

# ENTOMOLOGICAL EDUCATION IN CANADIAN UNIVERSITIES DURING THE 1981-82 ACADEMIC YEAR

Prepared by

The Study Group on Entomology Curricula  
of the Science Policy Committee  
Entomological Society of Canada

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## INTRODUCTION

The Science Policy Committee of the Entomological Society of Canada requested that a study be undertaken of the entomology curricula of Canadian Universities. The committee felt that it is appropriate that a national entomological society should be aware of the nature and extent of training in entomology, within Canada. Such awareness might reveal deficiencies in the overall pattern of Canadian entomological training which, if not corrected, could damage the future development of entomology in Canada.

The report is concerned with Bachelor's, Master's and Doctoral levels of study. Formal courses and supervised research both have a part in producing individuals with appropriate qualifications for those degrees, with emphasis on courses at the Bachelor's level, and on research at the two graduate levels.

Data on entomology courses and on graduate students undertaking research in entomological fields were collected and examined. These data provide a comprehensive picture of entomological education in Canada and, as such, are of value to the Entomological Society of Canada and to educators and administrators in entomological education. In addition students planning their education may find these data useful. Entry into graduate programs in entomology is either by way of undergraduate specialization in this field, or by a more general science degree, from either faculties of agriculture, or of arts and science.

## DEFINITIONS AND CLASSIFICATION

Before data collection could begin it was necessary to establish definitions to ensure uniformity of treatment of data. The following were used:

*Entomology:* Study of insects and terrestrial arthropods including their control.

*Institution:* Graduate data are classified by institution. An institution may include a number of campuses and departments.

*Campus:* A single campus of a university is the unit used in the undergraduate course data. A campus may contain more than one department offering courses in entomology, no distinction is made between such departments.

*Course with significant entomological content:* A course where more than 30% of the content was devoted to entomology.

Courses with significant entomological content were classified into either "Entomology courses", in which more than 50% was entomology, or others, where 30-50% of course content was entomology.

## DATA COLLECTION

All university departments in Canada in which entomology courses might be offered or graduate students trained in entomology were identified using Royce (1980). Course offerings in each of the departments were examined in the appropriate university calendars. Where courses had significant entomological content, details from the calendar were entered on a form. The completed forms were then sent to the department concerned for verification and addition of information not available in the calendar. All departments where graduate students might be trained in entomology were requested to provide information on number of students enrolled in such programs on a standard form. In addition, some departments in which undergraduate specialization in entomology could occur were asked to complete a form detailing program structure. The data were gathered in Winter 1981-82.

## COURSE UNITS

Course size were reported on forms as hours/week for a stated number of weeks. Because there is no uniformity regarding course length or number of contact hours/week, the study group converted all courses to a standard unit. The standard unit used (C.U.) represents about 30 hours of lecture time with or without a laboratory. Hence one C.U. represents a 13-week course of three 50-minute lectures/week. However, course lengths from 12 weeks to 15 weeks were also considered to be one C.U. This was done because the study group felt that the variation in course content between 12-week and 15-week courses was probably not large enough, compared with variation in content among courses of the same length, to justify the increased complexity caused by allotting different values to courses of different length.

## UNDERGRADUATE COURSES

From university calendars, 47 campuses appeared to have courses with significant entomological content, 39 campuses provided information additional to that in the calendar.

There are 84 course units (C.U.) in Canada with 30-50% entomological content, and 155 C.U. with more than 50% entomological content, including 2 C.U. at Nova Scotia Agricultural College. A complete breakdown of these, by campus, was made. Six campuses (four of them in the Maritime Provinces) offer a single course with 30-50% entomological content; such courses are usually called invertebrate biology and are a component of a biology degree. Twelve other campuses offer a single C.U. with > 50% entomology; these courses are usually associated with one or more invertebrate biology courses in a biology degree program.

There are 29 campuses offering 2 or more C.U. of courses with > 50% entomology; among them they offer 55 C.U. 30-50% entomology and 139 C.U. > 50% entomology. About 45% of all undergraduate Canadian C.U.'s with significant entomological content are offered on eight campuses (Table 1). The course units shown in Table 1 cannot be readily translated into programs of study which students take. Nevertheless some patterns are evident. Alberta, Guelph and Manitoba offer major programs in entomology within Faculties of Agriculture; their course offerings include service courses to other Departments within the Faculties of Agriculture and of Science, but also a strong program in the study of insect biology and applied entomology for entomology students. Macdonald college follows a similar pattern but the major offered there is in zoological sciences. At the University of British Columbia and at Simon Fraser University the emphasis is on pest control; hence there are fewer courses on

**Table 1. Field of knowledge covered by undergraduate courses with significant entomological content offered on eight campuses. Figures indicate number of course units in each field.**

	Alberta	B.C.	Carleton	Guelph	Manitoba	McGill Macdonald	Simon Fraser	Toronto St. George
Introductory, General, Unspecified <sup>1</sup>	3	3	0	2	3	1	2	2
Anatomy, Physiology, Biochemistry <sup>1</sup>	3	1	2	2	2	3	0	2
Systematics, taxonomy, evolution <sup>1</sup>	1	0	2	1	1	1	0	2
Ecology, Aquatic entomology, Behaviour, Social insects <sup>1</sup>	0	0	2	5	4	1	0	2
Applied entomology:								
crops, stored products <sup>1</sup>	0	0	0	0	1	0	0	0
forestry <sup>1</sup>	2	2	0	1	0	0	0	0
medical, veterinary <sup>1</sup>	2	0	0	1	1	0	0	3
insect toxicology <sup>1</sup>	1	0	0	0	1	0	0	0
general <sup>1</sup>	3	1	0	3	1	3	1	0
Apiculture <sup>1</sup>	0	0	0	3	0	1	2	0
Terrestrial arthropods <sup>1</sup>	0	0	0	0	0	1	0	0
Invertebrate Biology <sup>2</sup>	1	0	2	0	2	3	2	1
Pest Control <sup>2</sup>	0	3	0	0	0	0	1	0
Pesticides <sup>2</sup>	0	1	0	2	0	0	1	0
Parasitology <sup>2</sup>	0	0	0	0	1	0	0	0

<sup>1</sup> Courses with > 50% entomology

<sup>2</sup> 30-50% entomology

insect biology, and applied entomology is taught in agricultural systems — oriented pest control courses (e.g., "Crop protection — horticultural crops", which incorporates insect, weed and disease control). Carleton University and the St. George (Downtown) Campus of the University of Toronto offer courses in insect biology but, with the exception of Toronto's courses in arthropod-related disease, do not give courses in applied entomology.

Table 2 shows the C.U.'s offered in Canada broken down by region and field of knowledge. The C.U. distribution in British Columbia is greatly influenced by the two B.C. campuses in Table 1 which between them offer 20 of 26 C.U. Similarly, in the Prairies the Universities of Alberta and Manitoba account for 33 of the 52 C.U. In eastern Canada the contributions of C.U. units from campuses in Table 1 are relatively less important. In eastern Canada four campuses out of 38 offer more than 10 C.U. with significant entomological content; in western Canada there are also four campuses offering more than 10 C.U., but only nine campuses offer entomology courses. It has been suggested that entomology training is deficient in the maritime provinces (Turnock, 1980). There are nine campuses currently offering entomology courses in that region, and Nova Scotia Agricultural College plans to offer entomology courses from 1983. Until that time the only applied entomology course in the maritimes will be in forest entomology at the University of New Brunswick. Only four campuses in the Maritimes offer more than 2 C.U. with > 50% entomology.

In interpreting Table 2, it should be borne in mind that what is taught in insect ecology courses in one region may be taught in general entomology courses elsewhere; similarly crop protection entomology may be taught in general applied entomology courses. On a national scale there do appear to be some deficiencies. There are no undergraduate courses in insect pathology and only two in insect toxicology, despite their obvious importance in insect control. Terrestrial arthropods other than insects receive little attention except in Quebec.

**Table 2. Regional distribution of undergraduate C.U. with > 50% entomology classified by field of knowledge.**

	<i>Maritimes</i>	<i>Quebec</i>	<i>Ontario</i>	<i>Prairies</i>	<i>B.C.</i>	<i>Total</i>
Introductory, general, unspecified.	7	10	13	12	7	49
Anatomy, physiology, biochemistry.	1	5	8	5	1	20
Systematics, taxonomy, evolution.	2	4	6	3	0	15
Ecology, aquatic entomology, behaviour, social insects.	0	2	14	5	0	21
Applied entomology:						
crops, stored products	1	0	0	1	0	2
forestry	1	0	4	2	2	0
medical, veterinary	0	0	4	3	0	7
insect toxicology	0	0	0	2	0	2
general	0	6	5	5	3	19
Agriculture	0	1	3	0	2	6
Terrestrial arthropods	0	4	1	0	0	5
<b>Total &gt; 50% Entomology</b>	<b>12</b>	<b>32</b>	<b>58</b>	<b>38</b>	<b>15</b>	<b>155</b>
<b>Total 30-50% Entomology</b>	<b>11</b>	<b>8</b>	<b>40</b>	<b>14</b>	<b>11</b>	<b>84</b>
<b>Overall total</b>	<b>23</b>	<b>40</b>	<b>98</b>	<b>52</b>	<b>26</b>	<b>239</b>
Number of campuses offering some entomology	10 <sup>1</sup>	10	17	8	3	48 <sup>1</sup>

<sup>1</sup> Includes Nova Scotia Agricultural College

Table 3 shows that most courses with > 50% entomology are taken in the last two years of the undergraduate program. (In Quebec the first year in the university was considered equivalent to second year elsewhere). The table also shows that the courses reported in Table 2 are normally available. Only five courses are offered so infrequently that they would not be available to all students.

Data on enrolment in courses were collected from all campuses where these data could be supplied. Data on enrolment in 115 C.U. with > 50% entomology were obtained. For these data the average enrolment/C.U. was about 20 students; however when data were adjusted to reflect frequency of offering the average number of students/C.U./year was 22. This indicates

**Table 3. Frequency and time of offering of undergraduate C.U. with > 50% entomology.**

	<i>Regular Offerings</i>		<i>Irregular Offerings</i>	<i>Total</i>
	<i>Yrs 1-2</i>	<i>Yrs. 3-4</i>		
Maritimes	—	11	1	12
Quebec	4	24	4	32
Ontario	1	57	—	58
Prairies	6	32	—	38
British Columbia	—	15	—	15
<b>Total</b>	<b>11</b>	<b>139</b>	<b>5</b>	<b>155</b>

that for the limited data base available there were 2,526 student C.U.'s of > 50% entomology in a year; if this is extrapolated to the 155 such C.U. in Canada the figure becomes 3,405 student/ C.U./yr. These figures should be treated with caution since a student taking more than one C.U./year in entomology would be represented more than once. Examination of 13 C.U. for the University of Manitoba shows that about 90% of the student C.U.'s are the result of students taking one C.U./year; these are mainly students majoring in other disciplines. Departments offering high enrolment courses for non entomologists would probably have a similar or higher percentage of students taking 1 C.U./year; however departments with few service courses could have most students taking 3-5 or more C.U./year in entomology. Because of these uncertainties it is not possible to determine total enrolment of students in entomology courses. However it seems likely that well over half the 3,405 student C.U.'s represent students having their only course in entomology.

## UNDERGRADUATE PROGRAMS

The Universities of Alberta and Guelph, and Laval University were asked to supply details of the typical structure of a degree with major specialization in entomology. These programs are used to exemplify the different types of undergraduate programs with specialization in entomology. Table 4 shows that the entomology major program in Faculties of Agriculture emphasizes background science, humanities and arts courses in first year, one or two entomology and several agriculture courses in second year. In third and fourth years the programs are heavily laden with entomology, and while emphasis is on applied aspects, there is a thorough grounding in insect biology as well. The degree in the Faculty of Science at the University of Alberta has more emphasis on sciences in the first and second years than does the Agriculture degree; there is no humanities or arts component. There are a few more entomology courses in the science degree than in the agriculture degree, but many of the courses are the same in both degrees. Laval University offers a biology degree with specialization in entomology. The number of entomological courses in considerably less than in entomology degree programs. The Laval program has a more diverse entomological component than do many institutions offering degree programs in biology with entomological specialization.

## GRADUATE COURSES

Data on graduate course offerings were collected in the same way as those for undergraduate courses. The C.U. system is also the same, though less satisfactory since many graduate courses are projects, or are of unspecified duration. Twenty-five institutions offer graduate courses in the field. Four universities (Acadia, Québec à Trois-Rivières, Ottawa and Western Ontario) have graduate students studying entomology, but no graduate courses in entomology. Three universities (Bishops, Regina and Windsor) offer graduate courses but currently have no graduate students working in entomology. Dalhousie and Moncton currently have neither graduate students nor graduate courses. The universities offering the most graduate C.U.'s with > 50% entomology are McGill, Manitoba, Alberta, Toronto, Simon Fraser, Laval, British Columbia, and Guelph. These eight offer about 68% of the graduate C.U.'s. It is noticeable that seven of the eight are also on the list of campuses offering most undergraduate C.U.'s: Carleton was on the undergraduate list but not on the graduate list. Laval did not appear on the undergraduate list.

Table 5 shows the regional breakdown of graduate C.U.'s. Again the paucity of entomology instruction in the maritimes is evident. Although of five campuses in this region which offer graduate training in entomology, only two offer any graduate courses in entomology. However, at the graduate level, absence of a course in a subject does not necessarily mean absence of training in the subject. For example there are five graduate students in British Columbia whose field of research is "systematics, taxonomy and evolution", but there are no graduate courses offered in that field of knowledge (Table 5).

There are unique features in many graduate entomology courses in Canada, and only a few can be mentioned. Simon Fraser University's Master of Pest Management program is the only one of its kind in Canada. The M.P.M. program is not an entomology program but students may specialize in insect pest management; 15 were reported to have done so in 1981-82. Only two courses were reported on plant disease vectors, these were at Simon

Table 4. Examples of undergraduate programs leading to degrees specialized in entomology.

University	Alberta		Guelph		Laval	
	Faculty	Agriculture	Science	Agriculture	Science & Engineering	C.E.G.E.P. <sup>1</sup>
Year 1	Science Courses Humanities Courses Arts Courses	Science Courses Language	Science Courses Humanities Courses Agriculture Courses	Science Courses Humanities Courses Agriculture Courses	Science & Engineering	C.E.G.E.P. <sup>1</sup>
Year 2	General Entomology Agricultural Entomology Invertebrate Zoology Electives	General Entomology Forest Entomology Invertebrate Zoology Science Courses	Morphology of Insects Natural History of Insects Agriculture Courses Science Courses Humanities	Morphology of Insects Natural History of Insects Agriculture Courses Science Courses Humanities	Invertebrates Electives	
Year 3	Forest Entomology Medical & Veterinary Ent. Insect Morphology Insect Toxicology Agriculture Electives	Insect Morphology Medical & Veterinary Entomology Insect Ecology Project in Applied Entomology Science Courses	Pesticides in the Environment Introductory Agriculture Social Behaviour of Insects Invertebrate Zoology Agriculture and Science Courses	Pesticides in the Environment Introductory Agriculture Social Behaviour of Insects Invertebrate Zoology Agriculture and Science Courses	Biotaxonomy of Insects Insect Collection Forest Entomology Electives	
Year 4	Insect Pest Management Insect Taxonomy Project in Applied Entomology Insect Development Agriculture Electives	Insect Development Insect Taxonomy Insect Biology Insect Toxicology Project in Basic Entomology Insect Pest Management Insect Physiology Electives	Invertebrate Physiology Advanced Economic Entomology Insect Ecology Insect Biology Biological Control Forest Entomology Medical Entomology Agriculture Courses	Invertebrate Physiology Advanced Economic Entomology Insect Ecology Insect Biology Biological Control Forest Entomology Medical Entomology Agriculture Courses	Morphology and Anatomy of Insects Insect Pest Management Forest Entomology Electives Undergraduate Thesis	

<sup>1</sup> C.E.G.E.P. is the acronym for Collège d'enseignement général et professionnel which students enter for two years following Grade 11.

**Table 5. Regional distribution of graduate C.U.'s with > 50% entomology classified by field of knowledge.**

	Maritimes	Quebec	Ontario	Prairies	B.C.	Total
General, unspecified	1	9	5	2	2	19
Anatomy, Physiology, Biochemistry	2	7	8	8	3	28
Systematics, Taxonomy, Evolution	0	6	7	4	0	17
Ecology, Aquatic Ent., Behaviour	0	7	5	7	2	21
Applied Entomology:						
Crops, stored products	0	2	0	1	2	5
Forestry	0	2	2	1	3	8
Medical, veterinary	0	1	1	1	0	3
Insect toxicology	0	0	0	3	1	4
General	1	1	2	3	4	11
Agriculture	0	2	1	0	0	3
<b>Total &gt; 50% entomology</b>	<b>4</b>	<b>37</b>	<b>31</b>	<b>30</b>	<b>17</b>	<b>119</b>
30-50% entomology	2	4	7	3	5	21
<b>Overall total</b>	<b>6</b>	<b>41</b>	<b>38</b>	<b>33</b>	<b>22</b>	<b>140</b>

Fraser University (not in the M.P.M. program) and at the University of British Columbia. The University of Guelph offers a course on the classification and biology of immature insects; this seems to be unique in Canada. Macdonald College (McGill) offers two courses on soil fauna, including insects. The only course on stored products entomology is offered at the University of Manitoba. The University of New Brunswick offers a course on insect endocrinology. Sherbrooke is the only university to offer courses each of which deals with a separate insect order: Hymenoptera, Coleoptera and Homoptera. It should be noted that there are four C.U.'s in Canada at the graduate level in insect toxicology, but there are no courses in insect pathology.

## GRADUATE STUDENT ENROLMENT

All Universities at which graduate students might do research in entomology were asked to indicate the number, field of research, and source of their entomology students. Of the 33 universities contacted, 32 responded; there are no data from the University of Saskatchewan. Table 6 summarizes the area of research of graduate students. As of December 1981 there were 15 M.P.M. candidates, 171 M.Sc. candidates and 133 Ph.D. candidates specializing in entomology. In 1975 (McEwen *et al* 1976) the largest seven graduate schools were Simon Fraser, British Columbia, McGill, Guelph, Alberta, Manitoba and Toronto. All of the seven have increased graduate student enrolment in 1981 but there has been a larger increase in enrolment at Laval. The eight largest graduate schools in 1981-82 accommodated 67% of the students doing graduate work in entomology and are the same eight institutions which offer the most graduate C.U.'s in entomology.

Subject areas and institutions in which graduate students were concentrated were identified. (Table 7). Five or more graduate students per subject area per institution was used as a criterion for identification of concentration. Such concentration indicates in part special emphasis by institutions in certain subject areas, but other factors are probably involved as well in attracting students with particular predilections for specialization. It seems likely that a clumped pattern is normal, although size and location of clumps of specialists need not be constant over extended periods of time.

**Table 6. Numbers of students enrolled in graduate degrees in entomological fields classified by field of research.**

	<i>M.Sc.</i> <sup>1</sup>	<i>Ph.D</i>
Anatomy, Physiology, Biochemistry	37	25
Systematics, Taxonomy, Evolution	16	27
Ecology, Behaviour	58	50
Applied entomology: crops, stored products	30	17
Applied entomology: medical, veterinary	11	5
Applied entomology: forestry	19	5
Applied entomology: insect toxicology	9	1
Apiculture	5	1
Unknown	1	2
<b>Total</b>	<b>186</b>	<b>133</b>

<sup>1</sup> Includes 15 M.P.M. candidates.

**Table 7. Concentration of five or more graduate students by institution and subject area, during the 1981-82 academic year.**

	<i>Anatomy, Physiology, Biochemistry</i>	<i>Systematics, taxonomy, evolution</i>	<i>Ecology, behaviour</i>	<i>Applied entomology, crops, stored products</i>	<i>Applied entomology medical, veterinary</i>	<i>Applied entomology, forestry</i>
Alberta		+				
British Columbia	+		+			+
Carleton		+				
Guelph			+	+		
Laval			+	+		+
Manitoba			+	+	+	
McGill			+	+		
Memorial	+					
Montreal	+					
Québec à Montréal				+		
Simon Fraser			+	+		+
Toronto	+	+	+			
Waterloo		+	+			
Western Ontario	+					
York	+					



## SOURCE OF GRADUATE STUDENTS

All graduate schools providing information on field of research of graduate students also provided information on source of students. Table 8 shows Canadian source institutions of students in Masters', and Ph.D. programs respectively. At the Masters level 53% of students are in the same institution as that in which they took their bachelor's degree; often these students did change departments within the university. At the Ph.D. level, 38% of students remained at the same University as that of their previous degree; most of these students probably remained in the same department. The proportion of foreign students (students whose previous degree was non-Canadian) was 10% for Masters students and 23% for Ph.D. students. Regional differences in movement are noticeable. In the Maritimes students either remain at the same university or leave the region entirely. In Québec the percentage of students entering the region to undertake Ph.D. study is lower than elsewhere. However, both Québec and Ontario have low percentages of M.Sc. entrants from other provinces. In the prairies at the Ph.D. level no students change university within the same province, because frequently this is not possible; the proportion of foreign students at the Ph.D. level is high in the prairies. In British Columbia, although there is considerable exchange between the universities at Masters' entrance, there is little exchange at Ph.D. entrance.

The source institutions for graduate students are of interest: students are unlikely to do graduate work in entomology if they have received poor training or no training at the undergraduate level. Hence a high number of students proceeding to graduate school from a university implies exposure during the first degree to courses and professors which foster interest in entomology. Table 9 indicates the most frequent source institutions for graduate students. Also shown are lists of the most frequent sources of students who move from one institution to another. These were included because the number of students entering graduate programs in the same institution may be considerably influenced by size of the graduate school rather than source-related properties of the institution. It is noticeable that the lists in Table 9 include institutions which have not appeared on the lists of institutions offering the most courses at the undergraduate or graduate level or having the most graduate students. In particular the importance of the University of Waterloo as a source of Ph.D. candidates could not have been predicted from previous data.

The data collected do not allow the identification of undergraduate courses taken by students entering graduate school, but it is possible to examine the maximum entomology C.U.'s a student entering a master's program could have taken. For 164 master's students for which there are data, 18% came from institutions offering 0 or 1 C.U. in entomology, 40% from institutions offering 2-5 C.U., and 43% from the eight campuses offering more than 5 C.U. of entomology. However, some students from these eight campuses were identified as not majoring in entomology (or its equivalent) in their first degree; hence no more than 33% of students entering master's programs had undergraduate programs with more than 5 C.U. of entomology. A similar analysis of Ph.D. entrants is not possible because it is now known how many of these held M.Sc. degrees and how many entered directly from their B.Sc. programs.

The source institutions outside Canada of entomology students in Canadian graduate schools were classified only by country. The most frequently reported source countries are United Kingdom, United States, and India. The data collected do not allow source of a student to be related to that student's field of study. A tempting hypothesis is that students from "third world" countries would be more likely to study applied entomology than would other foreign students. Universities are classified on the basis of areas of concentration given in Table 7, and countries are classified into those with national per capita daily caloric intake of greater than 2,500 and those with less (Bartholomew *et al* 1980). Of the 14 students from countries with a caloric intake of less than 2,500, 10 attend universities with concentrations of graduate students in applied entomology: "crops, stored products", 4 attend universities without this specialization. From countries where caloric intake is over 2,500, 11 students attend universities with "applied entomology: crops, stored products" and 13 attend universities without this specialty. Nevertheless a statistical test shows no significant relationship between nutrient status or source country and whether or not "applied entomology: crops, stored products" is a specialty.

There is considerable variation in the pattern of foreign student recruitment among Canadian Universities. Nine of the 11 United States students attend graduate schools in Alberta or British Columbia, while eight of the 11 United Kingdom students are doing graduate work at Toronto, Queens or Guelph. The University of Manitoba has the highest proportion of foreign students in its graduate entomology programs, most of these are students with degrees from countries with low per capita caloric consumption. Canada can make an important contribution to the education of entomologists from less developed nations where these skills are vital. But in the final analysis Canada's projected goals for food and forest products and for managing other natural resources requires that training of sufficient entomologists for its own needs be sustained and, where possible, enhanced.

Table 8. Source of graduate students in entomological fields.

	Master's Programs						Ph. D. Programs					
	Total Number	% Same Institution	% Moved Within Province	% Other Province	% Foreign	Total Number	% Same Institution	% Moved Within Province	% Other Province	% Foreign		
Maritimes	9	44	0	22	33	2	0	0	100	0		
Quebec	52	69	15	10	6	27	52	30	7	11		
Ontario	63	51	25	12	11	52	35	23	21	21		
Prairies	21	57	10	29	5	26	27	0	31	42		
B.C.	38 <sup>1</sup>	37	24	26	13	24	50	4	17	29		
Canada	183	55	19	17	11	131	40	16	21	24		

<sup>1</sup> Includes 15 M.P.M. candidates.

**Table 9. Universities providing largest numbers of students for graduate work in entomology. (1981-82 academic year)**

<i>Masters</i>				<i>Doctorate</i>			
<i>All Institutions</i>		<i>Excluding students who do not move</i>		<i>All Institutions</i>		<i>Excluding students who do not move</i>	
Guelph	17 <sup>1</sup>	B.C.	6	B.C.	11	Waterloo	7
Laval	15	Guelph	5	Waterloo	10	B.C.	6
B.C.	13	McGill	4	Montréal	9	Alberta	4
Manitoba	10	Qué. à Montréal	4	Carleton	8	Carleton	4
Montréal	10	Victoria	4	Manitoba	8	Montréal	4
Qué. à Montréal	10	Montréal	3	McGill	7	Manitoba	3
Simon Fraser	10	Ottawa	3	Simon Fraser	7	Brock	2
Toronto	7	Toronto	3	Alberta	6	Dalhousie	2
York	6			Qué. à Montréal	4	Guelph	2
				Toronto	4	Ottawa	2

<sup>1</sup> Number of students from source shown.

## CONCLUSIONS

1. At the national level, two deficiencies in university programs in entomology are identified: Insect pathology is a neglected field of study in Canada, at both undergraduate and graduate levels. Toxicology, arthropods other than insects, and taxonomy of insect larvae receive formal treatment at few institutions.
2. On a regional basis, excluding the Territories, the Maritimes are least well endowed in terms of university-level entomology courses and programs. Data available show that most provinces other than the Maritimes, have at least one university with significant offerings in entomology, at both graduate and undergraduate levels.
3. Graduate students tend to be distributed among institutions in a clumped pattern by speciality.
4. The principal source institutions for Canadian graduate students in entomology are those with significant undergraduate programs in this field.
5. Most M.Sc. students take this degree at the same institution at which the Bachelor's degree was taken. Most Ph.D. students take their degrees at institutions different from those at which the previous degree was taken.
6. Other source institutions for graduate students in entomology are primarily in India, the United Kingdom, and the United States, with a few students representing an additional 16 countries.

## REFERENCES

- Bartholemew, J.C. et al (eds) 1980. The Times Concise Atlas of the World. Fitzhenry and Whiteside, Toronto.
- McEwen, F.L., Harris, C.R. and McGinnis, A.J. 1976. Entomological Manpower in Canada —Current Status and Future Projections 19 pp Supplement to Bull. Ent. Soc. Canada 8 (3).
- Royce, G. 1980. Directory of Canadian Universities. Association of Universities and Colleges of Canada, Ottawa.
- Turnock, W.J. 1980. Report of the President, Quebec City, October 1980. Bull. Ent. Soc. Canada 12, 60-66.