



Rethinking Departments of Entomology

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Entomology in many academic institutions stands at a boundary. Behind us is our natural habitat—taxonomy and morphology; toxicology and insect physiology; economic entomology and biological control—the old haunts where we were nurtured and made our living. In front of us is an unknown prospect of invitation and challenge, the testing grounds of our disciplinary possibilities. We are thus faced with two choices: either to re-define ourselves with bold, creative strokes and continue to be productive and dynamic units, or to cling to the past and risk disintegration through self-justification and collective denial. Whereas 25 years ago faculty positions were allocated primarily on the basis of the economic or medical importance of pests, the academic and scientific ground has now shifted, and positions are currently allocated primarily on the basis of needs in inter- and cross-disciplinary fundamental sciences (genomics, informatics, molecular biology, and population biology). Although in the context of earlier Agricultural Experiment Station (AES) mission statements, it is easy to rationalize why a new position is needed (e.g. horticultural or field crop entomology), many of the putative justifications for these positions are outdated with respect to the current, more all-encompassing AES and university missions. They also hold little sway in the intensely-competitive marketplace of FTE's, where multimillion dollar National Institute of Health (NIH) and National Science Foundation (NSF) grants, publications in high-impact journals,

erudition in the social sciences and humanities, and elite faculty awards (e.g. National Academy of Sciences; American Academy of Arts and Sciences; American Association for the Advancement of Science; MacArthur Fellowship; Nobel Prize) and large endowments reign supreme. All of these represent the universal metrics by which top-ranked universities are judged.

The allocation of new faculty positions at most universities is not the outcome of a set of lofty but unrealistic goals developed by out-of-touch senior administrators. Rather, the underlying principles upon which new positions are approved involve the budgetary reality in a world of highly competitive basic science, shifting priorities of state legislatures towards publically funded universities, reduced funds for agricultural research, and nationwide competition for students, funds, and prestige. Inasmuch as the university is the organizing principle for departments which, in turn, serve as the building blocks for the university itself, changes at each level are inextricably linked and thus mutually affecting. The prestige of departments both requires and contributes to the excellence of the academic institutions of which they are a part.

Departments organized around the study of insects are important for universities in general and colleges of agriculture in particular for the same reason that modern versions of the organismally-based departments such as botany and microbiology are still maintained at virtually all of the major research universities. The eminence of some

groups of organisms is so extraordinary with respect to both science and society that the scientific disciplines and, in turn, the departments themselves need to be renewed, reinvigorated, and restructured rather than dismantled if they fall out of step with the ever-changing goals and standards of the university at large.

This is precisely what has transpired across the country: departments of botany have become departments of plant biology, and departments of microbiology have retained the name but have undergone disciplinary restructuring (e.g. teaching and research focused on molecular science) and expansion (including subdisciplines such as pathology and immunology). Most departments of entomology have undergone changes over the past several decades to such an extent that they can now be considered organized around the overarching concept of insect biology—an area of insect studies located in the inter-zone between traditional entomology and modern biology.

Although most entomology departments nationwide historically are organized around insects as pests, successful entomology departments of today are essentially organized around the scientific and societal importance of insects, of which studies of pests is but one (albeit still important) component. Departments today are positioned to engage in a wide variety of research and teaching activities including ecology, behavior, evolution, epidemiology, systematics, genomics and computational biology, insect

genetics, neurobiology and development, chemical ecology, physiology, biochemistry, biophysics, and pest sciences. The research of faculty members may span multiple categories. Research goals vary from addressing fundamental questions in biology to applied studies in the control or use of insects, with some faculty members conducting research on both fundamental and applied topics. For example, AES stakeholders would expand beyond pest-related issues to include those concerned with problems related to areas such as forensic biology and criminology, biodiversity and taxonomy, conservation biology and outdoor recreation, and environmental toxicology and human health. This expansion in the types of stakeholders would require changing the terms used to characterize the insects we study from “economically important” to “biologically relevant” (as distinct from “model organisms” such as *Drosophila* used in the basic biosciences).

Models of the most successful entomology departments of today differ from the models of the 1960s and 1970s in several

respects (Table 1):

- The research programs of faculty with professorial and extension appointments differ in that: i) the former would be concerned with both basic and so-called *translational* research (basic research that is motivated, directed, informed, and driven by specific applied problems, as consistent with the AES and university missions) published in high-impact journals and funded through institutional sources (e.g. USDA; NSF; NIH, Bill and Melinda Gates Foundation); and ii) the latter would be responsible for developing applied research programs published primarily in mainstream entomology journals and funded through commodity groups, state agencies, industry, and USDA-AFRI (though grants through NSF, USDA, and NIH are strongly encouraged).
- Teaching in entomology departments today is in alignment with ongoing research interests of faculty operating at the frontiers of insect biology. Thus, a dynamic framework for teaching and

curricular development is based on a strategic pedagogical vision in which large-enrollment courses (e.g. Insect Sciences in the 21st Century) are the main contributors to departmental credit-hour quotas as well as to undergraduate education more generally, and specialty courses (e.g. Medical Entomology; Insect Systematics) would enable both faculty and students to be situated at scientific forefronts.

- Although an undergraduate major in insect sciences would be maintained, the greatest opportunity for attracting students would be through the creation of an innovative undergraduate minor involving programs such as Animal Biology, Plant Biology, Ecology and Evolution, and Pre-Med/Vet programs. Focusing on a strong minors program rather than on expanding a major in insect science is consistent with the specialized nature of the discipline.
- The fundamental criteria for new faculty hires would include the ability to:
 - i) develop federally-funded research

Table 1. Old versus new entomology department models.

Justification	Old Model insects as pests	New Model eminence of insects
Appointments	Research with representation across the broad entomological spectrum from applied to basic research	Teaching and research; emphasis on basic; focus on sub-groups of excellence such as vector biology, pest sciences, systematics, ecology, chemical ecology, and molecular biology; participation in interdepartmental graduate groups and organized research units
Faculty interests	comprehensive across entomology discipline; independent research (e.g. sole authorship) emphasized	clusters of excellence; faculty research interests are complementary and team-oriented; collaboration and synergy stressed
Funding	AES plus commodity groups (e.g. cotton, citrus, alfalfa, mosquito abatement); sporadic institutional and competitive federal funding	foundation of research program based on extramural funding from national institutions (e.g. USDA, NIH, NSF, Gates Foundation); with supplementary commodity, industry and/or foundation sources
Publications	primarily mainstream entomology with occasional papers in higher-impact journals	greater emphasis on higher-impact journals (e.g. Nature, Science, PNAS, PLoS, Ecology)
Merits/promotion	primarily research; quality and quantity of teaching less important; outreach minimal	require evidence of coherent research program, impact of research stressed, including journal impact factors and evidence of translational research; greater accountability of teaching and outreach
Teaching	conventional pedagogy (e.g. morphology, systematics; economic and medical entomology; toxicology)	combination of both large-enrollment and specialized insect/entomology courses; also interdisciplinary service courses
Undergraduates	fluctuate between small (10) to moderate (30) number of majors; service classes low enrollment	modest increase in students majoring in entomology; potential for substantial increase in entomology minors; undergraduates exposed to insects through large-enrollment service and general education courses
Outreach	activities initiated by individual faculty; mostly ad hoc, on-request, and sporadic	departmental-level facilitation of activities; faculty accountable for engaging in systematic outreach efforts
Cooperative extension	modest emphasis on research with primary focus on direct outreach to farm advisors and clientele; mostly reports and presentations	emphasis on research addressing agricultural, urban, and environmental issues as well as extending practical information to nontechnical, professional, and scientific audiences; funding from range of sources to support science-based solutions for short-term problems and long-term concerns

programs that compete at the highest levels of science

- ii) strengthen one or more of the main areas of excellence that correspond to current or future affinity groups
 - iii) be willing to contribute to outreach efforts
 - iv) create exciting, cutting-edge courses in insect sciences at both undergraduate and graduate levels
 - v) use stature as endowed chair to build an internationally-recognized research center or an organized research unit around scientific specialty
 - vi) qualify for joint appointments within and between colleges.
- Finally, because of the shift in the organizing principle of the department and research interests of the faculty from “insects as pests” to the “eminence of insects,” the academic unit in which an insect sciences department is situated may need to be revisited (i.e. Biological vs. Agricultural Sciences).

The transitional boundary at which we stand marks the division between the past, which was based on traditional entomology, and the future which, in order for us to progress, needs to be based on the more all-embracing concept of entomology. This model will bring departments in alignment with the direction of modern science, in syn-

chrony with universities growing both in size and prestige, and in step with the residents of the states that support them, who have the energy, vision, and enlightened attitude towards science that is frequently unrecognized. What may be missing in disciplinary coherency is offset by the strength of many of individual research and teaching programs and the stellar reputations of many entomology faculty; what is lacking in certainty about the academic future of entomology departments is counterbalanced by an emerging clarity about our strategic outlook, and internal disagreements about the details of the restructuring process are more than matched by our near-universal willingness to directly engage in principled, constructive debate. The long-term goals should not be to self-replace, but rather to use our collective knowledge to reshape a department for the future that uses the biological eminence of insects and their societal ramifications as an overarching theme around which dynamic research and teaching programs are organized. This will allow revitalized departments to prosper far into this new century and thus continue to be a vital academic force within each institution as well as in the home state and the country.

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