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Ecological Modelling: editorial overview 2000–2005

Sven Erik Jørgensen

DFU, Environmental Chemistry, University Park 2, 2100 Copenhagen Ø, Denmark

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Abstract

Ecological Modelling publishes from time to time editorials, that review the development of the journal: after 50 volumes, after 100 volumes and at our 25 years anniversary. This time we celebrate 30 years anniversary and focus on the time 2000–2005, corresponding to the volumes 126–185. Sixty volumes – almost one third of all volumes of Ecological Modelling! We will review the development by means of statistics as we have done previously but this time we will also try to look behind the statistics and try to assess the development in the scientific fields of ecosystem theory (systems ecology) and of ecological modelling. What are the recent research focus in these two subfield of ecology?

Keywords: Editorial overview; Journal statistics

1. Development of "Ecological Modelling" from year 2000 to 2005

The size of the journal counted as number of articles has increased slightly since year 2000 – from 188 in year 2000 to 329 in 2004. Fig. 1 shows the articles published from year 1986 to today. The major increase in the number of papers happened during the decade 86–95, when the number of volumes increased. The number of volumes has not increased from year 2000 to 2005, but the format has been changed and Elsevier has published volumes with more pages than foreseen to catch up with the backlog. The number of submitted papers has furthermore increase lately after the journal has started to use electronic submission in 2004. We have increased the number of rejected papers from about 30% in year 2000 to about 45% today but it is still difficult to catch up with the backlog. In addition, Elsevier has launched two important journals that are able to publish some of the papers that previously would have been published in Ecological Modelling. In 2004 started the journal Ecological Complexity and the first issue of a new journal named Ecological Informatics will be published round the corner. The articles that would have been publishable in Ecological Modelling in 1975, where it was difficult to get enough papers for the first volume, are now published in Ecological Economics, Ecological Engineering, Ecological Indicators, Ecological Complexity and Ecological Infor-

E-mail address: sej@dfuni.dk.

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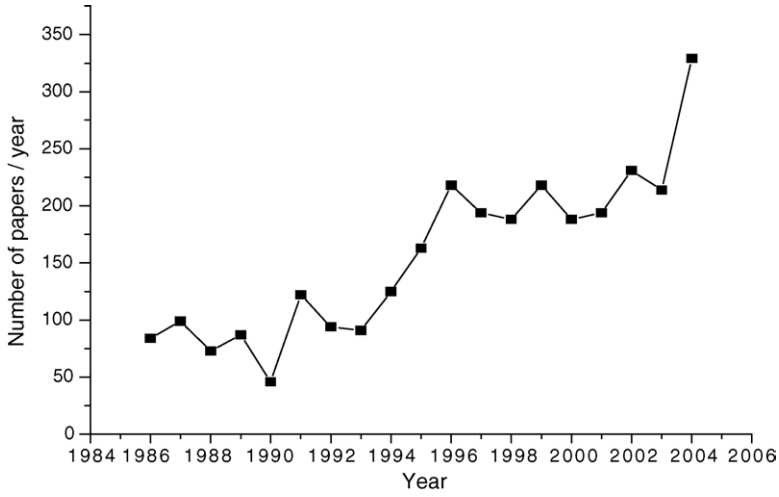

Fig. 1. Number of articles published in Ecological Modelling per year from 1986 to 2004.

matics. In spite of that, Ecological Modelling receives in increasing amount of good papers. We can clearly conclude that the field of Applied Ecology, System Ecology and Ecological Modelling has increased enormously during the last 30 years, and that Ecological Modelling has been able to meet the challenge.

We are able to see the increasing interest for ecological modelling and the journal with the same name, by the number of downloads per month. The number of downloads was in year 2000 in average about 6000 dls/month, while it has increase in year 2004 to about 26 000 dls/month. Also the citation index shows an increasing interest for Ecological Modelling publications. Fig. 2 gives the citation index versus the year for the period 2000–2004. As seen the citation index has almost doubled during these 5 years.

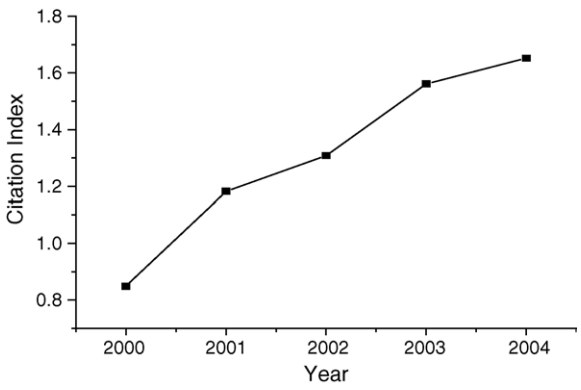

Fig. 2. The citation index × 100 is plotted vs. the year covering the period 2000–2004.

Table 1 gives an overview of the number of authors and articles for the different countries for 2000–2004 inclusively. The number of authors/mill inhabitants for this period is also indicated in this table. Furthermore, the percentage of papers is indicated for the first 25 years for comparison and the number of papers published in natural sciences in peer-reviewed international journals according to a statistics published in Scientific American in year 2000.

The numbers in Table 1 give several interesting pieces of information. US is now below the percentage for natural science in general, which is in accordance with allocation of research in US away from environmental sciences and ecology and toward biotechnology and nanotechnology. It is also interesting that many small countries in Europe have a very high per capita contribution to Ecological Modelling, for instance Denmark, The Netherlands, Sweden, Finland, Switzerland, Croatia and Slovenia. Canada, New Zealand and particularly Australia have all a relatively very high contribution, which was also the case before year 2000.

There is with other words build a good tradition for research in ecological modelling in these countries: Australia, New Zealand, Canada, Croatia, Denmark, Finland, Slovenia, Sweden, Switzerland and The

Table 1
Country breakdown for single journal

Country	Number of authors	Percentage	Articles	Number of authors/Mill inh.	Percentage of papers 1975–2000	Percentage of papers in natural science
US	792	27.78	321	2.69	35.2	30.8
France	179	6.28	73	2.98	3.5	5.7
Canada	163	5.72	66	5.17	6.1	4.3
Australia	162	5.68	66	8.22	4.4	2.2
Germany	148	5.19	60	1.79	8.1	7.2
Italy	117	4.10	47	2.05	3.5	3.4
The Netherlands	101	3.54	41	6.27	3.1	2.3
England	99	3.47	40	1.84	3.5	7.9
PR China	89	3.12	36	0.070	1.9	1.3
Japan	68	2.39	28	0.53	3.8	8.2
Denmark	63	2.21	26	11.79	3.8	1.0
Russia	63	2.21	26	0.44	3.5	4.1
Spain	56	1.96	23	1.37	1.1	2.0
Scotland	54	1.89	22	9.1	Was included in UK	
Switzerland	52	1.82	21	7.26	1.1	1.6
Finland	47	1.65	19	9.03	1.4	0.8
Sweden	44	1.54	18	4.95	2.6	1.8
Brazil	41	1.44	17	0.23	0.5	0.51
Mexico	41	1.44	17	0.39	0.22	0.22
India	38	1.33	15	0.036	1.4	1.6
New Zealand	33	1.16	13	8.73	0.7	0.41
Croatia	29	1.02	12	6.59	0.26	0.20
Portugal	27	0.95	11	2.70	0.40	0.20
Czech Republic	26	0.91	11	2.55	1.5	0.31
Greece	25	0.88	10	2.29	0.26	0.41
South Africa	25	0.88	10	0.55	0.9	0.44
South Korea	25	0.88	10	0.52	0.26	0.62
Slovenia	23	0.81	9	11.52	1.07 (97–99)	0.17
Belgium	22	0.77	9	2.14	0.52	1.1
Austria	18	0.63	7	2.22	0.70	0.65
Turkey	18	0.63	7	0.25	0.09	0.21
Argentina	16	0.56	6	0.42	0.60	0.35
Israel	14	0.49	6	2.19	0.40	1.0
Chile	11	0.39	4	0.70	0.13	0.15
Hungary	10	0.35	4	1.02	0.60	0.40
Norway	9	0.32	4	2.00	0.80	0.60
Taiwan	9	0.32	4	0.22	0.22	0.8
Thailand	9	0.32	4	0.14	0.00	0.11
Indonesia	7	0.25	3	0.032	0.09	0.06
Ukraine	6	0.21	2	0.123	0.18	–
Tanzania	6	0.21	2	0.163	0.00	0.01

The following countries have had two papers: Venezuela, Iran, Ireland, Slovakia, Colombia, Philippines, Bulgaria, Costa Rica, Tanzania, Cameroon, Ecuador and the following countries have had one paper: Estonia, French Guiana, Iceland, Lithuania, Mali, Morocco, Poland 20.07%. The following countries have had coauthors to papers: Bangladesh, Cote Ivoire, Egypt, Ethiopia, Guadeloupe, Kenya, North Ireland, Senegal and Trinidad.

Netherlands. These 10 countries have together contributed with 25% of all publications with slightly more than 90 million in habitants only (1.5% of the world population).

Particularly, China and France have increased their contribution significantly. China has definitely acknowledged that environmental issues are important for the further development of the well-fare. Publish-

ing is peer-reviewed international journals is becoming more important to Chinese scientists. France has been one of leading countries in the application of ANN and SOM in modelling and have therefore submitted many papers in the use of this modelling approach. Turkey has increased its research in modelling a factor 7, which hopefully is the first sign of an increasing research in environmental issues in general. There are also several new countries that have published during the last year in Ecological Modelling but never before year 2000. These are the Baltic countries, several African countries a few South-American countries. They are all very well come in our "club" of ecological modellers.

2. The research questions in focus

Which papers have been most cited? The following papers have obviously been of great interest for the readers of Ecological Modelling:

- Guisan and Zimmermann (2000) has been cited 219 times. Many papers have been published the last 5 years on spatial distribution. There is no doubt that it is a hot topic to include in the modelling effort the spatial distribution.
- Pearce and Ferrier (2000) has been cited 68 times. From our contact with the readers there is no doubt that there is a growing interest for modelling methods and to learn from other experience how to model this and this ecological problem. Generally, we have in our review process of the submitted papers emphasized the last years the need for presenting to the readers what we can learn from a paper about modelling a similar ecological problem in another context.
- Another paper by Guisan et al. (2002) has been cited 45 times. Again a paper focusing on modelling methodology and spatial distribution.
- Austin (2002) has been cited 42 times. Spatial distribution is clearly an interesting topic.
- Stockwell and Peterson (2002) has been cited 39 times. Again focus on the question: how can we produce good spatial models?
- Jørgensen et al. (2000) has been cited 38 times. Ecosystem theory or systems ecology seems also to have an increasing interest for the readers of the journal, acknowledging that a good model of an ecosystem requires that we know the properties of the modelled system.

The same papers are also among the most downloaded papers. The two papers by Guisan et al. have for instance been downloaded more than 6000 respectively more than 2000 times. Other often downloaded papers are:

(1) Gertsev and Gersetseva (2002). Downloaded 2488 times.
(2) Wu and David (2002). Downloaded 2307 times.
(3) Store and Jokimaki (2003). Downloaded 2126 times.
(4) Burnett and Blaschkle (2003). Downloaded 2074 times.
(5) Simas et al. (2001). Downloaded 1699 times.

From this review of most cited and downloaded papers it can be concluded that Spatial distribution, modelling technique and approaches, ecosystem theory to be used as basis for better modelling and climate change seem to be the most "hot" issues in ecological modelling. Another question is whether the papers actually published in Ecological Modelling in general focus more on these topics and than other topics. The next section will attempt to answer this question.

3. Research topics covered by ecological modelling from year 2000 to 2005

We have made a break down of the papers published from volume 126 to 185, totally 60 volumes in 11 classes. The classes are indicated below with reference to a few very informative, representative and recently published papers for each class. These references give a good impression of the spectrum of paper that Ecological Modelling is publishing. The 11 classes are with the number of papers indicated in brackets after each class:

(A) Modelling theory: covering new modelling techniques, possible improvements of modelling approaches, parameter estimations, modelling procedure included calibration and validation, discussions on uncertainty mathematical tools and selection of model complexity, etc. (240 papers). The 240 papers published during the last 5 years cover the entire spectrum of this subfield.

- Four representative papers have been selected to show the spectrum of papers in this subfield of ecological modelling:
  - Rinaldi and Sand Gragnani (2004).
  - Wu and Tsang (2004).
  - Robinson and Froese (2004).
  - Christensen and Walters (2004).

(B) Population dynamic models: covering single species models, prey–predator models, trophic chain models, age structure models, role of emigration and immigration, metapopulation dynamics and population stability, etc. (200 papers). Many of the 200 papers describe the development of single species but there are also papers covering the interactions between two species.

- Five representative papers illustrative the spectrum of papers:
  - Weclaw and Hudson (2004).
  - Cropper and Anderson (2004).
  - Jensen and Miller (2004).
  - Aggelis et al. (2005).
  - Reed and Levine (2005).

(C) Air exchange and air pollution: covering all models of the distribution of air pollutants, influence of air pollution on processes (mainly carbon dioxide and ozone) and exchange of air components with the hydrosphere, the litosphere or the biosphere (23 papers). The hottest topic in this class of papers is definitely the influence of an increased carbon dioxide concentration on vegetations and ecosystems.

- Two representative papers give an impression of the topics in addition to models of carbon dioxide:
  - Zavala (2004).
  - Aloyan (2004).

(D) Process models: covering single process models as for instance growth, mortality, photosynthesis and the influence of the temperature on these processes (50 papers). The papers are often based on measurements with a relatively low uncertainty of factors influencing one process only. In ecosystems we never have only one process, and it may be necessary to change the parameters and even the equations in a whole ecosystem model; but usually the process models are very good first estimations of parameters and equations for processes that take place in ecosystems.

- Two representative papers give an impression of this class of papers:
  - Bigler and Bugmann (2004).
  - Zeide (2004).

(E) Spatial and landscape models: covering models applying spatial distribution as a variable, models of landscapes, GIS – models and 2D and 3D models (130 papers). There has been an increasing interest for landscape modelling and it has furthermore been acknowledged that the spatial distribution is an important factor in population dynamics and in whole ecosystem modelling. GIS, 2D and 3D models very useful tools in development of this kind of models.

- Three representative papers illustrate this class of ecological modelling:
  - Valvavanis et al. (2004).
  - Garman (2004).
  - With and King (2004).

(F) Climate models: covering prediction of climate change, the influence of climate change on populations, communities, ecosystems or regions, microclimate and influence of climate change on process rates (31 papers). We will most probably see even more papers on models describing the impact of the climate changes on ecosystems in the future. There have been launched particularly in Europe many research project focusing on the consequences of the climate changes.

- Four representative papers show the type of papers that cover this class of ecological modelling:
  - Matala et al. (2005).
  - Oh et al. (2004).
  - Meynecke (2004).
  - Potter (2004).

(G) Ecosystem theory: covering the use of models to test or develop ecosystem theory, new elements of an ecosystem theory, how to use ecosystem theory to improve our models and all contributions to systems ecology in general (97 papers). Volume 158 issue 3 was devoted entirely to ecosystem theory or systems ecology. The issue published seven papers that showed that we have an ecosystem theory that can be used to explain ecological observations. Papers taken from Journal of Ecology that were published without any explanation were explained by use of ecosystem theory to illus-

trate that it is possible to a much higher extent in ecology to explain the observations and results than it is usually the case today.

- Four representative papers give the spectrum of topics in this class of ecological modelling papers:
  - Jørgensen and Fath (2004).
  - Fath (2004).
  - Hulburt (2004).
  - Jørgensen et al. (2004).

(H) Ecotoxicological models: covering the distribution and effect of toxic substances (30 papers). We have about 100 000 chemicals that are used in our every day life in the industrialized countries today and only for about 500 chemicals we have a clear picture of the environmental risk. We need therefore to make environmental risk assessment for 99 500 chemicals, which means that there are many possible ecotoxicological models. It would therefore not be surprising if we would in the nearest future see a growth in the number of ecotoxicological models.

- Two representative papers illustrate ecotoxicological models:
  - Watanabe et al. (2005).
  - Delfino (2004).

(I) Aquatic ecosystem models: covering all models of all types of aquatic ecosystems included wetlands (223 papers). The models published covering almost all possible aquatic ecosystems. Particularly many papers have been devoted to lakes, different types of wetlands and coastal area, although improvements in modelling the classical problem of oxygen depletion in rivers still are published.

- Four representative papers illustrate some of the other ecosystems in addition to lakes and wetlands that have been modelled:
  - Fulton et al. (2005).
  - Langmead and Sheppard (2004).
  - Håkanson et al. (2004).
  - Beran and Kargi (2005).

(J) Terrestrial ecosystem models: covering all models of all types of terrestrial ecosystems (187 papers). Again a wide spectrum of ecosystems have been modelled with particular emphasis on forests and agricultural systems.

- Three representative papers give the spectrum of topics in this class of ecological models:
  - Cao and Dawson (2005).
  - Monteiro Santos and Costa (2004).
  - Munier et al. (2004).

(K) Ecological-economic-sociological models: covering models that integrate ecology with economy and/or sociology (paper). The number of papers in this class was higher from 1975 to 2000, because this type of papers was published in Ecological Modelling from its start in 1975 and until the late 1980s when Ecological Economics started massively to publish ecological-economic models (Nendel and Kersebaum, 2004).

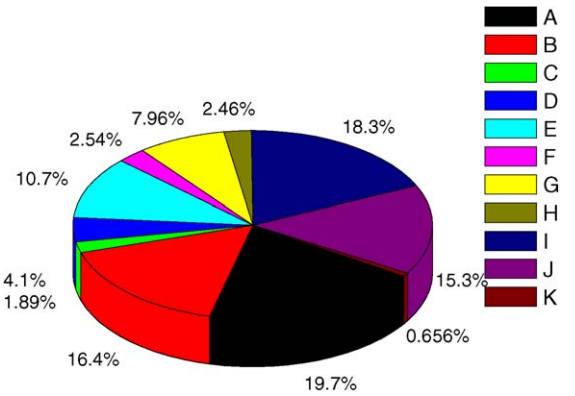

Fig. 3. The figure shows the percentage of papers in the various classes: (A) modelling theory, (B) population dynamics, (C) air pollution and gas exchange, (D) process models, (E) spatial, landscape and GIS models, (F) climate models, (G) ecosystem theory, (H) ecotoxicological models, (I) aquatic ecosystem models, (J) terrestrial ecosystem models, (K) economic-ecological models.

Totally 1219 papers have been published in the 60 volumes, 126–185, from year 2000 to 2005. Fig. 3 gives a pancake illustration of how the various classes are represented. The dominant topics are model theory and ecosystem theory, which are in accordance with the relatively high number of down-loadings and citation for this type of papers. These two classes have together 27.7%, while theoretical papers corresponding to these two classes had 25% in the editorial from year 2000, covering 1975–2000. Spatial models and climate models are also well represented (13.2%) among the published papers from 2000 to 2005, while they were much less represented in the review from year 2000 covering the 25 years from 1975 to 2000 (correspond approximately to global and climate (3.7%) in Table 1, see the paper: Jørgensen (2000). It explains also the

growing interest for spatial modelling and modelling the impact of climate changes. The "classical" modelling topics, populations dynamics, modelling aquatic ecosystems and modelling terrestrial ecosystems cover together approximately 50% which is approximately the same as for the period 1975–2000, where it was 51%.

Economic-ecological models have a smaller representation today than in the review from year 2000, probably because many economic oriented papers were published during the first years of Ecological Modelling, while the journal Ecological Economics would inevitably publish most of these papers today. The number of ecotoxicological papers have decreased, too, probably due to a slightly less focus on the environmental chemical problems today compared with the 1990s – or rather the models that were developed during the 1980s and 1990s are useful for other chemicals than they were developed for and it would therefore not be interesting to published them again.

All by all, the papers published in Ecological Modelling reflect the interest in the field, taken from the citations of papers and the number of down-loadings, provided that our assumption (that about 50% of the papers should represent typical and classical models) is correct. Accordingly, it is foreseen that the number of papers focusing on climate, climate change, landscape and spatial models will increase for the coming 5 years.

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