Comments on:
Consultation Paper:
Developing a National Biodiversity and Climate Change Action Plan

Having had a long (and continuing) involvement in studying the impact of Climate Change on Biodiversity (Chapman and Busby 1994, Dexter *et al*. 1995, Chapman and Milne 1998, Chapman 2003a, 2003b, Chapman in prep., etc.), I thought it appropriate that I provide some comments on this Consultation Paper. My past involvement in Climate Change impacts was while as a member of the Environmental Resources Information Network in the Department of Environment and Heritage. As well as carrying out two studies for the Department, one on the impact of climate change on threatened species (Dexter *et al.* 1995) and one on the impact of both threatened and common species in relation to environmental criteria such as vegetation and soils (Chapman and Milne 1998). I was also an advisor on a number of other climate impact studies commissioned by the Greenhouse Office – for example that of Poulequin-Young and Newman (1999). I have also been involved in the development of modelling methodologies for use with climate impact studies and with the use of data and information in these studies (Chapman and Busby 1994, Chapman 1992, 1999, 2002). Since leaving the Department, I have continued working in this area in South America, including working on Climate Change impacts (Chapman 2003a, b, Chapman in prep.), and am co-organising a joint international CODATA (Committee on Data for Science and Technology) /IABIN (Inter American Biodiversity Information Network) meeting on Climate Change impacts on Biodiversity in the Americas to be held in Campinas, Brazil early in 2004. I am also part of a team on a US National Science Foundation Grant looking at the development of predictive tools for modelling vector-borne diseases, including under climate change.

The proposed Action Plan is an important one and one that is likely to set an example for similar reports around the world. The paper has covered many of the issues that need to be covered and asks a number of quite searching (and in many cases, unanswerable) questions. The paper has, however, missed a number of issues. I will make a number of general comments and then specifically address some of the issues that the paper raises. Unfortunately, I have not had the opportunity to read the report by Howden *et al.* (2003), which would appear from the surface, a major background paper. I support most of the conclusions of that paper as far as I am able to determine them, but do have a disagreement with one aspect of that paper which I will elucidate below.

General Comments

Many climate change impact studies have focussed on a global increase in temperature and through GCMs (with a resolution of around 300km) attempted to look at climate change on a more regional level by climate GCM predictions to climate layers at the fine scale. The few detailed biodiversity impact studies available, have then used these, in conjunction with models such as BIOCLIM to study the impact on individual species. Some of these studies have taken a general increase in rainfall for example in an area (maybe 10% increase) and applied these criteria. However, especially for plant species, this may be quite misleading. Many impact

studies indicate that in large parts of Australia, there may be heavier rainfall events at greater intervals. It may be that these greater intervals have a greater impact on the survival of a plant species (i.e. increased dry periods), than either the overall increase in rainfall, or of the individual rainfall events (see also other caveats in Chapman and Milne 1998). These issues need to be taken into account. More recently, work has ensued with the development of Regional Climate Models (RCMs) at a resolution of about 30 km, but soon to be available at around 18km resolution, and these look extremely promising as far as biodiversity impacts are concerned (e.g. Skytus and McKeon 2002).

A second general issue that is often ignored, is how long-lived plant species are likely to respond to climate change. It may be that long-lived tree species (rainforest trees, huon pine, etc.) may very well survive for hundreds of years through quite large changes in the climate, but they may not continue to reproduce and set seed. The rainforest is unlikely to "move", but may gradually become quite senescent and not continue to regenerate. The affects of the climate change may then first be felt along the boundaries and edges, as the rainforest will likely continue to maintain its own microclimate within its interior. It is important, therefore, that such habitats be maintained at a large enough size so as to maintain large, undisturbed interiors, and be protected from edge effects such as roads, clearings, etc.

Often, migration of species is talked about with animals in mind, and the plants are completely ignored. The paper does mention buffer zones, and these could be quite important, especially on the southern and eastern edges of habitat types – southern, because this is where seed generation may have a better chance of surviving as the "suitable" climate moves south, and east, as that is the general direction of prevailing winds which help and support seed dispersal, etc.

Specific Comments

Page 2, first dot point: One other barrier to movement worth mentioning here, especially with plants (but also some animals) is soil types. In the report I did in 1998 (Chapman and Milne 1998), it showed that soil could be an important factor in deciding how a species may respond to climate change. In that report, it was shown that where the suitable climate moved for the Kowari, for example, the substrate (soil) was unlikely to be suitable for the animal to burrow into – being harder, more rocky soil than the sandy soil at its present known locations. Secondly, it was shown for the common, but environmentally very important Mitchell Grass, which is restricted to cracking clays, much of the suitable area under the various climate change scenarios was no longer on the cracking clays. So even if it could physically move to the new areas of suitable climate, the soil was not suitable in those areas.

Page 2, additional dot point. It is worth adding an additional dot-point into this area on the effects of heavier rainfall events with longer periods in between those events. This is a common scenario predicted under climate change for many areas of Australia. These longer dry periods will likely increase the problems due to drought and salinity, and increase the frequency and intensity of fire. These longer dry periods could be one of the most important factors with respect to the survival of many endangered plant species and habitats under climate change. The heavier rainfall

events could also have detrimental affects on riverine vegetation (due to increased flooding) and to near-coastal and estuarine species due to increased siltation.

Page 3, second paragraph. In the fourth line down it mentions "rainforest species" where this paper concentrated on rainforest vertebrates as mentioned further down. This should be altered in any future versions as is misleading. These figures do not necessarily apply to "all rainforest species".

Page 6 on Possible Structure and Indicative Content. Under Key Strategies 3. The Greenhouse Office commissioned one of the most important studies conducted anywhere in the World to date on the impact of climate change on Biodiversity. It is important that the results of that report be published, as it is important to researchers to build on, and important for others to be aware of. The report has been cited a number of times (e.g. Pittock and Wratt 2001), and other researches (in Australia and elsewhere) would like to have access to it, and be able to use it and cite it. It is quite a tragedy that this report – and I refer to the Poulequin-Young and Newman (1999) report has not yet been published. I understand that Odile Poulequin-Young was asked to make some changes to bring it up to date. But, as GCMs had changed since the completion of the report, these changes were unreasonable. I urge DEH and the Greenhouse to publish this report as soon as possible and to make it available to researchers. It is a very important work. See also comments under Question 19, below.

Page 8 – Theme 1.2. It is worth adding an extra point in this area on diseases. A lot of work has been conducted around the world on the possible increase in human diseases such as Malaria, Nile Virus, Chagas disease, etc. [I can supply references if required] but less on the possible impact of plant and animal diseases such as Phytophthora, chytrid fungus, etc. Some mention should be made of these, and early warning systems and methods for combating these diseases developed.

Page 8, Question 5. For modelling the effects of climate change on species, the type of data required are current locations (data from museums and herbaria as well as survey and observational data), with latitudes and longitudes. In addition a good DEM (available in Australia already), and well developed Regional Climate Models (RCMs). These later will need to be constantly updated as new information becomes available. With this information, good climate change modelling at the species level can take place.

Page 8 Question 6. The answer is yes – see my answer to Question 5, and as evidenced by studies already carried out (Dexter *et al.* 1994, Chapman and Milne 1998, Poulequin-Young and Newman 1999, etc.). Since these reports were done (all using GCMs), new GCMs have been produced along with much finer RCMs (currently at between 30 km and 75 km resolution, but likely to be available at between 15 and 20 km shortly (UK Met. Office 2003) – although a 15km resolution may already be available for Australia (Skytus and McKeon 2002)).

Page 10 Theme 2.1. I believe more emphasis needs to be put on Buffer Zones (as mentioned above), and also the need to look at the maintaining undisturbed, as far as possible, large areas of single habitat to allow for maintenance of possible micro-climate within them, for example in rainforests etc. (see comments above).

Page 10 Question 9. Apart from those mentioned in the paper, I would add soil type (see comments above - page 2, first dot point), wind direction and strength (for seed dispersal), etc.

Page 10 Question 12. Through impact studies such as those mentioned in this paper by Bennett *et al.* (1991), Dexter et al. (1994), Brereton *et al.* (1995), Chapman and Milne (1998), Poulequin-Young and Newman (1999) and many others both completed and on-going (there are a number of smaller ones concentrating on individual species) These reports already give a good start, and similar studies need to be encouraged.

Page 11, Theme 2.2. In the area of Removing impediments to migration and dispersal … etc., care must also be taken here to not make it too easy for weeds to take over and dominate, as these will be early colonisers, and likely to cause major problems to native species survival, migration and dispersal.

Page 12 Theme 3.1. In the second dot point, there are many modelling tools other than BIOCLIM – some better than BIOCLIM in some circumstances. It depends on what you are trying to model on what type of model one uses. BIOCLIM is just one of many. BIOCLIM is extremely good where there are low numbers of records such as with endangered species, but all models have their strengths and weaknesses (Chapman in prep.)

Page 12 Theme 3.1 under Explanation. "There would be a significant advantage in a centralised data repository". This is where I take issue with Howden *et al.* (2003). I don't know of any strong arguments for centralising data repositories at this stage of technology development. Organisations around the world are now pushing for and adopting distributed technologies for seamless data interchange. It is far better that the data be maintained and kept current by the data owners/custodians, and made available dynamically through systems such as Australia's Virtual Herbarium (http://www.cpbr.gov.au/avh/) which links data from nine of Australia's collections and makes the integrated data available, *species*Link (http://splink.cria.org.br/) a distributed Information System in Brazil that integrates biodiversity data from collections around the state of São Paulo, and Species Analyst (http://speciesanalyst.net/) an an online data retrieval system that links data from a number of museums and herbaria around the world. The Global Biodiversity Information Facility (GBIF) is working toward encouraging such distributed technologies, and these are now at a very advanced stage. The Distributed Generic Information Retrieval System (DiGIR 2003), for example, that many of these systems use, allows for information search and retrieval in a simple manner, and is starting to be adopted by many museums and herbaria around the world. Its development is being backed by GBIF and TDWG (Taxonomic Database Working Group). I would strongly disagree with the need for a centralised data repository.

Page 12 Question 14.

a) The answer to this question can be found as examples in papers such as Chapman and Milne (1998), and Poulequin-Young and Newman (1999) and other impact studies.
b) The answer is a definite "Yes" and again this can be seen in the examples already cited.
c) The data needs to be checked for accuracy and validated (Chapman and Busby 1994, Chapman 1992, 1999), but once the data has been checked the reliability, at the scale of modelling that is supported by the RCMs in particular, is quite suitable. I don't believe reliability is an issue with the data at these scales.
d) The ideal scale for modelling of species data, at a large regional to continental level, is about 3-arc minutes (c. 5 km). Any finer than this, especially with historic data, cannot be justified as the average accuracy of herbarium and museum data is, at best, between about 1.5 and 5 km. Any courser, one starts not to be able to adequately delineate niches. For climate-change studies, however, the uncertainties built into climate-change models (GCMs, RCMs) is such that modelling around 10-arc minutes (c. 18 km) is perhaps the best that can be justified. As very few RCMs are at this scale at the moment, the modelling is likely to be coarser than this, however, I would strongly urge that the aim be to carry out climate change modelling at a scale of around 10 arc-minutes. It is worth looking at the results of Skytus and McKeon (2002) who carried out comparisons at a range of scales from about 15km up to GCM scale.

Page 13. Theme 3.3. 4th dot point again advocates establishing a national centralised data repository served through a dedicated web-based clearing-house. I would strongly disagree with this and urge distributed data repository served through a distributed system such as DiGIR (DiGIR 2003) using registry systems such as UDI, and appropriate search and retrieval methods. For example, I would refer you to the CODATA/TDWG Task Group on Access to Biologiocal Collection data (ABCD) (http://bgbm3.bgbm.fu-berlin.de/TDWG/CODATA/default.htm). This system is being supported by GBIF as well as other organizations.

Page 15. Question 17. You have left out here perhaps the most important group of all that needs educating – the Politicians! Without support of the politicians around the world, nothing will happen with climate change – impacts or otherwise. I would nearly add a separate category in the report just for the education of politicians on climate change and climate change impacts – but perhaps that is not a politically wise thing to do!

Page 15, Question 18. One of the most effective mechanisms on climate change impacts is the media. Take for example the BBC in just one week (4-11 August 2003), the following headlines appeared on the BBC on-line service.

- Rising water temperatures have forced Germany to close one nuclear power plant and cut output at two others and technicians doused the Fessenheim nuclear power station near Strasbourg, France, with cold water to prevent it overheating.
- Police in the Ile de France region around Paris lowered speed limits from 50 km/h to 30 km/h because of ozone levels in the capital were 65% above levels considered safe for humans.

- "In all likelihood British Columbians have never lived through a drier forest situation than we are living through this summer" British Columbia Premier Gordon Campbell said.
- Officials in Croatia said the country was suffering the worst drought for 50 years, with its main river, the Sava, at its lowest level for 160 years.
- Slovenian temperatures are at their highest for a century and in Germany a record night-time high was registered on Monday.
- Temperatures in Milan reached a record 38.5C, breaking a previous record set in 1902.
- Following a day that saw London temperatures reaching an all time high of 35.3C.
- The UK had its hottest-ever day on Sunday, 38.1ºC (100.6ºF).
- The German city of Roth in Bavaria reached 40.4ºC (104.7ºF) on Saturday, a new German record.
- France says 11,435 people are now known to have died in a heatwave in the first two weeks of August.
- A British Airways Concorde was forced to stop in Canada to refuel as hot air, and its consequential high pressure, caused the plane to burn more fuel.
- Authorities in Switzerland have reported signs that Alpine ice caps are melting.
- Water levels on the river Danube have dropped to such low levels that the wrecks of Nazi ships sunk in World War II have become visible and traffic along the waterway may need to be stopped.
- Torrential rain and landslides have destroyed the homes of about 1,000 people on the west coast of New Ireland, a tropical island in Papua New Guinea.
- Latest figures show 90% of New South Wales, Australia is in the grip of drought.
- The heat has killed thousands of farm animals in western France, with 30,000 young pigs dead in the Loire region alone.
- In nine out of the past 12 years, average temperatures worldwide have been higher than at any time since records began in the 19th century and it is very likely that the 1990s were the warmest decade for 1,000 years.
- Flooding in the Sudan has been described as the worst in 70 years.
- May was the hottest May on record, June was the third hottest June ever.
- Rainfall records broken in three US States, with extreme rainfall in parts of the USA, Latin America and south-east Asia.

(Chapman 2003b)

If we are to make politicians and the public aware of what impacts are already happening, and what are likely to happen, we need these sorts of issues to be stressed – without at the same time being sensationalist, of course! The Internet is also becoming an ever more important source of information of the public. A properly constructed Web site, or portal, is essential. A place where people can go for information in a "one-stop-shop" manner.

Page 15, Question 19. There needs to be more research on impacts. Also it is important that the research be made public and be publicly accessible to other researchers. I mentioned the Poulequin-Young paper earlier – even if this was just published on a Web site – or submitted to an electronic journal for publication (there are plenty), or made available via CD-Rom – this would be valuable. To commission such a report and then not to make it accessible goes against everything this Action Plan is trying to achieve.

Page 24. Centralised Data Repository – see earlier comments. I am unaware what these significant advantages are likely to be, and I know of many significant

disadvantages of such a centralised repository. The key is to make information freely available and accessible. This is not a technical problem any more, but a political one.

Page 25. In the focus for research, there are a number of studies that are essential to an understanding of how climate change will impact on species. These include the effects of changes in pattern in the climate. For example the effects (as mentioned above) of heavier rainfall events at increasing intervals (i.e. longer dry periods). Also, there needs to be some studies on the effects on long-lived tree species – to what extent will a decrease in seed set affect the overall habitat of a rainforest, for example, when the older trees themselves may continue living for many hundreds of years? How will changing wind patterns affect seed dispersal? Will there be sufficient ocean mixing for heavy rainfall events in coastal areas not to cause a layer of freshwater to remain on the top of the ocean for long periods. This can be especially important in areas inside the Great Barrier Reef where wave action can be quite small and thus reduce ocean mixing. This can have a resultant devastating effect on near-surface coral and on mangrove tree species. What effect will climate change have on the spread of weed species? How can we stop weed invasions in sensitive areas? Etc.

Conclusions

The paper is a very important step, and I wish you every success in getting the Action Plan adopted and implemented. Australia has been at the forefront of Biodiversity Impact studies during the past 15 years, but is rapidly being overtaken with many new studies being carried out in Mexico and Brazil in particular. It is a pity that many of these early groundbreaking studies are not widely available, and are not being used and cited by these other researchers, because they were, and are, important and valuable pieces of research.

I am available for clarification of any issues I have raised.

References

Bennett, S., Brereton, Mansergh, I., Berwick, S. Sandiford, K. and Wellington, C. (1991). *The Potential Effect of the Enhanced Greenhouse Climate Change on Selected Victorian Fauna*, Melbourne: Arthur Rylah Institute Tech. Rep. 123. 224 pp.

Brereton, R., Bennett, S. and Mansergh, I. (1995). Enhanced Greenhouse climate change and its potential effect on selected fauna of south-eastern Australia: a trend analysis. *Biological Conservation* **72:** 339-354.

Chapman, A.D. (1992). Quality Control and Validation of Environmental Resource Data **in** *Data Quality and Standards: Proceedings of a Seminar Organised by the Commonwealth Land Information Forum, Canberra, 5 December 1991*. Canberra: Commonwealth land Information Forum.

Chapman, A.D. (1999). Quality Control and Validation of Point-Sourced Environmental Resource Data pp. 409-418 **in** Lowell, K. and Jaton, A. (eds) *Spatial accuracy assessment: Land information uncertainty in natural resources*. Chelsea, MI: Ann Arbor Press.

Chapman, A.D. (2002). Risk assessment and uncertainty in mapped and modelled distributions of threatened species in Australia pp. 31-40 **in** Hunter, G. & Lowell, K. (eds) *Accuracy 2002 – Proceedings of the 5th International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences*. Melbourne: Melbourne University.

Chapman, A.D. (2003a). *The Case for a 3 minute Climate Surface for South America*. Internal report No.3 to CRIA, May 2003. Campinas, Brazil: CRIA.
Chapman, A.D. (2003b). *The human legacy – reversing the trend.* Chapter xxx in Joly, C. *et al.* (eds). Biota [title to be finalised]. Campinas, Brazil: FAPESP/Biota. [submitted Oct 2003].
Chapman, A.D. (in prep.) *Environmental Modelling – Issues and Ideas*. To be submitted to *CODATA Bull*. 2003.
Chapman, A.D. and Busby, J.R. (1994). Linking plant species information to continental biodiversity inventory, climate and environmental monitoring 177-195 **in** Miller, R.I. (ed.). *Mapping the Diversity of Nature*. London: Chapman and Hall.
Chapman, A.D. and Milne, D.J. (1998). *The Impact of Global Warming on the Distribution of Selected Australian Plant and Animal Species in relation to Soils and Vegetation*. Canberra: Environment Australia.
Dexter, E.D., Chapman, A.D., and Busby, J.R. (1995). *The Impact of Global Warming on the Distribution of Threatened Vertebrates (ANZECC 1991).* Unpublished report to Department of Environment and Heritage. 163 pp.
DiGIR (2003). *Distributed Generic Information Retrieval (DiGIR).* http://digir.net/.
Howden, M. *et al.* (eds.) (2003). *Climate Change Impacts on Biodiversity in Australia. Outcomes of a workshop sponsored by the Biological Diversity Advisory Committee, 1-2 October 2003*. Canberra: Commonwealth of Australia [unseen – as cited in Discussion Paper]
Pittock, B. and Wratt, D. (eds). (2001). Australia and New Zealand **in** McCarthy, J.J., *et al.* (eds). *Climate Change 2001: Impacts, Adaptation and Vulnerability*. Cambridge: Cambridge University Press for Intergovernmental Panel on Climate Change.
Pouliquen-Young, O. and Newman, P. (1999). *The Implications of Climate Change for Land-Based Nature Conservation Strategies*. Final Report 96/1306 [unpublished], Australian Greenhouse Office, Department of Environment and Heritage, Canberra, and Institute for Sustainability and Technology Policy, Murdoch University, Perth, Australia, 91 pp.
Skytus, J. and McKeon, G.M. (2002). Evaluation of Global and Regional Climate Models in simulating spatial and temporal patterns of seasonal rainfall variability in the Australian Region. Chapter Six from McKeon, G.M. and Hall, W.B. (eds). *Final Technical Report, Learning from History: Preventing land and pasture degradation under climate change*. Brisbane: Department of Natural Resources and Mines. http://www.longpaddock.qld.gov.au/AboutUs/Publications/ByType/Reports/GlobalAndRegionalClimateModels/ChapterSixLowResolution.pdf
UK Met. Office. (2002).The Hadley Centre regional climate modelling system. http://www.met-office.gov.uk/research/hadleycentre/pubs/brochures/B2002/precis.pdf

Arthur D. Chapman
Professor Visitante
Centro de Referência em Informação Ambiental (CRIA)
Av. Romeu Tórtima, 388, Barão Geraldo
13084-520 Campinas SP Brazil
phone: +55 19 3288 0466
fax: +55 19 3249-0960
email: biodiv@achapman.org