TRINITY COLLEGE DUBLIN

PROVOST'S REPORT TO COUNCIL ON THE REVIEW OF THE SCHOOL OF NATURAL SCIENCES

1. INTRODUCTION

This report presents the outcome of a review of the School of Natural Sciences. An external peer review visitation was undertaken from the 3rd – 5th February 2010 by Professor Richard Bradshaw, University of Liverpool, Professor Angelika Brandt, University of Hamburg, Professor William Davies, Lancaster University and Professor Victor de Jonge, University of Hull. The internal facilitator was Professor James Lunney, School of Physics, Trinity College Dublin.

The report is based on (i) feedback from the External Reviewers received on the 25th March 2010, (ii) a submission from the School of Natural Sciences received on the 6th May 2010 and (iii) a submission from the Dean of Engineering, Mathematics & Science received on the 20th April 2010.

The main purpose of the School review is (a) to provide a structured opportunity for the School to reflect on its activities and plans for development, while benefiting from a constructive commentary by senior colleagues external to College; (b) to ensure that quality and standards in teaching, research and administration are being maintained and enhanced and that areas of concern in this regard are identified and addressed. Each School in College is reviewed systematically once every seven years.

2. OVERVIEW OF THE SCHOOL

2.1 Aims and Objectives of the School

Trinity College School of Natural Sciences was formed in 2005, bringing together the Departments of Botany, Geography, Geology, Zoology, the Botanic Garden, and the Centre for the Environment. It also incorporates a new virtual Centre, the Centre for Biodiversity and Sustainable Development. The Mission of the School of Natural Sciences (which is currently under review) is to be world class in its defined areas of research, to enhance the quality and innovativeness of the learning experience for its students, and to maintain existing and develop new research-based teaching programmes, particularly at 4th level.

2.2 Programmes to which the School provides teaching

Undergraduate:

The school is involved in the delivery of eight degree courses, six of which are long established and two of which were new in 2009-2010. All eight are of four years duration and have teaching input from other schools. They are:

- TR071 Botany
- TR071 Geography
- TR071 Geology
- TR071 Zoology
- TR071 Environmental Science
- TR001 TSM Geography
- TR077 Earth Sciences
- TR029 Political Science and Geography

Postgraduate:

- M.Sc. in Environmental Sciences
- M.Sc. in Biodiversity and Conservation
- M.Sc. in Environment and Development

2.3 Research

The School aims to promote a culture of excellence in research and to support research both at the individual level and on a collaborative basis within the envelope of academic freedom. In particular, it wishes to foster research and scholarship that is of international standard and is relevant to the current and anticipated needs of society.

Research activity in the School largely falls into four broad interdisciplinary catagories:

- Molecular Biology and Comparative Physiology;
- Ecology and Evolution;
- Earth and Environmental Science;
- Society, Space and Environment.

The School also has two research centres, one long established, the Centre for the Environment, and one newly created, the Centre for Biodiversity and Sustainable development. Both encourage and facilitate interdisciplinary research.

2.4 Summary Statistical Profile of the School for the Academic Year 2008/09[1]

Full-time Staff FTE	Undergraduate FTE	Postgraduate FTE	School Staff: Student Ratio	Faculty Staff: Student Ratio
40	**408**	**155**	**14**	**14**

Figures from Senior Lecturer's Annual Report approved by Council at its meeting on 16th December 2009

2.5 Accommodation and Facilities (Physical Resources)

The School is physically scattered over the island campus occupying 8 separate locations in 7 separate buildings and there is one installation off-campus, the Botanic Gardens in Milltown. The School has a total building stock of *ca.* 5,944sq. metres, of which 43% comprises laboratory space and 10% greenhouse and allied space. The School's dedicated lecturing space comprises 9 rooms totalling 497m^2: most of these, including all of the larger rooms, are frequently used by groups outside the School collaboration.

	Botany	**Botanic Gardens**	**Centre for the Environment**	**Geography**	**Geology**	**Zoology**
Offices	361	10	184	332	335	351
Laboratories (% ±dedicated teaching)	532 (40%)	22[3] (100%)	157 (38%)	240 (26%)	683 (30%)	927 (0%)
Significant other spaces	85[1] 36[2]	565[4]			85[6]	141[7]
Lecture theatres and Library	97		192	293[5]	142	111
Social	6	14			23	22
Total (m^2) (% of total)	**1,117 (19%)**	**611 (10%)**	**533 (9%)**	**864 (15%)**	**1,268 (21%)**	**1,552 (26%)**

[1] Herbarium; [2] Greenhouses; [3] Gardens Laboratory is multi-functional – servicing, teaching, research and technical support activity; [4]Greenhouses including potting shed, boiler room and growth rooms; [5]Includes Freeman Library which is 44% of this space; [6]Geology Museum; [7]Zoology Museum.

[1] *The staff FTEs include all Professors, Associate Professors, Senior Lecturers and Lecturers funded from the core HEA grant, or from self-financing courses, and all part-time and occasional staff and demonstrators, converted to an FTE, who are funded from core grant or from self-financing courses.*

3. REVIEWERS' RECOMMENDATIONS

The Reviewers make the following recommendations:

- The School is a natural flag-bearer for development of an institute within the topic of transport, energy and environment. The School is well-placed to play a dominant role within the sustainable development theme and could become internationally important.

- A vision and direction for the School is needed and its development is finally under way. The School research committee can act as a forum for strategy development.

- Administrative layers should be reduced in order to streamline multidisciplinarity in the School and de-emphasise discipline-driven planning.

- Remove heads of discipline from the School Executive Committee.

- An international dimension to the strategy would be important both in terms of profile and resources. Environmental governance is an example of one promising theme. Target European Union and international funding agencies.

- There is a lack of connection between academic planning at School level and strategic planning at college level which could be rectified by increased consultation.

- The ARAM deficit restricts scope for development. Mechanisms and incentives must be available for staff to deliver strategic priorities. Rewards are needed for delivering goals of the School e.g. new joint MSc courses. Rewards are also needed for excellence in research and teaching.

- Academics' need time to be freed up to deliver vision. The Reviewers suggest that College/School policy should be to reduce UG teaching loads and refocus admin to School level e.g. the successful MSc courses which align with strategic targets in College are in danger of stalling through a lack of School-based administrative support. Redundancy of modules in MSc courses could be diminished through joint interdisciplinary planning.

- The physical infrastructure is of poor quality from an international perspective and should be improved as a matter of urgency if TCD wants to allow for a further improvement of the science profile and international standing of the School.

- The Reviewers propose the introduction of a School work-load model. This can be light-touch but particularly in a time of transition, can be helpful in reducing stress and engendering a feeling of fairness.

- The Reviewers were pleased to see that new investment in posts was discussed at the School level and some interesting and innovative choices for recruitment were made.

- The development of a strategic plan for teaching, research and staffing matched to future societal needs and funding sources is urgent and should be prioritised. This will also help to increase the visibility of the School of Natural Sciences outside of TCD. An increase of collaboration with research groups from UCD would also increase visibility in Dublin and Ireland.

- A small group (e.g. the School research committee) could help with development of future research themes and assist in the active transformation from the present discipline-related structure to one which profiles the School as the main entity.

- The complete separation of all aspects of microbiology, molecular genetics and physiology to another School has not helped the development of interdisciplinarity or a more holistic approach to research questions concerning climate or environmental change, biodiversity and sustainability. Measures that encourage collaboration between Schools should be developed.

- Improvement of the physical infrastructure (high quality lab space has to be created) in order to allow the continuation of high research profile and to increase the potential of hosting more PhD and postdoc students should be a priority. A new building would help to improve interdisciplinary work and would reduce time needed for meetings (journey time to meeting place). A joint building would also facilitate the development of a new MSc course that includes all disciplines as well as the involvement of postdocs in teaching. This would compensate for work load of researchers who would have more time available for research. Unevenness of technical staff available for research in general would be easier to compensate. In general, technical staff balance between teaching and research support should match the balance of these activities within the School.

- 'Pump priming' funds should be made available to help the development of pilot projects in new areas. TCD should implement research awards for academic staff which could be given once a year per School – and maybe one per year at College level.

- Postdocs cannot themselves apply for competitive research funds. Special funds, however, might be made available at TCD level, for example for innovative research.

- The Reviewers argue strongly for a change to the system by which resources are allocated within the School. More resources should be available for collaborative, joint research initiatives that can forge new links between different disciplines. A competitive fund could be established for innovative research at TCD – every scientist (including postdocs) should be able to send in proposals.

- The financial system needs revision since academic staff spend considerable time with these matters.

- The relationship between the TCD research committee and the School is unclear to the Reviewers. How are the college research agenda/priorities driven? It seems bizarre that these were set up without buy-in from staff who are expected to deliver on the aspirations.

- Summer Schools or general workshops would help to inform all disciplines about research going on (low cost, high efficiency, streamline future research activities and fields) every year for 2-3 days where postdocs, PhD students, staff, etc. could present the most important work in the different projects. This would make expertise visible as well help identify gaps (e.g. GIS problem).

- The School could benefit from the development of one or two strong, integrating and internationally competitive themes under the flag of the TCD priority theme Transport, Energy and Environment. The Reviewers refer to a realistic example presented as an appendix to the main review report. In this example all available expertise in the School, including the Botanical Garden (mesocosm experiments) and zoological museum (demonstration function), could find a functional place. The integration of all available expertise is of course optional.

4. PROVOST'S RECOMMENDATIONS TO COUNCIL

In light of the Review Report and the responses from the School of Natural Sciences and the Faculty Dean, it is recommended that:

1. The School of Natural Sciences working closely with the Dean of the Faculty of Engineering, Mathematics & Science, and other relevant Academic Officers, should consider the detailed recommendations of the Review Report and draw up an implementation plan[2] for Council approval.

2. The Staff Office develops a plan and a timeline to consolidate administrative functions in multi-disciplinary Schools and assists Schools in its implementation.

3. The College Research Forum, comprising all Directors of Research, should normally meet once a term commencing in the academic year 2010/11.

4. College develops and implements a strategy to support multi-disciplinary schools achieve academic and administrative cohesion and development.

[2] See Procedures and Protocol for Quality Review of Schools 2008/09 at *http://www.tcd.ie/vp-cao/qu/qopdf/adrapp2.pdf*

5. REVIEWERS REPORT

School of Natural Sciences, University of Dublin, Trinity College.

3-5th February 2010.

Executive Summary

The School of Natural Sciences is a natural flag-bearer for development of an institute within the topic of transport, energy and environment. The School has a strong research base and dedicated staff, but would benefit from a new building and stream-lined administrative organisation with increased decision-making power focused to School level. Administrative layers should be reduced and discipline-driven planning de-emphasised. There is scope for increased international impact and funding through development of a strategic vision for the school in collaboration with college officers. Key areas of existing and developing research expertise should be highlighted to increase school visibility. Academics' time needs to be freed up to deliver vision through changes in the organisation of teaching and administration. The School would benefit from increased collaboration with research stakeholders and policy makers at national and international levels.

(i) Existing Provisions

(a) Research and Scholarly Activity

(i) Comment on the distribution of research interests, plans and output across School members in a national/international context;

The distribution of research interests within the School is extremely broad, comprising biological sciences (e.g. plants, birds, invertebrate animals), physical sciences (e.g. geology, geochemistry, geography), social sciences (e.g. environmental sciences and geography) and some integration in environmental sciences. Current contributions come from 38.5 principal investigators (47 if research fellows and research lecturers are included), 140 graduate students and 23 postdoctoral fellows. Moreover, 16.5 technical staff and 6 administrative staff work in the school. The numbers of technical staff are very unevenly distributed between the disciplines because of the disjunct housing of the former departments and the current 'moratorium' on new contracts.

According to TCD's strategic plan 2009-2014, the research topics Biodiversity and Conservation, Environmental Sciences, the Trinity Centre for Biodiversity and Sustainable Development, and an inter-School Transport and Environment Initiative (which all cover a wider range of topics e.g. evolution, ecology, evolution of fossil ecosystems, biofuels) are research themes and subjects under the TCD priority theme Transport, Energy and Environment. Not all opportunities for integration of these research themes have been exploited so they lack clear visibility both within the College and externally.

Certain research groups have a developed international profile and are among the leaders in their field e.g. biomass/biofuels, long term environmental and climatic change, stratigraphic palynology, taxonomy, biodiversity and conservation. Recent high quality recruitments have consolidated strengths in e.g. Palaeozoic orogeny, pollination biology and opened up promising new research topics e.g. genetic regulation of embryonic development, globalisation issues. Forthcoming retirements (e.g. leader of biomass/biofuels group and in Geology) make certain

research areas within the school vulnerable and there is scope to strengthen current research through links outside the school to e.g. Engineering (biofuels), Genetics (developmental studies), Law (environmental governance). It is also important for School development to retain good contact with biological disciplines currently placed in other Schools (e.g. genetics, microbiology and physiology).

The spread of interests within and between disciplines would benefit from new investment. In particular a strengthening of links outside the School could allow development of new themes of global concern within environmental issues (e.g. food security, environmental justice, safeguarding environmental 'services'). Current research generally complements activities in UCD, but the proposed Environmental Institute could pose issues of competitive overlap.

(ii) Give an assessment of the standing of the School in terms of published output relative to that of other Schools of international repute and in terms of the following:
publications in refereed journals in last five years;

In total the School has published over 500 articles in internationally peer reviewed journals. The school is very research active and has a large scientific output. Publication is however not always in the 'best' journals with the widest international readership. Many of the School researchers could increase their international visibility if they chose to 'trade up' in their choice of journal. This can be a rather tedious debate, but international standing is based on quality rather than quantity of output. Publications in the best journals increases peer approval and drives movement up the global University list. There are journals in all disciplines with impact factors above 4 and relatively few of the publications listed here achieve this. Less publication but with increased aspirations for quality would raise the international standing of the school.

likely publications in such journals in the next two years;
The current pattern of publication is likely to be maintained in the near future with perhaps an increase in early career publication reflecting the recent increase in PhD students. Increased focus on less but higher quality publication by senior researchers would benefit the School.

publications in other forms - books, monographs, etc. in the last five years;
similar publications in next two years.
Other forms of publication are sufficient in an international context. Regrettably these publications can attract less international attention, but they can be justified for strategic purposes (e.g. policy impact).

(iii) Evaluate the School in terms of its performance in the last five years, and likely success in the next two years, in raising external funding for research;

The School of Natural Sciences has been very successful in fund raising over recent years. Principle investigators have received grant money from a diversity of predominantly national funding sources. Since 2004 the school has brought 26 million euro into TCD. This recent funding record is very impressive by international standards within this subject area. However the heavy dependence on national funding will be hard to maintain in the near future given the state of the economy. It will be a challenge to broaden the portfolio. TCD obtained a high proportion of EU funding in these disciplines in the past and a strategy for increasing funding from EU and other international sources could usefully be developed. Links with the business community are barely mentioned in the self-assessment and there must be good potential for funding there.

Development of a strategic plan, focussing research around issues of concern, will assist with future funding, but planning and forethought are needed.

The physical infrastructure acts as a constraint for further research funding. The majority of the buildings and laboratories are old and technically unsuitable for some of the research carried out at present. If TCD wants to increase the potential and possibilities for external funding, TCD must establish the infrastructure necessary for improved and expanded research activities.

(iv) Comment on research students in terms of the following:
number of research students; number of research degrees awarded and completion times;

The number of research students significantly increased in all disciplines between 2004 and 2009, particularly in Botany. This is an impressive achievement but has placed considerable pressure on space and facilities and some of the working conditions are incompatible with the international reputation of TCD. The number of PhD awards has matched the growth in student numbers and the majority are now completed within 4 years.

quality of research output;
The research students are producing good quality output in most disciplines but would perhaps benefit in many ways from more interdisciplinary contact within School (most high-profile global issues which should engage School students are interdisciplinary). As with the staff, the research students could be encouraged to publish in more prestigious journals.

overall supervision/support for these students;
The general level of supervision and support for graduate students is good. The majority of PhD students are from outside TCD and would benefit from an increased level of school-wide activities and courses (e.g. Geographic Information System) and pooling of research equipment, facilities and staff. Some students pointed out that certain supervisors were overcommitted with teaching and administration and the students would have welcomed more direction. Students are not uniformly spread amongst the staff and increased joint-supervision could improve the amount of contact between staff and students. Use of an informal, School-based workload model would help identify those with high student supervision, teaching and research and allow appropriate compensation in other areas.

research funding (internal and/or external) for research students.
The vast majority of research students are in receipt of individual studentships or are funded by research grants of their supervisors. Research student numbers could probably only be increased by appointment of new staff and reallocation of supervisory, teaching and research activities and access to more office and laboratory space.

(v) Comment on the adequacy of student-staff liaison (formal and informal) in relation to research and the means by which students provide feedback about their research experiences in the School;

Interaction between students and staff is generally good within each discipline, but students would welcome broader contacts within the School as a whole. Feedback from students at discipline level generates appropriate responses but responses to student concerns are less obvious at school level. More technical support would be welcomed for research as technicians mostly seem to support undergraduate teaching.

(vi) Comment on the balance of published research, research supervision, and other research-related activities in the School;

Research supervision appears to function well and there is a strong emphasis on publication (discussed above). There appears to be less general strategic thinking over research direction and focus for the school. It could potentially be rewarding to publish less or in higher ranking journals and spend more time developing school-wide interdisciplinary and urgent research questions that include the international scientific community.

The present 'discipline' structure across the School has not encouraged PhD students and post docs to meet and exchange views and expertise. The first time that the postdocs from across the School met was preparatory to the review of the School. They decided to continue meeting each other.

(vii) Comment on other activities of the School that arise from the research standing of its members, e.g. membership of government-appointed commissions, officership of learned/professional societies, editorship of academic publications, other achievements and standing arising from research work.

National activities and visibility seem appropriate, but actions could be taken to increase international visibility e.g. participation in more international projects, commissions and committees, which can in turn lead to international advisory positions and policy impact at EU or UN level. TCD spokespeople on key environmental issues could come from this school.

Key issues concerning research and scholarly activity

- Broad research interests in School and some groups have strong international profiles.
- Visibility of research could be improved and positioned more clearly within strategic research themes for TCD.
- Investment is needed to develop new research links outside the school on topics of global concern and to interact positively with the proposed Environmental Institute at UCD.
- Publication output is very good but increased focus on less, but higher quality publication by senior researchers would benefit the School.
- Recent funding record is very impressive, but new sources (e.g. the business community) are now needed in the current economic climate.
- The poor physical infrastructure might act as a constraint for further research funding.
- Research student numbers are very good and their supervision works well. They would benefit from more school-wide activities.
- International visibility and policy-relevant research could be increased.

(b) Teaching and Learning

(i) In relation to other Schools of international standing in this academic discipline, please give an assessment, commenting in particular on the following inputs of teaching and learning in both undergraduate and taught postgraduate programmes:

The standards of teaching and learning in the School are generally high. Classes are often small and the staff are satisfied with teaching standards and have stressed the value of the individual disciplines as home bases for sophister students. Students are also satisfied with their overall experience, but were largely unaware of the existence of the school. Many sophisters do not obtain a place in the discipline of their choice, but are ultimately satisfied by the quality of the teaching in the final years and the close contact with staff. Environmental Science Moderatorship students suffer from not having an obvious home base. Teaching facilities and space both in laboratories as well as in lecture rooms are however often unsatisfactorily small and old leading to repeat practical classes and lectures (e.g. the lecture room in environmental sciences is so small that parallel lectures have to be provided in order to teach all students in the year).

There is a great variety of degrees and modules offered. Timetabling is complex and seems to be organised at the level of the discipline and consequently is rather inflexible. It could be advantageous for the timetables to be organised at School or Faculty level. Many students would have appreciated the opportunity to take more interdisciplinary modules (e.g. in year 3) but the timetable does not allow it. Students generally were excited by the new teaching possibilities arising from the formation of the School, but at UG level these have not yet fully materialised, despite a modularisation process currently in its first year of implementation. There is some unevenness in the teaching offered within the school, with some students having tutorials and practice in essay writing and others not. The new interdisciplinary MSc courses are successful but staff desperately need increased administrative, technical and financial support at school level for e.g. admissions, field and project work.

Staff in the school generally seem to have high teaching loads compared with UK and continental institutions, despite the recent reorganisation. The new MSc courses have imposed extra burdens and the course leaders are overstretched and find it hard to recruit teachers, particularly for field and project work. The students also commented on the lack of participation of some staff that had appropriate interests. In the absence of a work-load model we cannot assess how evenly the load is distributed among the staff. There does seem to be potential to reassess the teaching, check for overlapping courses (students reported that this does occur), reduce teaching loads and increase the flexibility of the courses available for undergraduates.

Content/level of the programmes and number of students;
The content of the programmes is very diverse but possibly lacks a certain flexibility due to timetable constraints. The senior sophister research projects are of a high standard but make demands on space that are hard to satisfy in e.g. zoology. There already seem to be too many students for the available space and resources. There could be value in more training in science writing at junior sophister level as this was reported as being unevenly covered across the school. Students in environmental sciences commented that the background knowledge of MSc students in chemistry, maths and computing was very variable.

Distribution of teaching across staff members;
This was hard to assess from the material supplied but teaching does appear to be unevenly distributed in a somewhat unplanned manner. Introduction of a workload model covering all academic activities would be highly beneficial, combined with a policy about some specialisation of activities. Postdocs expressed an eagerness to obtain teaching experience and are a largely untapped resource.

Hiring of external lecturers could help to reduce the generally high teaching load of the staff. External lecturers selected from collaborating organisations, particularly if they were end-users of research, would help introduce a novel slant to some courses, increase the impact of TCD research and teaching and raise the profile of TCD in the wider community

Senior management of the College should consider whether all staff should be expected to do all tasks? Is there scope for research specialists or teaching-only staff? Total loads can be made effectively equivalent through the use of a workload model.

Constructive alignment of curriculum, teaching methods, and assessment methods, and rationale for teaching and assessment methodologies used;
The early career scientists could be encouraged to play a leading role in School development through a new interdisciplinary MSc course. Strong promotion activities for this course are required. This development should be in line with the Schools' future research and management plan for a future teaching program, thematic and disciplinary research program and appointment of related staff positions.

The introduction of more 'issue-based teaching' might help address the relatively low student numbers associated with some disciplines. It may be that the courses can be made more attractive/ relevant to global concerns.

Adequacy of staff-student liaison in the School (formal and informal) in relation to teaching and learning;
Students have an opportunity to provide feedback after each course. Students could initiate special seminars or a forum in which they meet, even without teaching or research staff. Postdocs and PhDs within the school have apparently not really met together to discuss issues of general concern.

Supervision and support for students on postgraduate taught programmes;
The taught MSc courses were generally held in high regard by the students. Specific issues raised by the students were: lack of career guidance, very mixed background and capabilities of students, too little emphasis on knowledge exchange activities and too little fieldwork for a subject like biodiversity and conservation.

Arrangements for curriculum review and revision;
The school teaching committee currently meets on a regular basis to oversee teaching programmes, which are largely driven from within the disciplines. The present curriculum is very broad. As the school develops, debate could be useful as to how the curriculum could evolve to include new interdisciplinary opportunities created by research developments (see Appendix).

Methods used to evaluate teaching and learning in the School, and actions taken in response to student feedback;
There was little discussion about evaluation of teaching and learning during the review, although appropriate procedures and committees appear to be active. The school might consider the potential value of external opinion (e.g. industries/business graduate employers) on aspects of the curriculum.

Professional standing (e.g. accreditation by professional bodies, etc.);
Not considered.

Opportunities for study abroad, student exchanges, relevant outside experience;
Some students pointed out that certain field courses were too expensive and organised with little consultation. Scholarships may be helpful to broaden access to what are undoubtedly useful experiences and some are available through the Trinity Trust Field Course Grant scheme.

The visiting group heard little about study abroad programmes, apart from field excursions. Our view is that it is valuable for students to be offered an international experience of some kind. Despite some ERASMUS exchange, overseas opportunities do not seem extensive in comparison with other leading universities. This is also true of links and placements with business/industry. Are there sufficient visits to relevant industries and teaching contributions from outside the university?

Funding available to students on postgraduate taught programmes.
There appears to be little/no support in the form of college bursaries. A modest allowance towards project expenses (250 €) was mentioned.

(ii) In relation to other Schools of international standing in this academic discipline, please give an assessment, commenting in particular on the following outcomes of teaching and learning in both undergraduate and taught postgraduate programmes:
Student exam results and completion rates;
Impressive statistics which have got better in the last years

Progression paths of students following graduation;
See above, has also increased.

External contributions to teaching and learning in the discipline.
Should be improved, please see comments above.

Key issues concerning teaching and learning

- The teaching appears to be of high quality and the students are well satisfied.
- There is some duplication in the teaching provision.
- In comparison with comparable institutions, the teaching loads appear to be heavy – there is probably too much teaching and some compensation for this is needed. A workload model could be used to decide on appropriate loadings and compensation.
- Postdocs appear to be interested in contributing more to teaching. It would seem valuable to take advantage of this resource and free up time for research among teaching staff.
- Timetabling should be co-ordinated centrally (could be done by administrative staff if one layer of administration (at discipline level) is omitted and tasks for staff are newly defined).
- Many students do not get into first choice sophister subjects but good quality attention in 4th year seems to ameliorate some of the dissatisfaction felt with this situation.
- Zoology is over-subscribed as a teaching discipline. Excellent and popular 2nd year teaching is a contributory factor.
- Geology is likely to be oversubscribed due to increased interest in years 1-2. Botany is undersubscribed but there is much supply teaching elsewhere and emphasis on graduate teaching. Numbers of PhD students have doubled within the past 5 years.
- Students are invariably very supportive of the staff and do see the value of much of their work at TCD.

(c) Service to College and Society

(i) In relation to other Schools of international standing in this academic discipline, please give an assessment, commenting in particular on the following service activities:

S*ervice to College (e.g. contributions to governance of the College in terms of membership of College committees and the holding of positions of responsibility.);*

The service to the College is possibly too high. Several new committees and administrative structures were established at school formation on top of existing commitments. This has led to some duplication of effort resulting in a certain feeling of frustration. It could be useful to examine all committees for size and efficiency and aim to simplify procedures and structures where possible.

Contributions to public debate and formation of public policy;

This School deals with issues of global concern and important contributions are made by staff. Profiles for these issues should be raised still further in Ireland and beyond.

Use of research results to make a difference to people's lives;

This area can and should be improved within the School. Staff and students are not well engaged with the idea of science into business and work with end-users, policy-makers and innovation.

There are more opportunities to engage with the TCD Strategic Plan 2009 – 2014 in the key area of the environment, e.g. the bridge to College programme.

Local outreach activities of the school;
There is much evidence of constructive local outreach, particularly involving museums and special collections. Some individuals appear to be very active here. Outreach activities could be important arguments for sustained investment in the Gardens and other scientific collections.

Activities to commercialise intellectual property;
Is there sufficient knowledge transfer activity to industry?

External relations with the wider community;
Conservation issues, land use and biofuel are all research topics that are important for society. Relations with the wider community can be further developed once the school has integrated disciplines to a greater extent.

Key issues concerning service to college and society

- Local outreach activities are numerous and generally effective.
- The links to end-users and policy makers are not as fully developed as in institutions of comparable status.
- Service to college through administrative committees appears time-consuming and could be stream-lined.

(d) Resources
(i) Give an assessment of the resources of the School for teaching and research relative to those available to other Schools of international standing in terms of

Staff (e.g. academic, administrative, service support staff);
The School has a very small high-quality staff responsible for a wide range of disciplines. There is therefore a need to focus on strengths and aim to do a few things really well.

The technical staff is currently very unevenly distributed among groups and space! Our view is that they might benefit from a centralising of the administration and a better integration of disciplines within the School. The technical staff would also benefit from a new jointly-used building. There is now clear hesitation to move and reservations by staff are understandable. There must be clarity about the creation of efficient, effective housing with future capacity needs for theatres, laboratories, offices, Botanical Garden for future mesocosm work, etc. adequately satisfied. Consideration is needed about the herbarium, museums and other scientific collections. There can be some advantage to a pooling of administrative staff in a School team (see below).

Physical infrastructure for teaching, research, and staff (e.g. laboratories, lecture/seminar rooms, equipment, office spaces, social spaces).
The current physical infrastructure is not very good, and urgently needs to be improved in order to guarantee future high levels of science and education.

The Botanical Gardens are not fully utilised (or utilisable). In our view it is unreasonable to class this and some other very low grade space in the school as normal teaching/research space. This problem occurs in many other universities but seems to be particularly acute at TCD.

Key issues concerning resources

- A new school building and improvement to physical infrastructure is a priority.
- Centralised administration and increased integration of disciplines in the school would improve efficiency.
- The Botanical Gardens should not be classed as normal teaching/research space.

(e) Organisational Structures and Planning

(i) Give an assessment of the organisational structures and planning of the School relative to those available to other Schools of international standing in terms of the following:

M*anagement structures within the School;*

Administrative structures are rather complex and traditional in comparison with many other younger institutions. The administrative organisation could be simplified, where possible with disciplinary administrators moved to a School administrative structure. The financial administration and time-tabling have been mentioned by many as being potentially more effective if organised at School level. The school might be more effective if it was more autonomous with more decision-making powers over e.g. resources and appointments.

School committees and structures;

Committees and structures could be further developed to suit the new interdisciplinary profile of the school. In practice this means that the number of administrative levels should be reduced where possible as at present there are elements of four levels: College – Faculty – School – discipline. It would seem preferable to reduce the influence of the disciplines and perhaps faculties. Within the school, some committees could be smaller to expedite decision-making, e.g. remove automatic representation from all disciplines. The executive committee for example would be smaller and possibly more effective and focussed on the School without the participation of the heads of discipline.

School budget allocation and planning and decision-making related to budget;

Having the School as a cost centre would increase the capacity for strategic development. A new home for the School is a priority as most laboratories and lecture rooms are too small and too old for further internationally-competitive science.

Communication between School and staff, students, Faculty, and College;

There is scope for improving communication particularly with regard to development of strategy and to capitalise on the positive attitudes encountered among the School PhD students, postdocs and faculty (particularly the junior faculty). The School ‘away’ day programme should be encouraged to help with communication, School cohesion and development of future teaching and research. Occasional meetings/seminars for PhD students and postdocs would be a useful development. Inclusion of postdocs in School committees would help in recognition of the contribution of this group to School research. Strategic thinking at both the College and the

School level could be encouraged by occasional visits from senior administrators e.g. the Vice-Provost, or the College Dean of Research to discuss issues such as the case for linking this School with the Engineering School in a new building, about which there is currently some confusion.

Better communication within the School could advertise the potential advantages of this type of organisation e.g. increased visibility at College and national level of individual research groups, new investment, new teaching and research opportunities.

Student involvement in School decision-making.
At present many undergraduates are not aware of the existence of the School. There could be more involvement in School activities and planning through more active and informal communication and encouragement of students and junior School researchers to increase participation on key committees.

Key issues concerning organisational structures and planning

- Concentrate more administrative structures and decision-making at school level.
- Encourage the trend of increasing and open participation in school management.
- Support the increasing contacts between post-docs and PhD students within the school.

(f) Overall view and recommendations
(i) In the light of what is happening in other universities, comment on the School's self-assessment and view of the future, and developments since the last School review;

The self-assessment has been thorough and initiated useful discussions within the School at several levels. The report is characterised by constructive optimism, given the current economic situation, but also highlights the severe burdens placed on the School by previous financial deficits that have hindered development and reward for successful new initiatives e.g. MSc courses. Compared with comparable institutions, there has been relatively little investment in recent years. Certain reluctance for disciplines to blend into the School both administratively and in terms of research has restricted the potential benefits of the School formation.

The information about research output could have been better presented in the self-assessment. Data on citations and h-factors, together with sections of CVs, which are now available on the School website, would have allowed us to see who are the agenda setters. A section on the structure of the School for outsiders and a specific section on perceived strengths and weaknesses should be included. A scientific strategy and work plan for improved integration of the different disciplines could have been more fully developed.

(ii) Give your own views on the possible future direction of the School and outline any recommendations that you may have for improvement at School, Faculty and College level.

- The School is a natural flag-bearer for development of an institute within the topic of transport, energy and environment. The School is well-placed to play a dominant role within the sustainable development theme and could become internationally important.

- A vision and direction for the School is needed and its development is finally under way. The School research committee can act as a forum for strategy development.

- Administrative layers should be reduced in order to streamline multidisciplinarity in the School and de-emphasise discipline-driven planning.

- Remove heads of discipline from the School Executive Committee.

- An international dimension to the strategy would be important both in terms of profile and resources. Environmental governance is an example of one promising theme. Target European Union and international funding agencies.

- There is a lack of connection between academic planning at School level and strategic planning at college level which could be rectified by increased consultation.

- The ARAM deficit restricts scope for development. Mechanisms and incentives must be available for staff to deliver strategic priorities. Rewards are needed for delivering goals of the School e.g. new joint MSc courses. Rewards are also needed for excellence in research and teaching.

- Academics' need time to be freed up to deliver vision. We suggest that College/School policy should be to reduce UG teaching loads and refocus admin to School level e.g. the successful MSc courses which align with strategic targets in College are in danger of stalling through a lack of School-based administrative support. Redundancy of modules in MSc courses could be diminished through joint interdisciplinary planning.

- The physical infrastructure is of poor quality from an international perspective and should be improved as a matter of urgency if TCD wants to allow for a further improvement of the science profile and international standing of the School.

- We propose the introduction of a School work-load model. This can be light-touch but particularly in a time of transition, can be helpful in reducing stress and engendering a feeling of fairness.

- We were pleased to see that new investment in posts was discussed at the School level and some interesting and innovative choices for recruitment were made.

- The development of a strategic plan for teaching, research and staffing matched to future societal needs and funding sources is urgent and should be prioritised. This will also help to increase the visibility of the School of Natural Sciences outside of TCD. An increase of collaboration with research groups from UCD would also increase visibility in Dublin and Ireland.

- A small group (e.g. the School research committee) could help with development of future research themes and assist in the active transformation from the present discipline-related structure to one which profiles the School as the main entity.

- The complete separation of all aspects of microbiology, molecular genetics and physiology to another School has not helped the development of interdisciplinarity or a more holistic approach to research questions concerning climate or environmental change, biodiversity and sustainability. Measures that encourage collaboration between Schools should be developed.

- Improvement of the physical infrastructure (high quality lab space has to be created) in order to allow the continuation of high research profile and to increase the potential of hosting more PhD and postdoc students should be a priority. A new building would help to improve interdisciplinary work and would reduce time needed for meetings (journey time to meeting place). A joint building would also facilitate the development of a new MSc course that includes all disciplines as well as the involvement of postdocs in teaching. This would compensate for work load of researchers who would have more time available for research. Unevenness of technical staff available for research in general would be easier to compensate. In general, technical staff balance between teaching and research support should match the balance of these activities within the School.

- 'Pump priming' funds should be made available to help the development of pilot projects in new areas. TCD should implement research awards for academic staff which could be given once a year per School – and maybe one per year at College level.

- Postdocs cannot themselves apply for competitive research funds. Special funds, however, might be made available at TCD level, for example for innovative research.

- We argue strongly for a change to the system by which resources are allocated within the School. More resources should be available for collaborative, joint research initiatives that can forge new links between different disciplines. A competitive fund could be established for innovative research at TCD – every scientist (including postdocs) should be able to send in proposals.

- The financial system needs revision since academic staff spend considerable time with these matters.

- The relationship between the TCD research committee and the School is unclear to us. How are the college research agenda/priorities driven? It seems bizarre that these were set up without buy-in from staff who are expected to deliver on the aspirations.

- Summer Schools or general workshops would help to inform all disciplines about research going on (low cost, high efficiency, streamline future research activities and fields) every year for 2-3 days where postdocs, PhD students, staff, etc. could present the most important work in the different projects. This would make expertise visible as well help identify gaps (e.g. GIS problem).

- The School could benefit from the development of one or two strong, integrating and internationally competitive themes under the flag of the TCD priority theme Transport, Energy and Environment. We refer to a realistic example presented as an appendix to the main review report. In this example all available expertise in the School, including the Botanical Garden (mesocosm experiments) and zoological museum (demonstration function), could find a functional place. The integration of all available expertise is of course optional.

Richard Bradshaw Angelika Brandt William Davies Victor de Jonge

APPENDIX. A blueprint for creating internationally competitive research under the flag of the TCD priority theme Transport, Energy and Environment.

A research theme where all the expertise of the School of Natural Sciences can (but not necessarily 'must') find a place forms a suitable basis for added value (holistic approach, integration of results) to the different disciplines. The required input may vary from taxonomy, experimental and field work to modelling approaches.

A major theme may generate innovative thinking, intensified co-operation and could further strengthen collegiality. We are of the opinion that 'thinking big' and in an integrated manner could be helpful in setting up a new and major School-integrating research theme. Apart from the research challenges there are also funding issues, which can be difficult with inter-disciplinary research. 'Pump priming' money from College would be well invested both for increased co-operation within TCD as well as with the outside world (Figure 1).

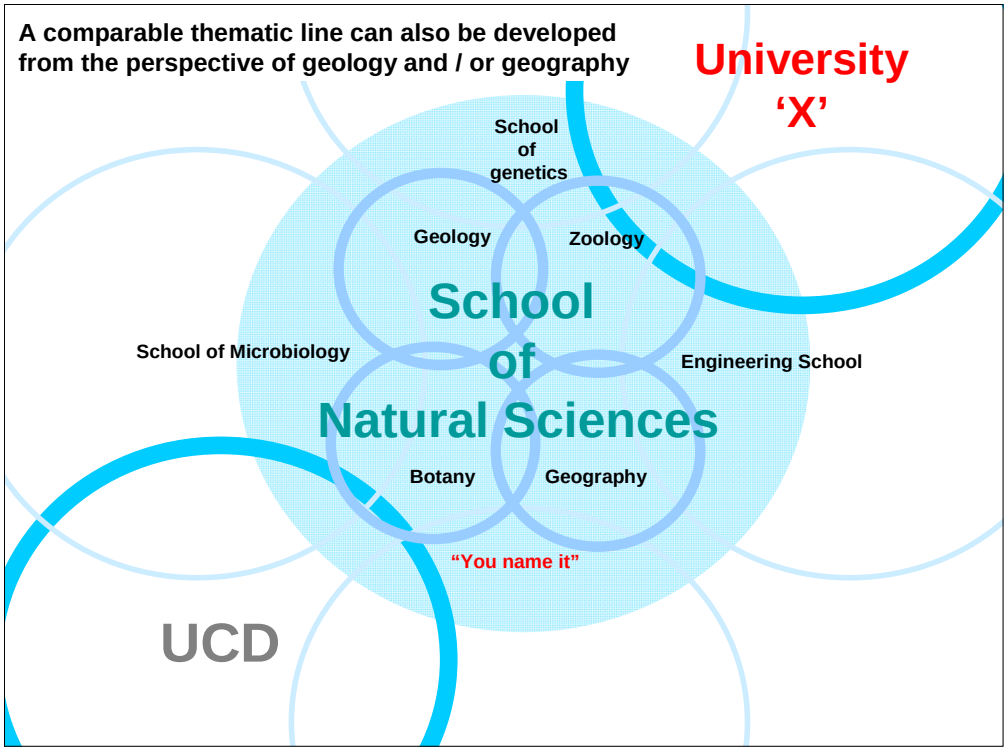

Figure 1. Visualisation of the position of the different science stakeholders in the field of natural and environmental sciences.

An example of a future strategy.

Starting from some of the environmental issues, one suggestion may be to develop research covering the 'integrated system' of applied science, policy making and management (Figure 2). This integrated system consists of the two main building blocks: ecology and socio-economics.

A challenging School-wide theme suggestion could be looking for the balance between ecological (geological, geographical, botanical and zoological) and socio-economic (including human behaviour, culture and heritage) aspects. Such an integrated study can be done in terms of carbon, energy or even monetary units.

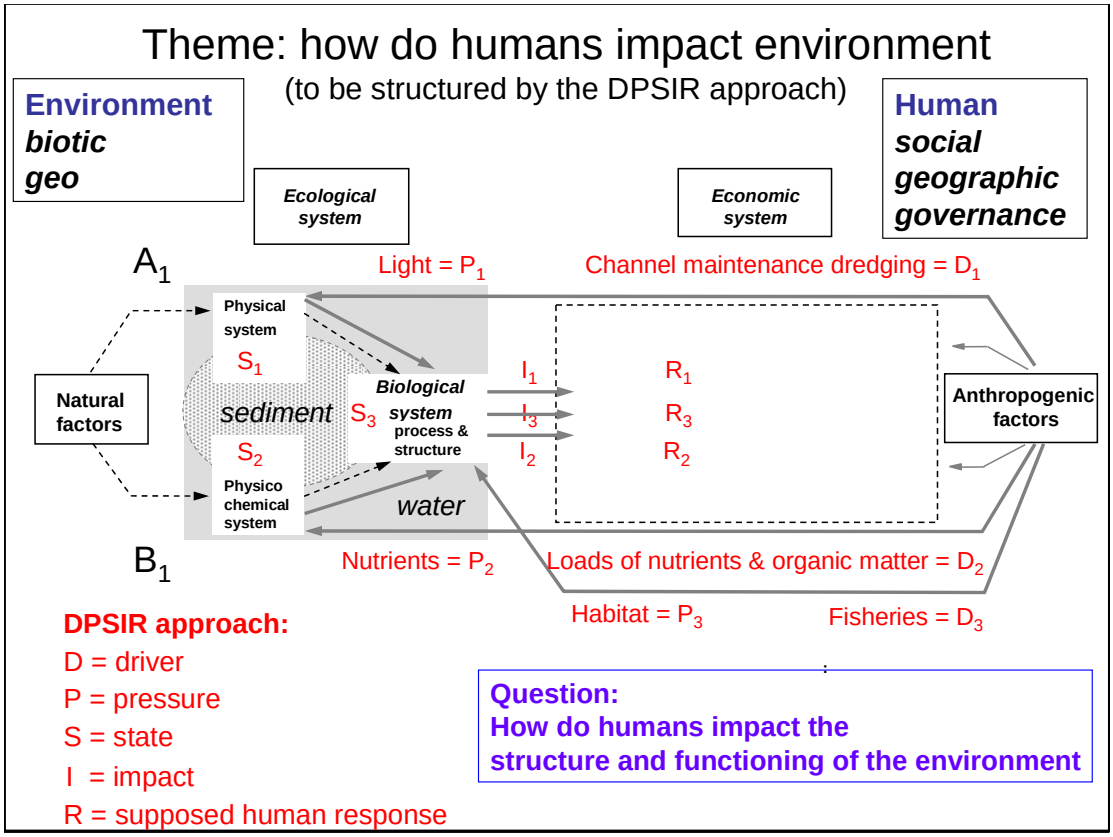

Figure 2. Diagram representing the 'integrated system' (the combined ecological and human socio-economic system). The natural system variation (left) is caused by natural factors (meteorological conditions as temperature and wind, weathering, …) impacting the physical and the physico-chemical subsystems. Anthropogenic variation (right) is caused by (Drivers and Pressures) also impacting the physical and physico-chemical subsystems but superimposed on natural variation. A useful practical approach could be to follow the DPSIR approach (developed by Turner). This approach is also indicated and illustrates how human impact can be visualised and thus also how it can be modelled.

A central approach could be formed by relating ecological food web or ecological network studies to the 'good and services' provided by these systems and thus involving economics and sociology. There are several ways of analysing the relationships between the functioning of systems and their architecture (see for instance recent work of Ulanowicz, Huisman, Scheffer and Bascompte for the marine and coastal environment). They are designed to research how systems function, investigate possible relationships between structure and function (Figure 3) and assess the impact of human activities superimposed upon natural variation. This all forms a suitable basis to study the boundaries and limits of sustainability.

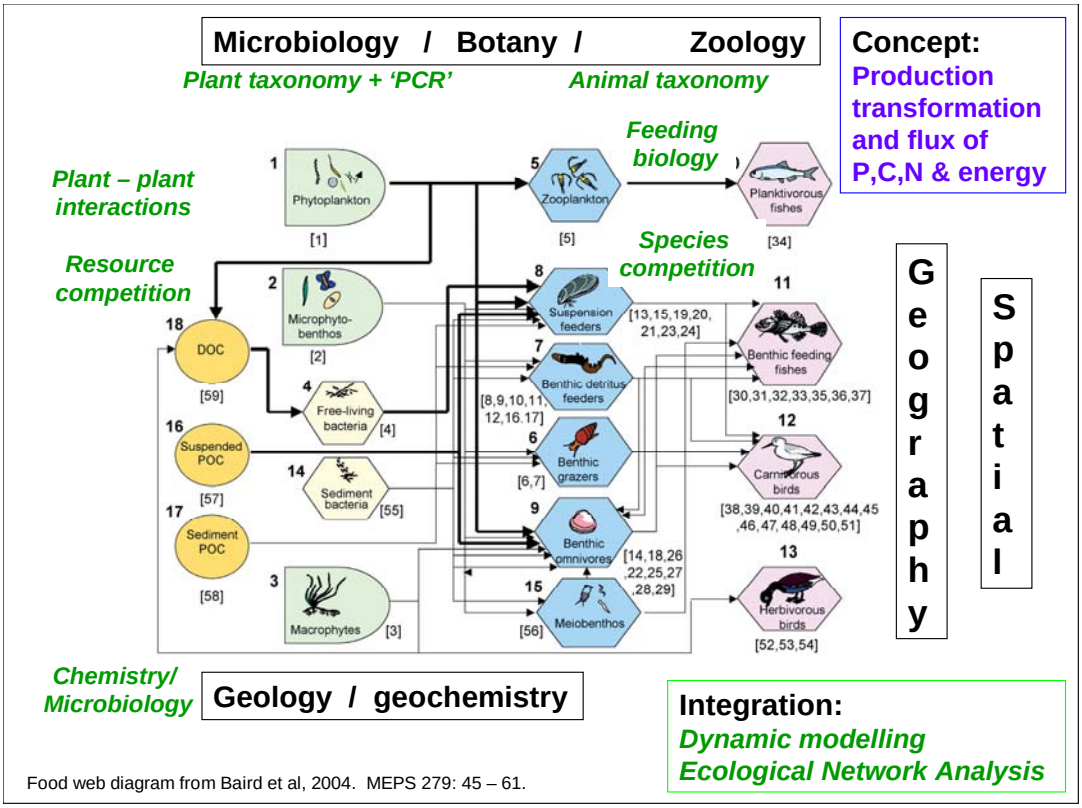

Figure 3. A coastal ecological network showing the relationships between (groups of) species. The thickness of the arrows indicates the magnitude of the carbon fluxes between the boxes.

Potential roles of the former disciplines are also indicated. The green text suggests the type of theoretical, experimental, field and taxonomic knowledge that is required to create a framework before flux analyses can be carried out to 'judge' the systems functioning, condition, organisational development, redundancy, input- output analysis, turnover etc.

The above mentioned approach could be developed for different systems (e.g. terrestrial, grassland, rural or urban areas, fresh, brackish and marine coastal and offshore systems). A 'network analysis' approach, which in different forms can be applied to both the human as well as the natural/ environmental system can be usefully adopted. Such a main theme gives opportunities for cooperation within the School (former disciplines) and between Schools (Natural Sciences and Genetics, Microbiology, Physiology) and also between universities (nationally and internationally).

The above is only one example and is presented from a specific (biological/environmental) perspective. Comparable themes could be developed from the perspective of a geologist or geographer. The aim of this example is to fuel the future School-wide discussion about integrative research.

6. SCHOOL'S RESPONSE TO THE REVIEW REPORT FOR NATURAL SCIENCES

Introduction

The School of Natural Sciences welcomes the helpful comments made in the review and we also, in general, accept the suggestions made for improvement some of which require action at a higher level – either by the Faculty or College. The report, and therefore our response, is broken down under a number of headings as follows:

Research and Scholarly Activity

We welcome the positive comments from the reviewers concerning our research output and scholarly activity. The School is described as "very research active and has a large scientific output". However, the reviewers suggest that we should concentrate on improving the quality of our publications and reducing the quantity: they also suggest that all disciplines should aim for journals with an impact factor of 4 or more. While research groups are very conscious of maximising their impact internationally, we believe that publishing in the most appropriate journals to reach the widest readership of their peers is vitally important even if the impact factors are by some standards low. Equally, the aim of publishing less needs to be balanced with our high level of postgraduate education which plays an integral part in our research activities. We have a high proportion of research students in all our research groupings and deem it essential that all students publish their work as prominently as possible for the benefit of their training as well as the benefit to the research group, the School and the College. Furthermore, due to the breadth of research in our School, impact factors vary considerably (often as a documented consequence of different numbers of citations per article per discipline) and in some disciplines there simply are no journals with impact factors above 4. Certainly, our researchers are very aware of the journals they are publishing in and do already publish in high impact journals – examples include Nature (Impact Factor 31), Trends in Ecology and Evolution (11.9), Ecology Letters (9.4), Biological Reviews (8.8), and Global Change Biology (5.9).

The reviewers were also very complimentary about our ability to attract research funds describing the School as "very successful in fundraising over recent years" and "this recent funding record is very impressive by international standards within this subject area". However, they do comment that our access to national funding is likely to be reduced because of the current economic situation. This observation had already been recognised by our School Research Committee during the process of drawing up a detailed database of all grants obtained since the year 2000. It should also be noted that the sources of funding that members of the School have accessed are extremely diverse and include basic science, biomedical and environmental research bodies. This lack of reliance on one or two particular funding bodies is undoubtedly advantageous in the present economic climate. We would like to have more support from the College's research office in proposal development and information on funding sources than is currently offered – perhaps with a member of staff partially seconded to help us in that regard.

The reviewers sought greater detail on our links with the business community and commented that policy-related research could be increased. Links with the business community undoubtedly exist, such as the Construction Industry, Petroleum, Pharmaceutical and Biotechnological companies and these provide some research funding to our School and we are actively forging links where these are appropriate. We are a little surprised by, indeed would disagree with, the comment about policy-related

research as we would contend that a large proportion of our research is policy-relevant and has significant impacts on various policies at local, national and EU level. Perhaps the issue is one of increasing the visibility of this work which we are currently attempting to improve in a variety of ways. Examples would include research on water quality, waste management, environmental and climate change, biodiversity, environmental governance, urban development, development and sustainability and infection and disease.

The reviewers comment upon the poor quality of much of the School's laboratory space and the limitation this places upon our research activities. We are entirely in agreement with this view and are actively engaged in discussion of the development of shared and enhanced research facilities for our key congruent research themes: new facilities are essential for our School's development.

The reviewers acknowledge the significant increase in the numbers of research students in all disciplines over the last five years. They also note that these students are completing on time and publishing their work. This provides evidence that our postgraduate steering committee structure (that guides and supports our postgraduate students through their research degree) is working well. The reviewers note that postgraduate supervision is good but that some supervisors may be overcommitted with teaching and administration. Some assessment of the relative commitments of individual staff might help to ameliorate this situation. However, the reviewers state that postgraduate numbers are unlikely to increase unless new staff members are recruited or existing staff can reduce some of their other activities (see pg teaching section).

The reviewers state that the School is a 'natural flag-bearer for development of an institute within the topic of transport, energy and environment.' At present we believe that we require to further develop the School's currently existing Centre for Biodiversity and Sustainability (and Centre for the Environment) as an essential first-step on the route to creating an institute. This demands resouce input from the College in terms of space and pump-priming (again something suggested by the reviewers) and we welcome this suggestion and the School's Research Committee have begun to consider how best this might be achieved as a concrete proposal is required.

The reviewers conclude that the School is undoubtedly highly active in research with impressive numbers of postgraduate students, grants and publications. What they identify as lacking is time for strategic thinking concerning our research direction and focus and perhaps a lower than ideal visibility of the work that is occurring. This is not particularly surprising given the challenges of creating a multidisciplinary school with very broad research interests and a staff who have comparatively high teaching loads and administrative burdens. The Research Committee has been working to enhance the profile of the School both internally and externally and to develop research themes that cross the disciplines and foster synergy and critical mass and we have recently made significant progress in increasing the visibility of our activities. The reviewers identify the Research Committee as a forum for strategy development and we agree that it is the most appropriate body for such activity within the School. Our recent away-day has allowed the School to work through proposals from the School's Research Committee and identify a single overarching research theme, 'Biodiversity and the Environment', to act as a strategic pillar of research endeavour for the School and to which all disciplines in the School can contribute.

The review also points out that there appears to be a disconnect between the College's Research Committee and that of the School (all Schools in fact) as the Director of Research of the School does not sit on the College Research committee – this policy, therefore, may bear reexamination.

Teaching and Learning

In general, in terms of teaching and learning, we are glad that the reviewers recognised that 'the standards of teaching and learning in the School are generally high' and that the students are 'well satisfied'. The reviewer's comments on teaching and learning are spread across sections and for convenience we have grouped them together under the undergraduate and postgraduate headings which mirrors the layout of our self-assessment.

A. Undergraduate teaching and learning

The format of the questionnaire which the reviewers were given by College asked about teaching and learning in 'this academic discipline', rather than 'this School'. We feel it is important to keep in mind that the School is not a discipline but a group of four distinct academic disciplines which have areas of common interest, particularly in the broad realm of environmental issues and natural history.

We are delighted that the reviewers found a high level of satisfaction among undergraduate students and staff in the School with regard to standards of teaching. We aim to continue to deliver our undergraduate programmes, and maintain the current quality, as we have done hitherto. However, the review has highlighted a number of issues which need to be addressed if we are to keep up our present standards.

The reviewers acknowledge the value to students of having a home base within a discipline; a feature currently fulfilled by the disciplines for certain moderatorships. We are aware that under the current structure, students following inter-disciplinary moderatorships (Environmental Science, Earth Science, Geography and Political Science) lack such a home base, and we are actively seeking ways of providing such students (and students who will be registered for other interdisciplinary degrees in future) with a strong sense of 'belonging' within their chosen degree programme. Initatives such as group tutorials, seminars and field trips will be expanded under the guidance of the course director.

The reviewers observed that, in comparison with other universities, teaching loads appear to be heavy. Student workloads and contact hours have remained largely unchanged for the past 30 or 40 years, but steady increases in student numbers have significantly reduced the staff-student ratio. Junior academic staff in particular are under enormous pressure to develop their research while coping with considerable teaching loads. Thus, we will try to find more effective ways of teaching, so that the benefits of small class sizes are not lost, and academic staff can retain time and space to pursue their research interests, their involvement with society, and their contributions to College. We will explore the increased use of lecturers from outside, post docs, graduate students and even undergraduate students themselves in maintaining and improving the broad educational experience as well as the use of e-learning / on-line resources as necessary and when appropriate. However, we do not endorse the reviewers' suggestion that staff might be divided into those who are primarily teachers and those who are

effectively full-time researchers, because this idea runs counter to the concept of 'research-led teaching'.

The reviewers recommend the implementation of a workload model to help ensure a fair distribution of labour. Teaching and administrative duties are largely allocated by the Head of Discipline in collaboration with the staff in the discipline. These duties are agreed by consent, and in a spirit of common purpose for the good of the discipline and of academic goals in general. Nevertheless, bearing in mind that consent may not always work, we have agreed to explore ways in which an academic's aggregated teaching, supervision, research, administration, and other commitments can be assessed in a helpful and pragmatic way, so that fair workloads can be seen to be carried by all.

The review did not mention the TR071 Science (Common Entry) programme. We suspect this was an oversight. The School reiterates its very strong support for this programme in which the majority of our students are registered. TR071 Science provides a broad training in several science subjects in freshman years, followed by specialist training in a single discipline (or in an interdisciplinary setting) at moderatorship level. Thus it is educationally robust and also highly attractive to school leavers applying to Trinity. In addition the reviewers comment that certain of the moderatorships in the School are likely to be oversubscribed due to increased interest or the development of new programmes – these include Geography, Geology and Zoology. As the other moderatorships in the School are all also at or close to quota, and given their comments on reductions in teaching loads, we have little room for further development with our current resources.

The review notes that timetabling is a potential problem in the School and they are correct: it is a significant impediment to increased co-operation across programmes / disciplines. However, many aspects of it are beyond the School's control. School staff lecture to students in programmes outside the School, and students attend lectures given by staff from other Schools. Geography has TSM students taking a number of different second subjects, so its lecture slots are completely inflexible. The Science Course Office prepares the timetable used by the School for freshman teaching in biology, geography, earth sciences and geology. In effect, therefore, the School is left to fit the sophister teaching into the remaining slots. Here, the critical issue is finding times for shared modules, and this clearly requires early intervention by the directors of interdisciplinary programmes. We are currently looking at the most effective way of ensuring that the timetable will continue to work, and of entering the large volume of data onto the CMIS system now that students have to be registered for each separate module they take.

B. Postgraduate Teaching and Learning

In terms of M.Sc. teaching the reviewers note the success of the established courses and underline the two issues identified in the self-assessment document:

1) A limitation on resources (facilities and staff) to allow development of the courses. This is brought about by the financial model where, although the courses are of great financial benefit to the School, there is limited freedom to re-invest the benefit. Engaging more of the existing staff in the Masters programmes is somewhat problematic, but has begun. Recently, it has been agreed by the School that Masters programmes are as central to the activities of the School as are the undergraduate moderatorships. Nevertheless, aspects of some of the programmes themselves remain peripheral to the interests of some

staff. All courses are under threat of survival if they are not properly resourced and this probably applies to masters courses more than undergraduate ones. This situation is even more critical than expressed by the reviewers.

2) Distribution of teaching across staff members. For our response to this see the comments in the Undergraduate Teaching and Learning section (above).

The majority of recommendations made by the reviewers relate to these two issues. For example they suggest bringing in expertise from outside to teach on the courses but this would require a financial model that allows flexible deployment of resources.
It is suggested that duplication of modules in M.Sc. courses could be diminished through joint interdisciplinary planning. It is unclear what is meant here. The two established courses are fully integrated and share several modules with no duplication. The co-ordinator of the new course inherited a set of proposed modules from the course proposers. There have been some difficulties delivering all modules on the new course but the course co-ordinator has been encouraged to discuss with the co-ordinators of other courses to rationalise as much as possible in terms of module sharing - this process is ongoing during this first year of the course.

References are made to the development of a School wide M.Sc. programme that would include specialisations across the School. There has been a large increase in taught M.Sc. programmes on offer in the School since its establishment with the addition of 3 new M.Sc. courses, 2 in the last 2 years. While these courses are a very positive addition they have placed considerable strain on staff, particularly academic staff. The School therefore cannot consider further expansion until resource and staffing issues have been resolved. Recent recommendations however, approved by the Graduate Studies Committee, with a view to increasing the flexibility of taught postgraduate courses, including the concept of mix and match Masters across modules, might allow the development of inclusive programmes in the future without the demands of developing new courses if current staff loads and timetabling constraints are addressed.

An additional comment from M.Sc. students draws attention to mixed background and capabilities of students. The other side of this coin however is the great diversity of individual experience that the study body brings and was an aspect commented on very positively by the students, reported by the external examiners. While the mixed capabilities will bring different challenges to the students and challenges to the teachers, we suggest that the good success rate on the class shows that these are challenges that are being met successfully.

Postgraduate Research and Scholarly activity

The review document comments on the high numbers of research students, high quality of research supervision and good completion rates within the School. A number of recommendations relevant to postgraduate research are made. The reviewers suggest that the School:

1) Produce fewer publications of higher impact

See under Research section above.

2) Identifies new sources of funding

The self-assessment document recognised the major challenge of maintaining our research student numbers in the current research funding climate. We certainly face a

downturn in funding to support students but the broad range of research areas in the School and the enormous range of current funding sources identified in the self assessment document puts us in a less vulnerable position than some Science areas. However we fully recognise the need to seek new sources of support.

3) Improves the physical infrastructure

Some laboratories and facilities have been refurbished but some areas of the School infrastructure are severely lacking. This issue is prominent in discussion and planning for physical integration of the School. This will require significant investment by the College.

4) More School-wide activities

In extensive discussions during the reviewers visit it was pointed out that integration across the disciplines has proceeded relatively slowly at some levels. There is a combination of reasons for this including the need for a period of readjustment but also a desire to maintain aspects of existing structures that work well while harmonising activities across the School. The diversity of areas of research interest across the School makes it unwise to attempt to oversimplify the grouping of activities in a way that is not useful from the point of view of synergy. With regard to postgraduate education discussions between postgraduate discipline representatives (on the PG T and L Committee) and with student representatives from each Discipline have focussed on increasing integration. While all agree that there would be benefits from increased integration in some areas, all parties (including the students) are cautious about a forced integration which does not bring synergy. A number of initiatives are currently under development including a student web based forum and a School wide Postgraduate event where students across the School will present their research and interact around the focus of invited external speakers. In addition, we have recently agreed to integrate the currently separate discipline-based research seminar series such that they reflect our research themes and will continue, therefore, to encourage the initiative taken by the PG 'Ecology Forum'.

In addition, the document mentions that some students feel that some supervisors are overburdened and that they would value more direction. The reviewers suggest that a more even spread of students amongst staff could improve this situation. While a small number of staff have a high number of students, the vast majority of staff have between 2 and 4 students. While an even spread is desirable, we do not agree that targets and limits should be set as different types of research activities across the School require different levels of input from the supervisor *e.g.* highly technical laboratory research compared to largely self conducted paper based research. Our students have a number of sources of support in addition to their supervisor where they can express any concerns about the level of supervision they receive; *e.g.* steering committees, Discipline postgraduate co-ordinators and Director of Postgraduate Teaching and Learning. Several students already have co-supervisors and this trend is now encouraged and increasing within the School.

The document also refers to responses to student concerns being less obvious at School level. It is not clear what is meant by this as the Discipline and School level structures are very much integrated: Discipline co-ordinators make up the School Postgraduate Teaching and Learning Committee that discusses and makes recommendations on

support and quality control structures. The students see this operating at a Discipline level but it is overseen and co-ordinated at a School level.

Service to College and Society

We note that the reviewers believe that the service of the School's staff to College is possibly too high, but believe that this reflects the highly Collegiate nature of the School's staff and, as the reviewers themselves point out, the fact that the College's structures remain overly complex requiring excess service. We are supportive of the idea that College review its committee structures with a view to streamlining them – whilst acknowledging that this has only recently been undertaken. We are in the process of reviewing our School's committee structures at the moment to see if we can simplify their operation.

Resources

A. Staff

The recognition that the School has a 'very high quality staff responsible for a wide range of disciplines' and that we need to 'focus on our strengths' is a welcome pointer but does not take into account the necessity to service a large series of distinct moderatorships. The suggestion that centralisation of Administrative and Technical staff be undertaken is predicated on the basis that the School occupies a single (or at least fewer) congruent, contiguous space. We believe that this is not feasible at present as the School is scattered over a large number of separate buildings. Nevertheless, some movement in this regard – for example increased co-operation and flexibility is possible but depends on College or Faculty wide agreements being reached and reporting lines being changed. We have recently agreed to set up a technical staff forum wherein all technical staff will be able to examine, amongst other issues, options for the delivery and provision of technical services in the future.

B. Physical

We believe that the reviewers recognition that 'the self-assessment document is thorough and tinged with constructive optimism' but 'also highlights the severe burdens placed on the School by previous financial deficits' which 'have hindered development and reward for successful new initiatives' is accurate.

We are particularly struck by the reviewers belief that the physical infrastructure of the School is 'not very good and urgently needs to be improved' and it well summarises our School's view on our physical resources. We fully accept their recommendation that 'a new home for the School is a priority as most laboratories and lecture rooms are too small and too old for further internationally-competitive Science'. In addition, we require dedicated administrative space for the School Office. Whilst we acknowledge that some progress in these regards is indicated as likely by the Faculty and College we do not believe that the current proposed phasing of the 'East-end complex' will allow for any really substantive change in the quality of most of our School's space before the next quality review is due. More urgent action by the College is needed than is so far proposed. The deficit in terms of teaching, research and office space is acute and imaginative but acceptable (to the School) alternatives should be looked at. Therefore, the School's Research and Teaching committees will examine and consider all potential options on-campus, will determine whether an immediately adjacent to campus option is worth further exploration and will make recommendations to the School's executive. Throughout this process, we will, as a collegiate School, bear in mind not only our own

needs but also the integrated nature of teaching and learning in the University which could be damaged beyond retrieval by piece-meal action.

The reviewers also point out that the costing of all space as of equal value (under ARAM and RPM) is unhelpful to Schools such as Natural Sciences, where large segments of the space are of very low quality or which, by definition, cannot be equipped to the same standard as laboratory space (*e.g.* greenhouses). This also requires action on the part of the College.

Organisational Structures and Planning

We accept the comments in the report that our School's 'administrative structures are rather complex and traditional' and 'could be simplified'. We also accept their argument that the number of administrative levels (in the University) could be reduced and that the influence of the disciplines and 'perhaps faculties' could be reduced – in other words that the role of the Schools be strengthened. The suggestion that some of the committees 'could be made smaller' within the School is also welcome and we believe that decision-making could be expedited, without loss of Collegiality if the School Executive Committee were to be made smaller. To this end we have proposed that Heads of Discipline step aside from the School Executive Committee. To ensure that information flow and decision making is not impeded they will meet as frequently as they desire with their representatives on the three relevant School committees or can themselves sit on them. In addition, they will meet prior to the School Executive Committee meeting with the Head of School and School Administrator to allow their collective views to be effectively fed through their representative. This will replace the meetings they now have with the Head of School thereby freeing-up some time for all concerned.

The suggestion that the School become a cost centre is also welcome and would make a number of things easier to manage. For example, it is currently impossible to set-up self-financing activities under the heading of the School to allow for interdisciplinary Masters teaching – such activities having to be rooted within a discipline. So, whilst the breakdown of financial information by discipline is sometimes useful from a management point-of-view whilst disciplines persist as cost-centres, it is also a constraining straight-jacket for further development of integrated, School activities. An immediate implementation of the School as the cost-centre is, however, constrained by insufficient resources at School level.

We believe that communication is working as well as it is possible to make it at all the major levels in the School and do not accept that there is much more that can be realistically done to improve communication beyond what has already been achieved given current time pressures on staff. So, for example, the School has initiated away-days, now has a 'GET' folder accessible by all staff, has a redesigned web-site where news and information is frequently posted, has frequent meetings to which all staff and students are invited and the Head of School already meets with all groups of staff (academic, administrative and technical) . Nevertheless, the School has produced an electronic newspaper (the first issue has just been circulated). We hope to continue this by producing an issue once a semester, resources permitting.

Timetabling was mentioned by the reviewers and the suggestion made that it be centralised. There may be ways that the process can be further streamlined within the School, though these may require changes in work-practise, but we firmly believe that it

would be better if timetabling were centrally dealt with at Faculty level for a whole variety of reasons not least including the need, now that modularisation has been implemented, to develop clear timetabled module patterns to ameliorate the current situation which has incompatible patterns at all levels (inter-faculty; inter-programme; inter-discipline).

In terms of furthering School structures we will examine what aspects of activity, currently undertaken at discipline level, could be redistributed to School level where such change makes academic and administrative sense. In particular, we have examined the functioning of the three principal committees of the School to identify whether movement of function from the disciplines to one of them can be effected over the next year. Rather than make changes in all areas simultaneously we prefer a stepped approach where we run a test-case to learn if and how such consolidation can work. It is clear that some areas of responsibility are more difficult than others to consolidate because of the physical disposition, amongst other reasons, of the School: this has canalised the decision. We have recently agreed to trial consolidation in the School Office of all postgraduate activities thereby supporting the activities of the Postgraduate Teaching and Learning Committee: we require a small staffing resource from the College to make this succeed. There are constraints on this process and in particular I believe that some investment in personnel resources may be required, as well, possibly, as negotiated redistribution of administrative duties.

Non-School specific recomendations

The reviewers make a number of generalised recommendations that require comment or action by the College, not the School. We draw attention to the following items mentioned in the report:

- The lack of connection between academic planning at School level and strategic planning at College level, especially, the fact that the School's Director of Research does not sit on the College's Research Committee (indeed no School's Director of Research does so by right).

- The restrictions imposed by the ARAM deficit in terms of development (which we believe reflects a generalised requirement for Schools that have brought together what were separate Departments to be treated differently under ARAM and RPM from other Schools which were formed from single large departments).

- Improvement in (and consolidation of) the School's physical infrastructure. We would welcome more rapid movement than is proposed under the College's draft development control plan. This might be achieved in a variety of ways all of which should be considered consensually by the College and the School.

- Examination of the policy of costing all space in the School at the same base-rate (this seems particularly unfair in our case as we have greenhouses which are completely unserviced with no water, light, or heat and which are costed at the same level as our best laboratory space as are our basement areas). We also note with some consternation that proposals in the draft development control plan appear to suggest that the basis for these charges might change (probably increase).

- Improvement in the Management Information Systems infrastructure available to Schools especially in the financial and, we believe, in the student services areas.

- Development of measures to increase collaboration between Schools.

- The necessity for pump-priming funds to be made available for developments (especially important for Schools in ARAM deficit).

- Reduction in the number of administrative layers (may require change in College HR policies).

- The secondment from College's Research Office of a part-time staff member to work directly with the School on proposal development and to provide information (beyond URLs) on funding sources.

The bottom line

- We have already made a number of the changes suggested by the reviewers, for example, we have consolidated our research under a single title or overarching research theme 'Biodiversity and the Environment'.

- We have also devised a specific multi-stage plan of action to try to test the viability of increasing the integration of our dispersed, multidisciplinary School. We emphasise that this must be seen as a test but have expectation that it could be successful. The trick, we believe, is to make changes which do not dismantle or threaten the academic activities of the disciplines whilst making their integration stronger, reducing duplication, simplifying and unifying administrative functions whilst introducing increased flexibility.

  - Stage 1 will deal with the Postgraduate Teaching and Learning Committee's remit. Specifically we wish to integrate the administration of all postgraduate activity within the School Office under a single EO. This has the advantage of removing administration from a number of Academics (freeing up their time), will provide dedicated administrative support to one of the three major committees of the School, will reduce the burden on the School Administrative staff and so will allow, potentially, for flexibility, streamlining and standardising, where desirable, of procedures and record keeping. Specifically, in this regard I request:
    - funding to support an EO position in the School Office for a trial period of 1 year; the EO to be specifically tasked with integrating the various postgraduate taught and research activities and administration of the School.

  - Stages 2 & 3 will develop a similar programme of integration providing administrative support to facilitate the integration and development of the undergraduate and research areas of the School.

  - Stage 4 is more complex and requires considerable planning. It is clear that the current unintegrated financial reporting mechanism is unfortunate and that financial reporting and budgets should be School-based and should not be Discipline-based. For example, currently overheads and some payments go directly to the disciplines and not the School, and nearly all financial information is controlled and reported at discipline level. This is probably pretty efficient given the current dispersed nature of the School. Nevertheless, the School could examine ways of integrating its financial systems (adoption of best and uniform technological solutions for example) subsequent to successful integration of the above areas.

  - Stage 5, next academic year, will use the newly created technical staff forum to examine the delivery and provision of technical services within the School and how these might be realistically realigned to provide at least as good a service as is currently provided and with enhanced career opportunities. A similar type of process is envisaged for the administrative areas of the School.

- Outside of these activities, we have agreed to examine, via the Undergraduate and Postgraduate Teaching and Learning Committees, how to provide a transparent data-set which, though not a workload model per se, will enable academic staff to transparently view their own activity in the School in comparison with that of their colleagues.

- In addition, the School's Research Committee are examining the roles and remits of the School's currently existing Centre for Biodiversity and Sustainability and Centre for the Environment as an essential first-step on the route to creating an institute.

- To effect these changes, thereby allowing efficient development and enhancement of our School's teaching and research and administrative activities I believe that there must be immediate reconsideration of the RPM model to specifically allow for the very different problems posed by Schools which have been formed by aggregation of separate departments and adjustment of the reporting relationships of staff within such Schools to reflect the reality of the existence of Schools.

J. Parnell
Head of School of Natural Sciences 6th May 2010

7. DEAN'S RESPONSE TO THE REVIEW REPORT FOR NATURAL SCIENCES

The Dean welcomes the report of the reviewers, and in particular

- The recognition of the strong research base and dedicated staff, the high achievements and international recognition of many of the staff, and the contributions many have made to a realistic yet ambitious Strategic Research plan for the School.
- The recognition of the impressive research income of > Euro 26 million in last 5 years
- The noting of the impressive number of taught masters and research postgraduates
- The high quality of the Teaching and Learning provided by the School.

The Dean also notes and supports the recommendations of the Reviewers that

- The School would benefit from a new building both in terms of new and appropriate standard of facilities but also through a physical consolidation
- The School would make a strong contribution to a Research Strength of Energy, Environment and Transport, possibly using Sustainability and/or Climate Justice as a key theme. This approach would increase the School's international impact and funding.
- The School would benefit from administrative, technical and organizational consolidation
- Attention should be placed on further improvements on research quality publications, freeing up research time, introduction of a Workload model into School activities, organization of timetabling at school level.
- Forthcoming retirements and increased student quotas make the School very vulnerable
- The School although being very active in both research and teaching, both at undergraduate and postgraduate level, does not benefit well from any Resource Allocation Model.

The Dean notes the hard work of successive School Heads to address over the last 5 years, the issues noted above. Plans for a new building are well advanced and some staff issues have been addressed. Plans are in place to fund/appoint Chairs in 3 of the School's 4 Disciplines, and the need for more staff to support extra student recruitment is recognized. The Dean supports strongly the view that the School should play a large role in a new Research theme and in this regard already supported new staff, a post-graduate research scheme on joint interests with Engineering on Sustainability and Environment, and its central place in Climate Justice.

The Dean has provided some financial support to stimulate organizational change in the School, but this can only be achieved by discussion, consultation, negotiation and thus strong support from College HR.

The Dean also notes the need for decision-making to be done at School level but again this requires attention not only from School and Faculty but also through changes in College HR Policy.

The Dean also notes the comment about the need for more communication to stake-holders at all levels in the School, and intends to address this issue in the coming year beyond using the current channels such as the Faculty Executive, Faculty Forums and Faculty Newsletters.

20th April 2010.