. <u>SAOPCENJA</u> (44)	1.7	231	6	2.6	1975–1990
130. <u>BILJNA ZAST</u> (1)	1.7	156	1	0.6	1975–1977 ⁴¹
131. <u>STRUKA ZNANOST</u> (37)	1.6	68	2	2.9	1980–1985
132. <u>AN KLIN B M STOJANOV</u> (37)	1.4	482	13	2.7	1975–1990 ⁴²
133. <u>PROMET ZAGREB</u> (17)	1.2	570	2	0.3	1989—>
134. <u>MEDICINAR</u> (35)	1.2	305	6	2.0	1975—>
135. <u>PRAXIS MED</u> (37)	1.1	464	10	2.2	1975–1990
136. <u>KOZA OBUCA</u> (17)	1.1	1866	6	0.3	1975—>
137. <u>MEDICINA</u> (35)	0.9	1235	17	1.4	1975—>
138. <u>JADRANSKI ZBORNIK</u> (51)	0.4	272	5	1.8	1975–1997
139. <u>ANALI OPCE BOLNICE S</u> (37)	0.4	283	2	0.7	1975–1984 ⁴³
140. <u>ACTA MEDICOR</u> (37)	0.2	505	2	0.4	1975—>
141. <u>ANAL OPCE BOLNIC J K</u> (37)	0.2	225	1	0.4	1975–1989
142. <u>BIOCHEMIA MEDICA</u> (23)	0.0	318	0	0.0	1994—> ⁴⁴

¹Journals included in WoS are underlined²Changed to ACTA PHARM³Changed from PREHRAM TEHNOL BIOT⁴Indexed in WoS in part⁵Changed from RAD MED FAK ZAGREB⁶Changed to GOD JUGOSL CENT KRIS⁷Changed from ACTA PHARM JUGOSL⁸Changed from KINEZILOGIJA

- ⁹Changed to GOD AGR CONSPEC SCI
- ¹⁰Changed to FOOD TECHNOL BIOTECH
- ¹¹Split from FIZIKA
- ¹²Split into FIZIKA A and FIZIKA B
- ¹³Split from FIZIKA
- ¹⁴Changed to ACTA MED CROATICA
- ¹⁵Changed to HRVATSKI METEOROLOSK
- ¹⁶Changed from GEOL VJESNIK
- ¹⁷Changed from ACTA MED IUGOSL
- ¹⁸Changed from ZNAN PRAK POLJOPR TE
- ¹⁹Changed to KINESIOLOGY
- ²⁰Changed from JUGOSL GINEKOL OPSTE, changed to GYNAECOL PERINATOL
- ²¹Changed from IZV JUGOSL CENT KRIS
- ²²Changed from RASPRAVE PAPERS
- ²³Changed to GEOL CROAT
- ²⁴Changed to NEUROLOGIJA
- ²⁵Changed to POLJOPRIVREDA
- ²⁶Changed to CROAT SPORTS MED J
- ²⁷Changed to JUGOSL GINEKOL PERIN
- ²⁸Changed to FRAGM PHYTOMHERBOL
- ²⁹Changed to CROATIAN MED J
- ³⁰Changed from JUGOSL GINEKOL PERIN
- ³¹Changed from NEUROLOGIJA
- ³²Changed to PAEDIAT CROAT
- ³³Changed from ARHIV ZA ZASTITU MAJ
- ³⁴Changed from BILJNA ZAST
- ³⁵Changed from FRAGMENTA HERBOLOGIC
- ³⁶Changed from ANALI OPCE BOLNICE S
- ³⁷Changed from POLJOPRIVREDNA ZNANS
- ³⁸Changed to BIOCHEMIA MEDICA
- ³⁹Changed from AN KLIN B M STOJANOV
- ⁴⁰Changed from NEUROPSIHIJATRIJA, changed to NEUROL CROATICA
- ⁴¹Changed to GLASNIK ZASTITE BILJ
- ⁴²Changed to ACTA CLIN CROAT
- ⁴³Changed to MED AN
- ⁴⁴Changed from GLASNIK HRVATSKOG DR

Biological sciences category in our sample is covered by the following fields: Biology, Entomology, Marine & Freshwater Biology, Ornithology, Parasitology and Plant Sciences, and average value of $C/P = 0.547$. Compared to ESI 1995–2005, this category has 10.58 citations per paper. A field with the highest $C/P = 1.89$ is Marine & Freshwater Biology, due to the journals *Acta Adriatica* and *Bilješke Notes* (Table 2). Both journals are published by Institute for Oceanography and Fisheries, Split. In addition the special value of these results lies in a fact that these journals are not indexed by SCI-expanded, which means that they have no self-citations. We could explain this pretty high SCI value of C/P for these journals with the relevance of papers and also with an important fact that papers are published in English.

C/P value of Croatian journals for chemistry is 4.44, which puts chemistry in the first place related to all other fields or categories. Compared to the ESI 1995–2005, an average value for this category is 7.95 citations per paper. However, real contribution appertain to journal *Croat Chem Acta*, as the most prestige Croatian journal with C/P = 5.57 (see Table 2), indexed by SCI at the begging in 1974. In this case we could agree with SOMBATSOMPOP & AL. [2002] that journals with older ages tended to have more opportunity to be cited.

Engineering is relatively broad category, represented in our sample with 12 fields. Depending on fields the oscillations in number of citations per paper is visible, e.g. Biotechnology & Applied Microbiology with the highest C/P value, and Engineering and Medical Laboratory Technology with the lowest C/P. One of the factors contributing to this result in the field of Biotechnology & Applied Microbiology is a journal *Chem Biochem Eng Q* with C/P = 1.42. This journal is indexed by SCI-expanded, and all papers are published in English. Also, it is important to mention the fact that we have only one journal in this field. Comparing our result for Engineering as a category, C/P = 0.126, with ESI 1995–2005, number of citations per paper is 3.08. One of the reasons for a pretty low value of citations per paper for Croatian journals in this category could be the language barrier. Namely, the majority of journals publish articles only in Croatian.

Geosciences are ranged in the fourth place, in consideration to the average number of citations per paper (C/P = 0.253) comparing to the ESI 1995–2005 data (7.49). Two extremes are noticeable: Geography (C/P = 0.07) and Palaeontology (C/P = 1.96). It is important to stress out that Palaeontology as a field in our sample is represented with only one journal, with relatively low number of papers and which ceased at the beginning of nineties (see Table 2). Average paper received almost 2 citations (1.96). In the filed of Geography we have four journals and all of the papers are published in Croatian.

Data obtained for Mathematics show high homogeneity of the field. Included journals have an average C/P = 0.719, while the ESI 1995–2005 data for this field reports about 2.60 citations per paper. Comparing these two results it is clear that papers published in Croatian mathematical journals received approximately one third of the world average citations for this field.

Similar to the results obtained for Engineering, in the category of Medical Sciences differences in an average number of citations per papers for some fields are noticeable. Pharmacology & Pharmacy with C/P = 1.16 is a field with the best results, owing to the journal *Acta Pharm Jugosl*. This journal published papers in English and it was indexed by SCI until 1991. According to the ESI 1995–2005 data for the field of Farmacology & Toxicology value of the mean citations per paper was 9.24. The field with relatively high mean citations per paper in this category is Public, Environmental & Occupational Health, especially thanks to the journal *Arh Hig Rada Toksiko*, with C/P = 0.598.

Physics is a category, after chemistry, with the highest number of citations per paper. In this sample it is represented with four fields. Oceanography with $C/P = 3.30$, is a field with the highest mean citations per paper, owing to contribution of the journal *Thalassia Jugoslavica*. This journal is ranked in the first place by mean number of citations per paper ($C/P = 3.99$). Physics as a category, according to the ESI 1995–2005 data has a mean of 7.12 citations per paper. Comparing the data obtained for the journal *Thalassia Jugoslavica* with the ESI 1995–2005 data, it is noticeable that this journal received more than a half of the world average number of citations per paper. Additionally, it is important to stress out that this journal has never been indexed by SCI database. Therefore, all received citations are free of journal self-citations, and their recognitions are a product of relevant papers. Also, it is worth to mention that all of papers were published in English.

The second ranked field in this category is Astronomy and Astrophysics, represented by the journal *Hvar Obs B*, with $C/P = 1.77$. Neither this journal was indexed by SCI, but all papers were published in English.

While we do not have an indicator like IF, for the purpose of this research we must introduce a new indicator, NCP (Normalized citations per paper divided by IF of categories for year 1989, as a mean year between 1975–2001). A status for each journal could be more objective if we take a mean year of journal publishing period instead of the year 1989.

The main reason for this decision lies in the fact of huge time consuming job, and as we mentioned earlier, IF of some fields does not change significantly during the time period.

Our results show that among 11 journals with $C/P > 1.00$, two journals, *Hvar Obs B* and *Croatian Med J*, with calculated NCP, gained lower status. Their NCP value is less than 100 (see Table 2) due to relatively high value of category IF.

Four journals have a C/P less than 1 ($0.61 < C/P < 0.77$), but their better NCP rank is a consequence of a relatively low IF of their categories. Those journals are: *Travaux ICSOBA*, *Vet Arhiv*, *Mathematical Inequalities and Applications* and *Glasnik Mat*. *Travaux ICSOBA* has ceased, and it has never been indexed by SCI-expanded. Journal *Glasnik Mat*, even though never indexed by SCI is ranked by its NCP in the fifth place on the scale of 142 Croatian journals. *Vet Arhiv* was irregularly indexed by SCI-expanded. Only one journal from this group, *Mathematical Inequalities and Applications*, is indexed by SCI-expanded since the first volume.

It was mentioned before, and it is visible in Table 2, that 10 journals from our sample are indexed by SCI-expanded (underlined titles). Potentially, those journals have a higher number of citations per paper due to the possibility of journal self-citations. Those journals are not in the same position compared to the remaining 132 journals, without an option of journal self-citations. To solve this problem two methodological approaches can be used: to exclude journal self-citations for SCI indexed journals, or to

add journal self-citations to all of the journals. For example, the calculation of impact factor for journal *Kem Ind* [ANDREIS, 1998] shows that the number of journal self-citations in the 1975–1999 period is 498. With an addition of these citations the total number of SCI-expanded citations per 100 papers (450) will be more than 110% higher, and this journal can be compared with the journal *Mathematical Inequalities and Applications* (number 9 in Table 2)

Among the journals with the highest impact measured by NCP (in the range from 486.2 to 100.1) which have never been indexed by SCI-expanded, and have ceased in the meantime, are *Thalassia Jugoslavica*, *Paleontologia Jugoslavica*, *Travaux ICSOBA*, and *Acta Geologica*. Journal *Acta Pharm Jugosl* was indexed by SCI until 1991, coincidentally with the change of the name. According to the NCP value this journal is ranked as 7th, but with the name changed to *Acta Pharmac*, it decreased to 26th. We suppose that one of the reasons for this decrease could be exclusion of journal self-citation. Namely, CAMPANARIO & GONZALEZ [2006] in their study identified that large number of journal self-citations contributed to the impact factor.

Among 13 (9.1%) journals with NCP > 100.5 journals were, and 4 of them are currently indexed by SCI-expanded (Table 2). Remaining 4 journals from this group, which are active (*Ann Forestales*, *Glasnik Mat*, *Acta Adriatica* and *Vet Arhiv*), could be covered by SCI-expanded.

However, it should be mentioned that some journals contain meeting abstracts, which were partly indexed by SCI-expanded as source items in the time span 1975–1989. Some issues of certain volume of *Period Biol*, particularly supplements containing only meeting abstracts, as well as extended abstracts that are sometimes classified as articles. In our study all type of papers are taken as source items, regardless on article type (review, article, note, letter, meeting abstract). Since some journals have a large number of meeting abstracts whose number of citations is generally very low, in Table 3 are presented 100C/P according to the type of article. Generally, meeting abstracts are poorly cited, as show the data for SCI-expanded indexed journal *Period Biol*: 2136 articles have 100C/P=100.7, while 2717 meeting abstracts (56% of source items) have 100C/P=10.1 resulting in a total 100C/P=52.9 for 4853 source items.

An exception is *Izv Jugosl Cent Kris* whose 70 meeting abstracts (29.5% of source items) are significantly higher cited (100C/P=88.6) compared to articles (100C/P=45.5). The reason for relatively large number of citations related to meeting abstracts is the specific nature of abstracts in the field of crystallography: crystallographic data presented in few sentences are sometimes a valuable reference for scientists in this field.

An additional parameter strongly related to IF is the uncitedness. VAN LEEUWEN & MOED [2005] analysed the correlation between uncitedness and IF for 1995 and have shown that journals containing a smaller number of publications tend to have a larger share in uncited papers, as well as the fact that IF 1 is generally correlated with uncitedness of 50%. However, our data for journals having citations per paper (CP)>1,

presented in Table 4, show that the number of papers is not generally directly correlated to the uncitedness, as well as the uncitedness does not have a major influence on CP. For example, the same number of citations arises from three papers with 50 citations or from 150 papers with one citation that will significantly decrease uncitedness.

Journals with highest CP have a dominant contribution from highly cited papers (first three journals). Although journals No. 5 and 6 have a similar CP (about 1.95) they significantly differ in uncitedness (34.5% and 65.5%, respectively) because of the different contribution of papers with less than 10 or more than 10 citations. However, data for all of 142 journals (Figure 1) show that the correlation between CP and uncitedness does exist for journals with less than one citation per paper.

The main reason for very poor citations of more than 90% STM Croatian journals could be the same as stressed out by REN & ROUSSEAU [2002] for Chinese and Japanese journals: *The influence of scientific evaluation procedures, and local versus international science, language problems,* and ZITT & AL. [2003]: *...the lower impact of the nationally-oriented journals is associated with a low internationalization of journals.*

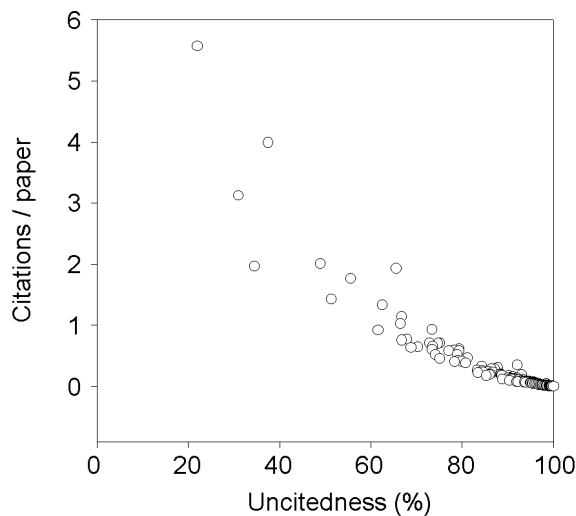


Figure 1. Distribution of citations per paper and uncitedness for Croatian journals

Table 3. Contribution of meeting abstracts (MA) to the number of citations

Journal	Source items	100C/P	MA	100C/P	%MA
GOD JUGOSL CENT KRIST	724	19.6	664	6.3	91.7
NEUROLOGIJA	1215	4.6	876	0.1	72.1
PERIOD BIOL	4853	52.9	2717	10.1	56.0
REUMATIZAM	707	6.2	264	2.6	37.3
IZV JUGOSL CENT KRIST	237	58.2	70	88.6	29.5
PREHRAM TEHNOL BIOT	727	23.8	213	0.5	29.3
THALASSIA JUGOSL	356	399.2	44	90.9	12.3

Table 4. Uncitedness and distribution of citations for journals with NCP>100

Journal title	NCP	Papers	Distribution of citations (%)				
			0	1	2-9	10-49	>50
1. THALASSIA JUGOSL	486.2	356	37.3	14.9	35.4	11.8	0.6
2. <u>CROAT CHEM ACTA</u>	410.1	1825	21.9	15.6	46.0	15.8	0.7
3. ANN FORESTALES	390.1	58	65.5	13.8	15.5	5.1	-
4. PALAEONTOLOGIA JUGOS	289.0	29	34.5	27.6	34.5	3.5	-
5. GLASNIK MAT	237.3	875	67.8	14.8	16.5	0.8	-
6. ACTA ADRIATICA	207.2	327	48.9	14.7	33.0	3.3	-
7. <u>ACTA PHARM JUGOSL</u>	206.8	650	30.9	20.5	42.8	5.5	0.3
8. <u>FOOD TECHNOL BIOTECH</u>	206.7	109	62.4	9.1	27.5	1.8	-
9. <u>MATH INEQUAL APPL</u>	154.6	56	75.0	10.7	12.5	1.8	-
10. VET ARHIV	141.6	993	73.3	15.1	10.9	0.6	-
11. <u>CHEM BIOCHEM ENG Q</u>	128.2	306	51.3	19.1	27.1	2.0	-
12. TRAVAUX ICSOBA	128.0	333	68.7	18.0	12.9	0.3	-
13. ACTA GEOL	100.1	69	66.7	10.1	20.3	2.9	-

Under the pressure of scientific evaluation procedures Croatian scientists also tend to publish their more important works in international journals. The reasons for publishing articles in Croatian journals could be of local importance, rejections by international journals or issues of national science policy.

As our results showed, publishing papers only in Croatian definitely is a barrier for the international recognition. Namely, all of the journals with NCP>100 and CP>1, publish their papers in English.

Type of errors detected by citation analysis

A classification of the type of errors in the process of citation is explained in detail by GLÄNZEL & AL. [2003]. These authors distinguish four main sources of errors: errors caused by citing authors; errors caused by the editors of the journals; errors caused by the database producer; and errors caused by the user of the bibliographic database. The authors themselves are probably responsible for most of the errors that have an effect on citation analyses. A paper that received 138 citations, had 25 incorrect citations. The error caused by citing authors amounts to 18.1%.

Although our search of SCI-expanded by both, journal title and author name, resulted in 10772 items (raw data), only 9007 of those papers do really exist, i.e. about 1700 items can not be identified at all. Raw database contains at least 17% of “ghost” articles that do not exist. Our sample, after the correction contained 28397 citations of 10772 items, which is about 0.4 citations per paper or about 2.6 citations per cited paper.

The raw and corrected data of cited papers from Croatian journals is presented in Table 5.

Table 5. Distribution of citations for raw and corrected data

Number of citations	1	2	3	4	5–9	10–24	25–49	>50
Raw data (10772)	6409	1765	790	499	865	367	63	14
Corrected data (9007)	4513	1701	811	520	953	420	73	16
Difference	1896	64	–21	–21	–88	–53	–10	–2

The major contribution to the distribution of citations originates from a single incorrectly cited article (2307 items). They are also responsible for the fact that papers being cited three or more times after the correction, have more citations compared to the raw data.

Since 3717 (about 34%) cited items contain at least one error, the article identification is made impossible. A detailed information on the accuracy of SCI-expanded data is obtained by analysis of errors in 10772 cited items from Croatian journals and the results show that more than 1/3 of items can not be identified (Table 6).

About 18% of articles (1627) originate from *Croat Chem Acta* (SCI-expanded indexed journal) with article-to-article link of about 91% (1485 articles). All other journals including *Period Biol* and *Acta Pharm Jugos* (partly indexed by SCI-expanded) have an article-to-article link of about 73%. Although 2563 (69%) of incorrectly cited items contain only one out of six possible errors, the most frequent individual error (37% with respect to items) as well as general (26% with respect to all errors) is an incorrect journal title. That indicates that analysis of Croatian journals can not be made by searching by journal title only.

However, for the purpose of IF, only two parameters in cited items are important: journal’s title and year of publication (numerous misspelled first author’s name/initials, journal’s volume or paper’s page have no effect on IF). The most important parameter for journal analysis is the title. Journals as a SCI-expanded source items generally have a unique abbreviation (limited to 11 characters in SCI or 21 characters in SCI-expanded), while source items not covered by SCI-expanded are abbreviated non-uniformly, according to the references in citing paper, and in most cases can not be identified at all. One of the numerous examples of the variations of cited articles in Croatian journals is shown in Table 7.

Table 6. Type of errors in raw data: 3717 (34.5%) cited items containing at least one error that article-to-article-link makes impossible

Number of items [Numbers of errors in item]	Type of errors					
	Name	Initial	Journal	Volume	Page	Year
843 [1]	–	–	843	–	–	–
596 [1]	–	–	–	–	596	–
445 [1]	–	–	–	445	–	–
262 [1]	262	–	–	–	–	–
258 [1]	–	–	–	–	–	258
226 [2]	226	226	–	–	–	–
159 [1]	–	159	–	–	–	–
148 [2]	–	–	148	–	148	–
143 [2]	–	–	–	143	143	–
103 [2]	–	–	103	103	–	–
62 [3]	–	–	–	62	62	62
56 [2]	56	–	56	–	–	–
49 [3]	–	–	49	49	49	–
41 [3]	41	–	41	41	–	–
39 [2]	–	–	39	–	–	39
29 [2]	–	29	29	–	–	–
29 [2]	–	–	–	–	29	29
27 [3]	27	27	–	–	27	–
22 [2]	–	22	–	–	22	–
18 [2]	–	18	–	18	–	–
18 [2]	18	–	–	–	18	–
16 [2]	–	–	–	16	–	16
15 [2]	15	–	–	15	–	–
14 [4]	–	–	14	14	14	14
10 [3]	10	10	–	–	–	10
9 [3]	9	9	–	9	–	–
7 [2]	7	–	–	–	–	7
7 [4]	7	7	7	–	7	–
6 [3]	–	6	6	–	6	–
6 [3]	6	–	6	–	6	–
6 [3]	6	–	6	6	–	–
6 [4]	6	6	–	6	6	–
5 [2]	–	5	–	–	–	5
5 [3]	–	5	5	5	–	–
4 [3]	–	–	4	–	4	4
3 [3]	–	–	3	3	–	3
3 [3]	3	–	3	–	–	3
3 [4]	–	3	–	3	3	3
2 [3]	–	2	2	–	–	2
2 [3]	2	–	–	2	2	–
2 [4]	2	–	–	2	2	2
2 [4]	2	2	2	2	–	–
2 [4]	–	2	2	2	2	–
1 [3]	–	1	–	1	–	1
1 [3]	–	1	–	–	1	1
1 [3]	–	1	–	1	1	–
1 [4]	–	1	1	–	1	1
1 [4]	1	–	1	1	1	–
1 [4]	1	1	–	–	1	1
1 [4]	1	1	–	1	–	1
1 [5]	–	1	1	1	1	1
1 [6]	1	1	1	1	1	1
3717	709	587	1372	911	1153	464

Table 7. An example of the paper and journal identification in SCI-expanded database

Cited author	Cited journal	Vol.	Page	Year	Citations	
					raw	corrected
DIRIENZO F	2ND YUG IT CRYST C D		A102	1976	9	–
DIRIENZO F	CRYSTALLOGR C DUBROV		A102	1976	1	–
DIRIENZO A	P YUGOSL CENT CRYST S	11	A102	1976	4	–
RIENZO F	P YUGOSLAV CTR CRY S	11	A102	1976	1	–
DIRIENZO F	P YUGOSL CENT CRYST S	11	A102	1976	2	–
RIENZO FD	IZJV JUGOSLAV CTR S	11	A102	1976	1	–
DIRIENZO A	P YUGOSLV CENT C A S	102		1976	1	–
DIRIENZO F	2ND YUG IT CRYST C D			1976	1	–
DIRIENZO F*	IZV JUGOSL CENT KRIS	11	A102	1976	–	20

*Correct citation of the article that can not be found in SCI-expanded

The full journal name (*Izveštaj jugoslavenskog centra za kristalografiju*) is most frequently abbreviated as *Izv Jugosl Cent Kris*. However, none of the shown cited items have this, or similar, abbreviation (*Izjv* instead of *Izv* or *Izvj* is a typing error), while English version (*P Yugoslav Ctr Cryst*) and its variations are not an appropriate journal abbreviation. The data show that no citations can be found using the search by journal title only, while four out of eight cited items can not be found using the search by authors name and initial.

LANGE [2002] described confusion regarding the abbreviations of two journal titles (*Educational Research* and *Educational Researcher*), which led to *Educational Researcher* being ascribed an exaggerated impact for a period of almost 20 years.

Searching for citations of Croatian authors and journals shows that cited English version of a non-English journal titles contributes to citations of well-known journals, for example *J Phys Chem* instead of *Z Phys Chem* or *Chem Ind* instead of Croatian *Kem Ind*). If the cited article is published a year or two before the citing article, it can influence the IF of a well-known journal. Even when the journal name is a single six-character word such as *Fizika* (i.e. physics) only about 53% of items, or about 59% of citations can be found by searching the journal title (Table 8).

The fact that this journal has a relatively simple title and can be found with 40 different abbreviations, supports the conclusion that most of the Croatian journals can not be identified according to the abbreviated titles of cited works in SCI-expanded database. In addition, this example points out the unsolved problem of correct citing of supplements in the SCI-expanded system. Citations like *Fizika S2* or *Fizika S1* are related to supplements of certain volumes, and “S2” and “S1” are not a part of journal’s title, as listed in SCI-expanded. An additional contribution to the IF can be the fact that two or more journals have the same journal title, or that a book of the same title also exists. For example, besides 313 items correctly cited as *Fizika*, there are also 104 items titled *Fizika* that are related either to a Russian journal or to Croatian or Russian books.

Table 8. An example of differences in citing journal *Fizika*

Cited journal title	Items		Citations	
	number	%	number	%
FIZIKA	313	53.3	757	59.5
FIZIKA ZAGREB	41	7.0	99	7.8
FIZIKA S2	32	5.5	79	6.2
FIZIKA S1	29	4.9	40	3.1
FIZIKA S	29	4.9	35	2.8
FIZIKA S2	27	4.6	32	2.5
FIZIKA S3	20	3.4	56	4.4
FIZIKA S	14	2.4	20	1.6
FISIKA	6	1.0	15	1.2
FIZ	6	1.0	13	1.0
FIZIKA S1	6	1.0	6	0.5
FIZIKA S3	5	0.9	16	1.3
FIZIKA ZAGREB S	5	0.9	8	0.6
FIZIKA ZAGREB S2	4	0.7	6	0.5
FIZIKA ZAGREB S3	4	0.7	17	1.3
FIZ S	4	0.7	8	0.6
FIZIKA ZAGREB S	3	0.5	3	0.2
FIZIKA ZAGREB S1	3	0.5	3	0.2
FIZIKA YUGOSLAVIA	3	0.5	9	0.7
PHYSICA S3	3	0.5	3	0.2
FIZICA S2	2	0.3	4	0.3
FIZICA	2	0.3	2	0.2
FIZ ZAGREB	2	0.3	6	0.5
FIZ YU	2	0.3	7	0.6
FIZIKA ZAGREB S2	2	0.3	3	0.2
FIZIKA YUGOSLAVIA S	2	0.3	2	0.2
FIZ S1	1	0.2	2	0.2
FIZIKA A	1	0.2	1	0.1
FIZIKA YUGOSLAVIA S	1	0.2	1	0.1
FIZ S2	1	0.2	3	0.2
FISIKA S	1	0.2	1	0.1
FIZ S3	1	0.2	1	0.1
FIZIKA ZAGREB S1	1	0.2	1	0.1
FIZIKA YUGOSLAVIA S2	1	0.2	2	0.2
FISIKA S3	1	0.2	1	0.1
FIZ YUGOSLAVIA	1	0.2	1	0.1
FISIKA S2	1	0.2	1	0.1
FIZIKA SFRJ	1	0.2	2	0.2
FIZXIKA	1	0.2	1	0.1
FYSIKA	1	0.2	1	0.1
FYZIKA	1	0.2	1	0.1
HVAR FIZIKA YUGOSLAV	1	0.2	1	0.1
FIZIKA YUG	1	0.2	1	0.1
PHYSIKA ZAGREB	1	0.2	1	0.1

SCI-expanded database unifies titles only for indexed journals, while all other source items are abbreviated on the basis of the title given in the citing article. Consequently, numerous variations of journal titles can be found for the same journal. Some of them are considered as alternate titles (such as *Chem Biochem Eng Q* or *Chem Bioch Eng Q*) while some items contain errors that make journal's identification impossible or relate cited title to some other journal (such as *Chem Bioch Q* or *Chem Bioeng Q*).

Conclusion

The aim of this research was to obtain an insight into the potential significance of papers published in Croatian journals which deal with the STM for the time span 1975–1998, by measuring their citedness within SCI-expanded database for 1975–2001. Among 142 journals classified in 10 categories and 55 fields respectively, according to JCR distribution, 10 journals were indexed by SCI-expanded database. Rest of the journals, more than 90%, have never been indexed by ISI, but they did have a chance to be cited either by Croatian authors who published papers in journals indexed by SCI-expanded or by foreign authors.

For the purpose of this research we introduced a new scientometric indicator *Normalized number of Citations per 100 Papers* (NCP) that allows us direct comparison of the journals from various categories ($NCP = 100C/P / IF_{1989}$). The year 1989 was chosen as a mean value for time span 1975–2001.

Only 11 journals from our sample (7.7%) got an average of one or more citations per paper. In that group, in the time span studied, only 5 were indexed by SCI-expanded. Results show that 48.6% of Croatian journals have $NCP < 10.0$, and 53.5% journals have $CP < 0.1$. A more objective indicator concerning the field of subject is definitely NCP.

By citation analysis of journals, correction of incorrectly cited articles has been made and it has been established that 69% of papers contains at least one out of six identification parameters used to link citation to the original paper. The most frequent error, both individual (37% with respect to items) and general (26% with respect to all errors), is the incorrect journal title that has a significant influence on recognition of Croatian journals.

Obtained results arise a question of the importance of Croatian journals, and a necessity of funding their publishing. Journals covering the STM should basically have no boundaries from scientific point of view. Justification for the publishing these journals could be found in the research conducted by SANZ & AL. [1995]. They established that the same group of scientists publishes the applied research results in national journals while basic research results are being published in international journals.

Results of this research could be usefull for journal editors as a guideline for adapting their editorial policy in order to improve a reception of their journals on an international level.

*

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References

- ANDREIS, M. (1998), Primjena scientometrije u vrednovanju domaćih časopisa i znanstvene produkcije prema bazama ISI: kritička analiza. In: D. POLŠEK (Ed.), *Vidljiva i nevidljiva akademija*, Institut društvenih znanosti Ivo Pilar, Zagreb, pp.111–119.
- ARAUJO RUIZ, J. A., VAN HOOYDONK, G., TORRICELLA MORALES, R. G., ARENCIBIA JORGE, R. (2005), Cuban scientific articles in ISI Citation Indexes and Cuba Ciencias databases (1988–2003), *Scientometrics*, 65 : 161–171.
- BROWN, L. D. (2003), Ranking journals using social science research network downloads, *Review of Quantitative Finance and Accounting*, 20 : 291–307.
- BUELA-CASAL, G., PERAKAKIS P., TAYLOR, M., CHECA, P. (2006), Measuring internationality: Reflections and perspectives on academic journals, *Scientometrics*, 67 : 45–65.
- CAMPANARIO, J. M., GONZALEZ, L. (2006), Journal self-citations that contribute to the impact factor: documents labelled “editorial material” in journals covered by Science Citation Index. *Scientometrics*, 69 : 365–386.
- DANELL, R. (2000), Stratification among journals in management research: A bibliometric study of interaction between European and American journals, *Scientometrics*, 49 : 23–38.
- GLÄNZEL, W., SCHLEMMER, B., THIJST, B. (2003), Better late than never? On the chance to become highly cited only beyond the standard bibliometric time horizon, *Scientometrics*, 58 : 571–586.
- GLÄNZEL, W., SCHUBERT, A., BRAUN, T. (2002), A relational charting approach to the world of basic research in twelve science fields at the end of the second millennium, *Scientometrics*, 55 : 335–348.
- JOKIĆ, M. (2001), Časopis Tekstil u pedesetogodišnjem razdoblju od 1952. do 2000. godine – neki od bibliometrijskih pokazatelja, *Tekstil*, 50 : 614–622.
- JOKIĆ, M. (2003), Evaluation of Croatian journals covered by the ISI databases (Institute for Scientific Information), *Periodicum Biologorum*, 105 : 95–98.
- JOKIĆ, M. (1998), The significance of Acta Adriatica in scientific communication in the field of marine biology, fisheries and oceanography, *Acta Adriatica*, 39 : 81–90.
- JOKIĆ, M., ANDREIS, M., KLAJČ, B. (2002), Pedeset godina Kemije u industriji – bibliometrijski i scientometrijski prikaz, *Kemija u Industriji*, 51 : 116–122.
- JOKIĆ, M., SIROTIĆ, G. (2002), The communicability of the journal Acta Botanica croatica over the 1991–2000 period, *Acta Botanica Croatica*, 61 : 221–230.
- KLAJČ, B., ANDREIS, M., Impact factors of scientific categories – A critical analysis of SCI (1975–2002), manuscript to be submitted.
- KOZLOWSKI, J., RADOSEVIC, S., IRCHA, D. (1999), History matters: The inherited disciplinary structure of the post communist science in countries of Central and Eastern Europe and its restructuring, *Scientometrics*, 45 :137–166.
- LANGE, L. L. (2002), The impact factor as a phantom, Is there a self-fulfilling prophecy effect of impact? *Journal of Documentation*, 58 :175–184.
- LEYDESDORFF, L., ZHOU, P. (2005), Are the contributions of China and Korea upsetting the world system of science? *Scientometrics*, 63: 617–630.
- MARIČIĆ, S., SOROKIN, B., PAPEŠ, Z. (2000), Croatian journals at the end of the 20 century – A bibliometric evaluation, *Društvena Istraživanja*, 9 : 1–17.
- MUST, U. (2006), “New” countries in Europe – Research, development and innovation strategies vs bibliometric data, *Scientometrics*, 66 : 241–248.
- NISONGER, T. E. (1999), JASIS and library and information science journal rankings: A review and analysis of the last half-century, *Journal of the American Society for Information Science*, 50 : 1004–1019.
- REN, S., ROUSSEAU, R. (2002), International visibility of Chinese scientific journals. *Scientometrics*, 53 : 389–405.
- SANZ, E., ARAGON, I., MENDEZ, A. (1995), The function of national journals in disseminating applied science. *Journal of Information Science*, 21 : 319–323.
- SCHUBERT, A. (2002), The web of scientometrics. A statistical overview of the first 50 volumes of the journal, *Scientometrics*, 53 : 3–20.

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- SOMBATSOMPOP, N., RATCHATAHIRUN, P., SURATHANASAKUL, V., PREMKAOLNETR, N., MARKPIN, T. (2002), A citation report for Thai academic journals published during 1996–2000, *Scientometrics*, 55 : 445–462.
- SOROKIN, B. (1990), Život (domaćih) časopisa u Hrvatskoj, *Scientia Yugoslavica*, 16 : 163–178.
- TURBAN, E., ZHOU, D., MA, J. (2004), A group decision support approach to evaluating journals, *Information & Management*, 42 : 31–44.
- UGOLINI, D., CASILLI, C. (2003), The visibility of Italian journals, *Scientometrics*, 56 : 345–355.
- VAN LEEUWEN, T. N., MOED, H. F. (2005), Characteristics of journal impact factors: The effects of uncitedness and citation distribution on the understanding of journal impact factors. *Scientometrics*, 63 : 357–371.
- ZITT, M., RAMANANA-RAHARY, S., BASSECOULARD, E. (2003), Correcting glasses help fair comparisons in international science landscape: Country indicators as a function of ISI database delineation. *Scientometrics*, 56 : 259–282.