

Protocols for Moving Germplasm among Countries in Africa

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Abstract

The paper briefly describes the international protocols, codes of practice, and guidelines that have been developed to control the introduction of alien species, with particular reference to genetically modified aquatic organisms. The effectiveness of implementation of these instruments/regulatory measures in southern African countries, with focus on South Africa, is also discussed. Majority of the guidelines and international protocols relating to movement of aquatic alien species and to which the southern African countries are a party have not been followed. Practical measures to address the constraints in implementation of the regulatory measures/national legislations in Africa are suggested.

Introduction

The term “germplasm” is an old word referring to a theory proposed by Weismann in 1886 concerning a “particular kind of protoplasm” found in germ-cells. In the modern context, however, the term is equivalent to “genetic material”, and such material can be transported in a variety of ways including the following:

- (i) within the cells of living, functioning organisms;
- (ii) within *in vitro* tissue cultures; and
- (iii) within “carriers” such as bacterial or viral cells, or in special solutions at low temperatures where DNA, or portions of DNA, may be transported.

It should be noted that protocols and legislation relating to introductions of genetically modified organisms (GMOs) are concerned with the introduction of the actual organisms (as in (i) above) and/or tissue cultures (as in (ii) above), but not with the transfer of genetic material as described in (iii) above, over which there are very few international regulations (Kirby personal communication).

Living organisms, as defined in (i) above, include dormant stages of life cycles (for example, seeds, eggs, pupae). Although the relevant protocols that have been developed to control the spread of organisms beyond their native ranges generally deal with both

plants and animals, the focus of this paper is on aquatic animals.

The issue of controlling the movement of GMOs between countries appears to be a new one. When this is seen within the whole context of the introduction of alien species into regions beyond their native ranges, however, it soon becomes clear that a GMO can be regarded as a special type of “alien species”, and this is how it is dealt with in this paper. One of the chief concerns relating to such introductions revolves around the threat of genetic contamination of indigenous stocks as a result of mating between the imported species or GMOs and indigenous species. The protocols and codes of practice that deal with the movement of GMOs are not usually fundamentally different to those previously in place for the control of importation of alien species, and are often found as a sub-set or addendum to previously-developed protocols. Legislation, as opposed to protocols and codes, that deal with importation of GMOs, however, is often different to that covering the introduction of alien species. Most of the legislation on the release of GMOs into the environment deals mainly with plant material, and does not relate specifically to alien aquatic species.

This paper focuses on international protocols, codes of practice, and guidelines that have been developed to control the introductions of alien species into new regions, particularly those protocols that relate specifically to GMOs

¹ The views of the author, as expressed in this publication, do not necessarily reflect those of the SAIAB.

or include clauses that relate to GMOs. The effectiveness of the implementation of these measures in southern African countries (with particular emphasis on South Africa) is also examined.

Definitions of Terms

Genetically Modified Organisms (GMOs) (Also referred to as living modified organisms or LMOs). There are a number of definitions of GMOs, but for the purpose of this paper the definition proposed by the European Union (CEC 1990) has been adopted: "A GMO is an organism in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination." This definition excludes the products of selective breeding and organisms that have had their chromosome set altered (e.g., Polyploidy).

Alien species. (IUCN definition = non-native, non-indigenous, foreign, exotic): A species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e., outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes, or propagule of such species that might survive and subsequently reproduce.

Established species. (= naturalized species): An introduced species that has established self-sustaining populations in natural or semi-natural habitats. This excludes species that are only found in captivity in artificial environments. In many protocols such as the ICES/EIFAC Code of Practice (Turner 1988; ICES 1995), the assumption is made that all species kept in artificial environments, such as aquaculture facilities, will at some stage have the opportunity to escape into natural habitats, where they may or may not be able to establish self-sustaining populations.

Protocols and Codes of Practice to Regulate the Introduction of Alien Species and GMOs into New Regions

A number of codes of practice and protocols have been developed to deal with the issue of alien species and many of these protocols, for example, the Food and Agricultural Organisation (FAO) Code of Conduct for Responsible Fisheries

(CCRF) (FAO 1995) and the ICES/EIFAC Codes of Practice (Turner 1988; ICES 1995) have been modified to include sections on the transfer of GMOs. The Cartagena Protocol, however, deals more specifically with GMOs. The FAO and other international bodies have also developed a number of technical guidelines that assist in the implementation of the protocols. A summary of the more widely accepted international protocols, codes of practice and technical guidelines is outlined in Table 1.

Most international conventions and proposed codes of practice usually have limited legal status within the signatory countries. They are not regulations, but voluntary systems that can be adopted to address particular problems.

Common themes and principles espoused in many International Codes of Practice relating to the importation of alien species

- * Emphasis on the enactment of suitable recommendations on the setting up of appropriate agencies for the application and enforcement of such legislation. In this respect it is recommended in the IUCN guidelines (website on the Species Survival Commission) that countries should "ensure, wherever possible, the designation of a single authority or agency responsible for the implementation and enforcement of national legislation, with clear powers and functions. In cases where this proves impossible, ensure there is a mechanism to coordinate administrative action in this field, and set up clear powers and responsibilities between the administrators concerned."
- * Emphasis on the importance of setting up a decision-support system, such as the protocols set up by EIFAC/ICES (Turner 1988), to assist legislators in making informed decisions.
- * Since control or eradication of alien species is extremely difficult once populations have been established in natural waters, the emphasis is on prevention of further importations rather than eradication of established populations. The greatest focus is, therefore, on the control of importations of species into countries.
- * Unintentional introductions often involve parasites and the importation of species via

Table 1. Instruments relating to the transfer of alien species and/or GMOs into new regions.

Instrument	Area of emphasis	Comments	References
FAO Code of Conduct for Responsible Fisheries (CCRF)	Sustainable use and conservation of living aquatic resources.	Voluntary code on general issues of responsible fisheries.	Bartley 1998 FAO 1995
ICES/EIFAC Code of Practice on the introduction and transfer of marine organisms	Purposeful introduction of marine (ICES) and inland (EIFAC) species and GMOs.	General code of practice created for developed areas, but is being accepted in principle in developing areas.	Tuner1988 ICES 1995 Bartley 1998
FAO/Sweden Precautionary approach to Fisheries. F1. Technical papers 350/1 and 2.	Precautionary approach to capture fisheries and species introductions.	Defines in a rigorous manner what the precautionary approach means.	FAO 1996 Bartley 1998
Cartegena Protocol on Biosafety (linked to Convention on Biodiversity)	Seeks to protect biological diversity from potential risks posed by LMOs resulting from modern biotechnology.	Notification and assessment procedures including "advanced informed agreement" (AIA) procedure for ensuring that countries are provided with information necessary to make informed decisions before importation of the LMOs.	website*
Convention on Biodiversity	Comprehensive agreement covering many aspects of biodiversity including alien species and GMOs.	Contains biosafety control link to website. Article 8(g) deals with LMOs. Article 8(h) deals with alien species in general. Article 19 directs parties to consider the need and modalities for internationally binding protocols on the safe transfer and handling of LMOs that may have adverse effects on the conservation and sustainable use of biological diversity.	website*
IUCN Guidelines for the prevention of biodiversity loss caused by alien species	Fosters cooperation between countries and recommendations on enactment of domestic legislation.	Links to many other protocols and codes of practice.	website*
International Network on Genetics in Aquaculture (INGA)	To foster regional and international cooperation in aquaculture genetics research.	Facilitates exchange of germplasm while striving for conservation of biodiversity in developing countries.	website*
SADC Protocol on Fisheries	To prevent introduction of species or GMOs into shared aquatic ecosystems.	Ensures neighboring countries are informed of any alien species or GMO introductions.	SADC 2001

* See reference list for website addresses.

ballast water. Prevention of the importation of these species involves measures to treat ballast water, setting up various quarantine measures, and disseminating information to travelers at ports of entry into countries.

* Many agreements, such as the CCRF, make the assumption that imported species, even if kept in semi-captive situations, will have the opportunity to escape into natural waters. Introductions into aquaculture facilities are, therefore, regarded as being essentially the same as introductions into natural waters.

* Since impacts are unpredictable, intentional introductions should be based on the

precautionary approach. Where information is lacking, unreliable or uncertain, caution must be exercised with regard to permitting new introductions. Other implications of the precautionary approach are not agreed upon. It may imply that, unless there is a reasonable likelihood that an introduction will be harmless, it should be treated as likely to be harmful. FAO has tried to define what this approach involves in relation to capture fisheries and species introductions (FAO 1996; Bartley and Minchin 1997). Among other things, the approach implies reversibility of impacts, the establishment of reference points and pre-agreed contingency plans.

- * Invasive alien species (including GMOs) can be regarded as “biological pollution” agents. Part of the regulatory response to introductions should, therefore, be based on the principle that “the polluter pays,” where “pollution” represents the damage to native biological diversity and the “polluter” represents the person or agency involved in the importation. Enforcement should involve appropriate levels of punishment for infringement, payment for initial impact assessment and payment for eradication/mitigation efforts should the alien species have harmful effects on the environment.
- * Introductions should only be permitted if positive effects outweigh the actual and potential adverse effects.
- * Introductions should not be permitted if experience elsewhere indicates that the probable result will be a loss in biological diversity.

Special Features of Protocols dealing with GMOs

In addition to the general principles as outlined above, protocols (or sections of protocols) that deal with the issue of GMO introductions include a number of unique features. Of particular interest is the Cartagena Protocol on Biosafety, which was adopted at the Conference of the Parties to the Convention on Biological Diversity (CBD) in Montreal in January 2000. The Protocol (which adopts the term “Living Modified Organism” in preference to GMO) establishes an Advance Informed Agreement (AIA) procedure to ensure that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory (Bartley 1999). The Protocol also contains reference to a precautionary approach and establishes a “Biosafety Clearing-House” to facilitate the exchange of information on living modified organisms and to assist countries in the implementation of the Protocol (Bartley 1999). The aims of this Protocol are partially outlined in the following statement (extracted from Section 13):

“The objective of this Protocol is to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse

effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on trans-boundary movements.”

Important aspects of this Protocol are outlined in Text Box 1. This indicates that emphasis has been placed on proper notification, transparency, and trans-border cooperation. Of particular interest is Appendix 1 of the Protocol that outlines the detailed requirements associated with the descriptions of the donor and recipient organisms as well as the nucleic acid or other modification introduced, the technique used and the resulting characteristics of the LMO.

Translating International Agreements into Practical, Workable Policies

Information on the relevant legislation and implementation throughout Africa was not readily available. For this reason, this paper has focused on the Southern African Development Community (SADC) countries, with particular emphasis on South Africa, for which information was available.

International conventions and agreements are essentially contracts between different states and they have no legal effect domestically. They only become effective when governments pass relevant domestic legislation to bring such laws into effect. International agreements do, however, have some impact on their own: states that are signatories to such agreements do not normally openly flout them even if the relevant domestic legislation has not yet been enacted. They cannot, however, force their own citizens to abide by international laws until they have passed the relevant domestic legislation (Midgley, personal communication).

Putting various international protocols and agreements into effective use normally involves three phases.

- Phase 1: Country becomes signatory to a particular international agreement.
- Phase 2: Enactment of domestic legislation in accordance with the principles set out in the international agreement. Well-thought-out legislation will make provisions for the establishment of an appropriate enforcement agency and penalties for violations of the law.
- Phase 3: Implementation and enforcement. This relates to the establishment

Text Box 1. Important clauses of the Cartagena Protocol on Biosafety.

Procedures for LMOs developed for domestic use (extract from Article 11)

1. "A party that makes a final decision regarding domestic use, including placing on the market, of a living modified organism that may be subject to trans-boundary movement for direct use as food or feed, or for processing shall, within fifteen days of making that decision, inform the parties through the Biosafety Clearing-House."

Risk assessment (extract from Article 15)

"A risk assessment undertaken pursuant to this Protocol shall be carried out in a scientifically sound manner, ... in order to identify and evaluate the possible adverse effects of living modified organisms on the conservation and sustainable use of biological diversity, taking also into account risks to human health."

"The party of import shall ensure that risk assessments are carried out for decisions taken under Article 10. It may require the exporter to carry out the risk assessment."

"The cost of the risk assessment shall be borne by the notifier if the party of import so requires."

Risk management (extract from Article 17)

1. "The parties shall, taking into account Article 8 (g) of the Convention, establish and maintain appropriate mechanisms, measures and strategies to regulate, manage and control risks identified in the risk assessment provisions of this Protocol associated with the use, handling and trans-boundary movement of living modified organisms."
2. "Measures based on risk assessment shall be imposed to the extent necessary to prevent adverse effects of the living modified organism on the conservation and sustainable use of biological diversity, taking also into account risks to human health, within the territory of the party of import."
3. "Each party shall take appropriate measures to prevent unintentional trans-boundary movements of living modified organisms, including such measures as requiring a risk assessment to be carried out prior to the first release of a living modified organism."

Unintentional trans-boundary movements and emergency measures (extract from Article 17)

1. "Each party shall take appropriate measures to notify affected or potentially affected States, the Biosafety Clearing-House and, where appropriate, relevant international organizations, when it knows of an occurrence under its jurisdiction resulting in a release that leads, or may lead, to an unintentional trans-boundary movement of a living modified organism that is likely to have significant adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health in such States. The notification shall be provided as soon as the party knows of the above situation."
2. "Each party shall, no later than the date of entry into force of this Protocol for it, make available to the Biosafety Clearing-House the relevant details setting out its point of contact for the purposes of receiving notifications under this Article."
4. "Consultation with the affected or potentially affected States to enable them to determine appropriate responses and initiate necessary action, including emergency measures."

Annex I outlines the information that is required in the notifications mentioned under Articles 8, 10 and 13.

Annex III (on Risk assessment) contains further details of the objectives, uses, principles and methodology associated with risk assessment.

and functioning of an appropriate management authority that will be responsible for evaluating proposed introductions. Ideally, if the FAO Code of Conduct for Responsible Fisheries is to be followed, it would also be necessary to appoint independent review panels to carry out the "review and evaluation" using an appropriate decision-support protocol as outlined in Appendix 1.

Effectiveness of enforcement is largely dependent on the quality of the original legislation and on local capacity in terms of funds and the availability of trained personnel with sufficient skills to understand and enact the law. Widespread corruption could also result in a breakdown of enforcement of the law.

Legislation may not, however, always follow the above path. Countries may enact their own legislation without reference to international

agreements, or with only minor references to international agreements. They may also merely pay lip service to international agreements without actually incorporating the major aspects of the agreements into their own legislation. Domestic legislation in various countries, therefore, exhibits various degrees of compliance with the international agreements.

International and Regional Agreements to which SADC Countries are Signatories

The preamble to the SADC Protocol contains references to the FAO Code of Conduct for Responsible Fisheries (CCRF). In addition to this, all 12 member states are signatories to the Convention on Biodiversity (Davies and Wishart 2000).

Regional Agreements: The SADC Protocol on Fisheries records that "a state party shall not introduce exotic species or genetically modified

species into aquatic ecosystems shared by two states including the full extent of the river basin unless the affected state parties agree to the introduction." This protocol has been signed by all member states and contains a reference to the FAO-CCRF.

Implementation of Legislation

It is beyond the scope of this paper to examine legislation in any great detail, but in order to assess problems related to implementation, it would be necessary to consider some of the relevant sections of the legislation.

As noted previously, a GMO can be regarded as a special type of alien species and the management of the introductions of GMOs is dealt with in the same international protocols or in similar protocols as those concerned with alien species as a whole. In South Africa, and probably in most other countries, the legislation concerned with the importation of GMOs is, however, different and under different jurisdiction to that controlling the importation of alien aquatic species. The reason for this relates to the fact that GMO legislation is concerned principally with agricultural crops, and is not really comparable to legislation that is concerned principally with the conservation of freshwater ecosystems. This reflects the fact that there have been very few (if any) requests for the importation of aquatic GMOs into South Africa and this is probably also the case for the rest of Africa (Kirby personal communication).

It is, however, likely that in future there will be some requests for permits for the importation of aquatic GMOs, in which case it may be necessary to adapt existing laws controlling the importation of alien aquatic species. To gain insights into the possible problems that may arise in relation to the implementation of such legislation, it is necessary to examine the way in which existing legislation is implemented.

Legislation Relating to Alien Aquatic Species

The issue of relevant national legislation and its implementation was discussed during an ALCOM meeting on the problems of alien species in the Limpopo River (van der Mheen 1997). A number of nature conservation officials from the four SADC countries that border the Limpopo River (Mozambique, South Africa, Swaziland, and Zimbabwe) participated in the meeting.

Information from van der Mheen (1997) has been summarized in Table 2.

Implementation of laws relating to nature conservation in South Africa is in a state of flux, partly because of the upheavals that followed the reorganization of provincial administration subsequent to changes to the constitution in the 1990s, which has seen the creation of nine provincial authorities from the previous four.

Legislation Relating to GMOs

The only information on legislation that could be obtained relates to legislation in South Africa embodied in the Genetically Modified Organisms Act of 1997. Some sections of this legislation are in Text Box 2. The Act makes clear recommendations concerning the application of the Act and contains many items that deal with the implementation of the Act. There is a great deal of emphasis on transparency, particularly relating to the notification of intention to release GMOs.

Implementation in relation to Alien Aquatic Species

In order to illustrate some of the problems that have been experienced in relation to the enforcement and application of the law, it is worth examining the experiences of nature conservation officials as well as case histories of certain events surrounding the importation of some "controversial" species into southern Africa. Information on the application and implementation of the law is based on the direct experiences of the author as well as through personal communications with the officials in provincial nature conservation departments in South Africa.

Authority relating to the issuing of permits rests with provincial conservation departments, but is ultimately under the authority of the Department of Plant and Quality Control (within the Department of Agriculture) which normally provides some policy guidelines to provincial conservation departments. The situation regarding the control of the provincial nature conservation Departments is, however, extremely complex. At a national level these departments fall under the Department of Environment Affairs and Tourism, but at a provincial level, they are aligned to a variety of different provincial departments. Although provincial authorities issue permits,

Table 2. Legislation/regulations in certain SADC countries that border the Limpopo River that contain clauses of some relevance to the importation of alien species, as well as extracts from the relevant legislation and the government departments responsible for administering such legislation¹.

Country	Relevant government departments (main department that controls importation of alien species and subsidiary departments).	Relevant legislation/regulations/policies and relevant sections of acts.
Botswana	Main department: Ministry of Agriculture. Subsidiary departments: Department of Water Affairs (Ministry of Public Works and Housing); Ministry of Commerce and Industry.	Fish Protection Act: "The Minister may make regulations which shall apply to such areas as are specified therein, providing for the more effectual control, protection and improvement of fish, and the government and management of any specified area in which fishing may be carried on, and without prejudice to the generality of the foregoing for all or any part of the following purposes ... (g) prohibiting, restricting or regulating the bringing into Botswana of live fish; (h) prohibiting, restricting or regulating the transfer within Botswana of any live fish."
Mozambique	Main department: Department of Water Affairs (Ministry of Public Works and Housing). Subsidiary department: Ministry of Agriculture and Fisheries. Related instruments/committees: National Water Council.	National Water Policy, but no clear legislation specifically on alien introductions. Present legislation (from 1960) states: "The Secretary of State for Fisheries, in co-ordination with the Ministry of Agriculture, should determine necessary measures for the development of agriculture, namely: (b) rules required for the introduction of new species. The Secretary of State for Fisheries can define measures to conserve the fisheries resources, namely: (c) adopt any conservation measures necessary for the preservation of fish resources."
South Africa	Department of Water Affairs and Forestry and subsidiary Institutes (such as Institute for Water Quality Studies); Department of Agriculture and subsidiaries (Department of Plant and Quality Control); Provincial Departments of Nature Conservation (subsidiary to Department of Environment Affairs and Tourism, but under control of a number of different departments in different provinces). Important Committees/Programs: NACC ² and NAEBP ³ .	Department of Plant and Quality Control (subsidiary of Department of Agriculture) responsible for issuing permits for importation of alien species. Provincial Department of Nature Conservation responsible for application and enforcement of law. Legislation complex and presently in a state of flux, but government produced a white paper on "The Conservation and Sustainable use of South Africa's Biological Diversity" ⁴ that contains clauses relating to the importation of alien species. It is expected that improved legislation will follow from this document. The NACC has produced prohibited and approved lists of alien species for importation and a number of guidelines have been developed concerning stocking of particular groups of alien aquatic species (for example bass, trout, carp and other species). NACC has, however, now been disbanded (see comment in main text of this paper).
Zimbabwe	Main department: Department of National Parks and Wildlife Management (Ministry of Environment and Tourism). Subsidiary departments: Department of Water Resources (Ministry of Energy and Water Resources Development); Department of Natural Resources (Ministry of Environment and Tourism)	Introduction and transfer of fish (National Parks & Wildlife Act of 1975): "No person shall (a) without reasonable excuse, the proof whereof lies on him, introduce into any waters any species of fish or any aquatic plant which is not native to such water or (b) import any live fish or ova of any fish except in terms of a permit issued in terms of Section 83."

¹ (from van der Mheen, 1997 and Angliss, Coke, Engelbrecht, Impson and Kruger personal communication).

² NACC - National Aquatic Conservation Committee.

³ NAEBP - National Aquatic Ecosystem Biomonitoring Program

⁴ See comment elsewhere (in Text Box 2) and the relevant sections of this white paper.

they normally receive policy guidelines from the central authority.

The National Aquatic Conservation Committee (NACC) comprising of representatives from all provincial conservation departments was initiated in 1995 with the objective to provide policy guidelines, particularly with regard to

the granting of permits. This resulted in the compilation of Prohibited and Approved Lists (which related mainly to ornamental species and aquaculture species). Policy guidelines were also developed concerning the stocking of certain groups of fish (for example grass carp) in natural waters. This was an ad hoc committee that did not make use of any protocols or codes of practice,

Text Box 2. Features of the South African Genetically Modified Organisms Act that deals with implementation of the law.

The following items of this Act have specific recommendations concerning application of the law (only headings and brief description given below):

3. Setting up an Executive Council of Genetically Modified Organisms.
4. Objectives of the Council.
5. Powers and duties of the Council. This section outlines the procedure involved in applications for permits, assessment of permits, registration of the application, decision process by the committee, and conditions of notification (ensuring some degree of transparency relating to the decisions of the committee).
7. Meetings of the Council (Item 7) outlining times when meetings should be called.
8. Appointment of a registrar (Item 8) that is charged with the administration of the Act.
9. Functions of the registrar (Item 9).
10. Setting up an advisory Committee "which shall consist of not more than ten persons appointed by the Minister after the recommendation of the council... of whom –
 - (a) not more than eight members shall be knowledgeable persons in those fields of science applicable to the development and release of genetically modified organisms;
 - (b) two persons shall be from the public sector and shall have knowledge of ecological matters and genetically modified organisms."
11. Functions of the Committee.
12. Funding.
13. Conflict of Interest.
14. Prohibition of Activities concerning genetically modified organisms.
15. Inspectors.
16. Routine inspections by inspectors.
17. Determination of risks and liability.
18. Confidentiality.
19. Appeals.
20. Regulations.

but drew on the expertise of various academics and conservation personnel.

In 1998 NACC meetings and consequently the committee was disbanded (Coke, personal communication) as the provincial departments could no longer afford to pay for the costs of attendance. The feeling amongst the nature conservation officials is that the NACC served an important function and that there is a great need for policy guidance from the central government. In spite of this, some of the officials felt that the law was functioning reasonably well, but felt that there was room for improvement.

Case History: Alien Freshwater Crayfish in Southern Africa

There has been considerable pressure from various aquaculturists to permit the importation of various species of freshwater crayfish into southern Africa. During the early 1990s, permits were granted to allow the importation of certain species of *Cherax* into the former Orange Free State Province (OFS). Following a consultancy to examine the potential impact of these species on natural waters (de Moor and James 1993), the former Transvaal Province prohibited the importation of such species. The OFS then attempted to revise the conditions under which the crayfish were to be kept in captivity in the

aquaculture facility where they had been permitted. This caused a great deal of controversy amongst aquaculturists, particularly from the person who had been granted the permit to import the crayfish into the OFS. Following this controversy, the Department of Agriculture commissioned a second, more comprehensive, literature review on the potential impact of a number of alien species of crayfish (*Cherax tenuimanus*, *C. quadricarinatus*, *C. albidus*, *C. destructor*, *C. esculus* and *Procambarus clarkii*) (de Moor and Holden 1997). The applicant for the permit was responsible for paying for the first evaluation whereas the Department of Agriculture was responsible for the second.

Since 1997, there have been numerous requests from various aquaculturists for permits to import alien crayfish, particularly *C. quadricarinatus*. The Department of Agriculture has, however, kept the report of de Moor and Holden confidential and has not issued any policy guidelines to provincial nature conservation departments regarding the importation of these species. (Note that, with the exception of *C. tenuimanus*, the importation of all these species was previously not allowed). In the absence of any further directives from central government, most provincial departments have, based on their own information-gathering processes, decided not to allow the importation of this species. The lack of coherence in policy and

the confidentiality surrounding the de Moor and Holden report has, however, raised protests from conservation-related NGOs, such as the Wildlife and Environment Society of South Africa (Rogers 2000; Cooper personal communication) that are opposed to the introduction of alien freshwater crayfish, as well as from a group of freshwater ecologists who voiced their opposition to the importations (Cambray et al. 1999).

During the 1990s, an import permit for the cultivation of *C. quadricarinatus* was, however, granted by the Swaziland government and an aquaculture facility was set up near the Sand River Dam (Komati River, Crocodile tributary of the Nkomati System) very close to the Mpumalanga border. In spite of the fact that this species was still prohibited in all South African provinces, culture of this species was promoted by the importer (Copeland 1999). Subsequently the importer has abandoned his aquaculture farm in Swaziland and crayfish have escaped into the Sand River dam where they are reported to be spreading into neighboring irrigation canals (Engelbrecht personal communication). There are also unconfirmed reports that another species of freshwater crayfish (*Procambarus clarkii*) that is also banned in South Africa has also been found in the region, and it is suspected that this may have escaped from one of the aquaculture farms. It is not certain whether the aquaculturist had a valid permit to keep *P. clarkii* in Swaziland.

In relation to the above, it is clear that many of the guidelines and international protocols (such as the CCRF) to which SADC countries are a party, have not been followed, and it is worth noting the following aspects of this case study:

- Transvaal Department of Nature Conservation had intended to adopt the “polluter pays” principle, but there are problems in implementation, particularly in cases where the “polluter” has to pay consultants directly. There is clearly a need for a central agency to manage funds (as is the case for the implementation of GMO-related legislation described below).
- The lack of transparency in relation to the publication of a report (de Moor and Holden 1997) that was commissioned by a government department and paid for with public funds. Applicants for importation permits have complained of the lack of transparency as reasons why permits are not usually given (Kirby personal communication).

- Evaluation process was not followed up by a decision-making process (as recommended in the CCRF, espoused in the SADC Protocol on Fisheries).
- Lack of coherence in relation to implementation between different provinces within South Africa (the former Transvaal and Orange Free State) and between neighboring states (South Africa and Swaziland).
- Lack of policy guidelines from a central authority regarding the granting of permits.
- Lack of notification, particularly between different countries despite the fact that this species was prohibited in South Africa and was placed in a communal watercourse close to the borders of the two countries.
- Lack of coherence between different sectors of the scientific community. An alien species that was prohibited for importation was actively promoted as a “desirable” species at an aquaculture conference.

An examination (Table 2), suggests that in the four SADC countries bordering the Limpopo River, the issuing of permits for the importation of alien species does not follow any specific protocols and is probably done on an *ad hoc* basis, at the discretion of the minister (who is advised by various experts).

Implementation in Relation to GMOs

Unlike the legislation relating to the importation of alien aquatic species (Table 2), the legislation relating to the importation of GMOs in South Africa has a number of specific directions regarding the application of the law (see Text Box 2):

- assigning a “registrar” who is charged with the administration of the Act;
- setting up of an advisory committee, including directions concerning the composition of such a committee; and
- high degree of transparency regarding notification of intention to release a GMO.

In many ways the implementation of the GMO legislation functions well, particularly in relation to the following aspects (Prof. Kirby personal communication):

- payment for evaluation is borne by the applicants via a fee that is paid to the registrar who then administers the evaluation process; and

- the registrar appoints various people (particularly those on the advisory committee) to assist in assessing the evaluations submitted.

Costs are kept at a minimum with evaluation being largely carried out by the advisory committee that is paid a fee by the registrar. However, there has been some criticism regarding the implementation of the law. Procedures relating to notification were not carried out strictly in accordance with the law and it was felt that there should have been a greater degree of transparency.

Conclusion

From the above description it is clear that many of the important principles outlined in protocols (such as the Cartagena Protocol) on GMOs have already been incorporated into South African legislation. Of particular importance is the functioning of the central registrar and the advisory committee, a feature relating to implementation that was written into the initial legislation. Unfortunately, this is not the case regarding legislation and implementation relating to importations of alien aquatic species.

The South African government has, however, recently published a White Paper on the conservation and sustainable use of biological diversity (1997) that contains a section on the importation of alien aquatic animals (see Text Box 3). The intention to improve legislation relating to alien species is embodied in the following statement:

“Government recognises that many past efforts at control have been unsuccessful, a major problem being the fact that responses have been reactive, with actions taken only after invasive alien species have become a problem. This ad hoc approach has not been cost-effective, and has resulted in drastic impacts on biodiversity. To redress this, Government will adopt a proactive, preventative and precautionary approach to control the introduction and spread of alien organisms.”

Work is currently underway on the development of a new bill on biodiversity in South Africa and it is hoped that many of the principles outlined in some of the international protocols (such as the EIFAC Code of Practice and the CCRF)

that are espoused in the South African White Paper, will find their way into this legislation and into its implementation. Although time constraints did not permit a detailed examination of the implementation of the law in other African countries, a brief description of the relevant legislation (van der Mheen 1997 and summarized in Table 2) suggests that, at least in the four SADC countries bordering the Limpopo River, legislation and implementation of legislation relating to alien aquatic species fall short of many of the recommendations outlined in international protocols such as the CCRF.

Recommendations

Many of the problems surrounding implementation of the law arise from a lack of capacity (in terms of funds and trained personnel) as well as inadequate legislation and a lack of clarity on the part of governments concerning the implementation of legislation. In order to overcome some of these problems, it is recommended that the following initial actions be taken:

- 1 That principles espoused in most protocols on the importations of alien species be enacted in domestic legislation in African countries.
- 2 That such legislation contain clauses outlining the setting up and functioning of appropriate implementing agencies (such as the “registrar” that is responsible for the implementation of the GMOs Act in South Africa).
- 3 In addition to the above implementing agency, it is also desirable to set up an advisory committee comprising some government enforcement agents (such as nature conservation officers) as well as outside experts (for example academics from local universities and other research institutions). This committee would be responsible for assessing evaluations submitted by independent consultants, conducting evaluations, or appointing independent consultants to carry out such evaluations. Such an advisory committee would also be responsible for alterations to lists of prohibited and approved species.

Consideration should also be given to setting up procedures and protocols that are relatively simple to use and cost effective. In this respect, the following recommendations are made:

- 1 Protocols should be simple, and consideration be given to the EIFAC/ICES Code of Practice (as outlined in Appendix 1) and adapted to the needs of the particular country concerned.
- 2 Steps should be taken to streamline implementation of the law and reduce costs. Practical measures include the following:
 - i. That the implementing agency charges a fee from all applicants to assist with administration costs.
 - ii. That the “polluter pays” principle be adopted (i.e., potential importers pay costs for consultancies). The implementing agency collects payment from the “importer” and oversees the appointment and payment of independent consultants to conduct special evaluations.
 - iii. In less complicated cases, it may be possible to ask members of the advisory board to be responsible for evaluations, for which they would be paid a small fee.
 - iv. Funding for the advisory committee should be made available through central government agencies rather than provincial government agencies that are often short

Text Box 3. South Africa’s white paper on the conservation and sustainable use of biological diversity (1997).

Section dealing with policy strategy with regard to alien species in general.

“The Government will adopt a proactive, preventative and precautionary approach to control the introduction and spread of alien organisms. This approach will take into consideration the need to balance the risks associated with introducing and releasing alien organisms with the potential social, economic and environmental benefits derived therefrom.

To achieve this objective, the Government, in collaboration with interested and affected parties, will:

- *(a) Review, streamline and, if necessary, strengthen existing legislation to control the introduction and spread of potentially harmful alien organisms. Actions will be taken to improve the effectiveness of legislation and ensure consistency; and*
- *(b) Strengthen the enforcement and effectiveness of existing punitive measures to control the introduction and spread of potentially harmful alien organisms.*
- *Develop a regulatory procedure for the introduction of alien organisms into South Africa, whereby the potential risks of introduction are comprehensively assessed against intended benefits prior to introduction. This assessment will be followed by the adoption of appropriate mitigatory or preventative measures.*
- *Develop control and eradication programs, and provide ongoing support to existing programs, based on a priority-rating system and in relation to costs and resources. This will consider threats posed to biodiversity, as well as social, economic, and environmental costs and benefits derived from using and removing identified organisms. The planning of intensive mechanical clearing operations will take account of job creation schemes and will provide for regular follow-up.*
- *Prevent wherever feasible the unintentional introduction of alien organisms to South Africa.*
- *Develop a national policy on the inter and intra-provincial translocation and inter-basin transfer of species, including the updating of lists of prohibited and approved taxa.*
- *Promote the use of local, indigenous species in the rehabilitation and revegetation schemes.*
- *Provide incentives to landowners to control or eradicate alien organisms identified as threatening biodiversity.*
- *Strengthen, support and coordinate the efforts of existing institutions and programs to detect the early establishment of invasive alien organisms, and to catalogue and describe such invasions.*
- *Support and strengthen the development of biological and other control methods for alien organisms that threaten biodiversity.*
- *Improve understanding concerning the impacts of alien organisms on biodiversity.*
- *Improve public education and awareness concerning the risks posed by the planting or illegal importation of alien species, and identify actions that can be taken to avoid such risks or to control the spread of alien organisms.*
- *Improve capacity amongst implementing agencies to regulate the introduction, control and eradication of alien organisms that threaten biodiversity.*
- *Negotiate and liaise with neighboring countries to maximize commonalities and minimize conflicts between policies, legislation, and practices relating to alien organisms that threaten biodiversity.”*

of funding. It may also be desirable to seek international funds to assist in the functioning of such advisory committees.

- v. Use should be made of expertise available through international organizations as well as the websites of organisations, for example the FAO, SCOPE, INGA, the IUCN Invasive Species Specialist Group (ISSG), the Species Survival Commission (SSC), and the Database of Introductions of Aquatic Species (DIAS).

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c. Cartagena Protocol:

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b. Objectives of INGA:

<http://www.worldfishcenter.org/inga/objectives.html>

c. Germplasm exchange:

<http://www.worldfishcenter.org/inga/germplas1/html>

Appendix 1: The EIFAC/ICES Code of Practice

Bartley and Coates (1997) and Coates and Bartley (1997) have recommended that a modified version of the code of practice initially developed by ICES/EIFAC (Turner 1988) be applicable to the African region. This paper, therefore, focuses on elements of this Code of Practice as well as the Cartagena Protocol on Biosafety (which forms part of the Convention on Biological Diversity), which has been developed for GMOs.

The ICES/EIFAC Code of Practice

In its simplified form, the code proposes that the following steps be taken in order to arrive at an informed decision regarding the importation of alien species into the country. (Note that the assumption is made that species kept in semi-captivity will, sometime in the future, have the opportunity to escape into natural waters, so such importations are treated in the same way as deliberate introductions into natural waters.)

- Step 1: Proposal to introduce or transfer species into new regions beyond its native range.
- Step 2: Evaluation: in-depth risk/benefit analysis in ecological, genetic and socio-economic terms and proposed quarantine arrangements.
- Step 3: Independent Review: review of proposal and evaluation, checking its thoroughness, accuracy, advising on the appropriateness of the proposal and making recommendations as to how to proceed.
- Step 4: Decision by the appropriate decision-making authority on whether to proceed with the introduction. This authority should also specify quarantine conditions and any other conditions (such as regions where introductions are allowed) under which the species may be held.

(Note that the above description has been considerably simplified from the original recommendations as outlined in Turner (1988) which should be consulted for a more detailed account of these procedures. Of particular importance are the recommended regulations, especially regarding quarantine conditions, associated with the final importation of the species into the country.)

Bartley and Coates (1997) and Coates and Bartley (1997) noted the following practical issues that are essential for the proper functioning of the above procedures.

Administrative infrastructure: This is necessary for the control and management of introductions as well as the evaluation process. Penalties

for defaults under legislation should also be commensurate with the degree of economic and environmental damage that inappropriate or unapproved introductions can cause. In addition to the existence of a controlling body operated by a government department, it will also be necessary to set up a review board as described in the next paragraph.

The review process: It is essential that an independent review of the proposal and its evaluation are made. It is best that the membership of the review panel should not include any person with a direct interest in the outcome of the proposal. A review panel might include, but not necessarily be limited to, the following individuals/interest groups:

- Fisheries and aquaculture specialists that also have some expertise in aquatic ecology;
- Aquatic ecologists;
- Socio-economists with experience in the aquatic sector (fisheries and/or aquaculture) and more broad socio-economic experience;
- Fisheries/aquaculture geneticists;
- Representation from the environment/conservation sector; and
- Representation from the human health sector.

Decision-support systems: Various decision-support systems can be used to assist the review panel to come to an informed decision. Kohler and Stanley (1984) developed a review and decision model in which the panel of experts is required to address a series of questions in relation to the proposed introduction. The model is composed of five levels of review: decisions on whether to accept or reject the proposal are made at each level. The graded nature of the process means that proposals can be rejected at an early stage of the process. This streamlines the process and circumvents the necessity of having to go through the whole procedure for organisms that do not “pass” the lower levels of review.

The decision model can also make use of an opinionaire (Text Box A1) that incorporates a scoring system into the questions asked during the review process. This facilitates the process and helps the panel to arrive at a consensus decision (Text Box A2).

Text Box A1. Opinionnaire* for appraisal of introductions of aquatic organisms.

Questions	Response					
	No	Unlikely	Possibly	Probably	Yes	Don't Know
1. Is the need for introduction valid, and are there no native species that could serve the stated need?	1	2	3	4	5	X
2. Is the organism safe from over-exploitation in its native range?	1	2	3	4	5	X
3. Are safeguards adequate to guard against importation of disease/parasites?	1	2	3	4	5	X
4. Would the introduction be limited to closed systems?	1	2	3	4	5	X
5. Would the organism be unable to establish a self-sustaining population in the range of habitats that would be available?	1	2	3	4	5	X
6. Would the organism have mostly positive ecological impacts?	1	2	3	4	5	X
7. Would most consequences of the introduction be beneficial to humans?	1	2	3	4	5	X
8. Is the database adequate to develop a complete species synopsis?	1	2	3	4	5	X
9. Does the database indicate desirability for introduction?	1	2	3	4	5	X
10. Based on all available information, do the benefits of the introduction outweigh the risks?	1	2	3	4	5	X

* Each member of an evaluation board or panel of experts circles the number most nearly matching his/her opinion about the probability for the occurrence of the event. If information is unavailable or uncertain then "don't know" is marked. Mean values obtained from the responses of the panel are used to come to a consensus decision in the Kohler and Stanley (1984). Review and decision model reproduced in Text Box A2.

Text Box A2. Review and decision model for evaluating proposed introductions of aquatic organisms (simplified from the Kohler and Stanley 1984 model by B. Steinmetz — as quoted in Turner 1988).

Review Level	Opinion Mean Value**	Decision
Review level I		
1. Is the need for importation valid*	# 2 > 2	- reject - to next question
2. Is the organism safe from over-exploitation in its native range?	# 2 > 2	- reject - to next question
3. Are safeguards adequate to guard against the importation of disease/parasites?	# 2 > 2	- reject - to next question
4. Would the introduction be limited to a closed system?	∃ 3 > 3	- approve - to review level II
Review level II		
5. Would the organism be unable to establish a self-sustaining population in the range of habitats that would be available?	∃ 3 > 3	- approve - to review level III
Review level III		
6. Would the organism have mostly positive ecological impacts?	# 2 > 3 ∃ 3	- reject - to review level IV - to next question
7. Would most consequences of the introduction be beneficial to humans	# 2 > 3 ∃ 3	- reject - to review level IV - approve

continue >

> continued

Review level IV		
8. Are data adequate to develop complete species synopsis?	> 3 ∃ 3	- conduct detailed literature review - to next question
9. Does the database indicate desirability of introduction?	# 2 > 3 ∃ 3	- reject - conduct research - approve
10. Would benefits exceed risks?	# 2 ∃ 3	- reject - approve

* The importation is not considered to be valid if an indigenous species could better fulfill the purpose for which the species is to be imported. The proposed importation should adequately fulfill the need for which it is to be imported. (For example, if the aquaculture potential of the candidate species is less than very good, then it would not adequately fulfill the need if it was being imported for the purpose of aquaculture.)

** Mean of values obtained for each question, based on answers given by the review panel (as detailed in Text Box A1).