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Quality of Environmental Impact Assessment (EIA) Reports on Biological Pest Control

Presented by: Ms T H Carroll

Student Number: 13141511

Supervisor: Dr F P Retief

ABSTRACT SUMMARY

Quality of Environmental Impact Assessment (EIA) Reports on Biological Pest Control for *Lantana camara*

Decision making regarding the release of biological control agents for invasive species such as lantana, *Lantana camara*, requires the consideration and evaluation of environmental impact assessment (EIA) reports by a competent authority. Although various biological control agents have been authorised for release into the environment for the control of lantana, the quality of the EIA reports that form the basis for decision making has never been evaluated. The evaluation of the quality of EIA reports on the release of biological control agents by means of an adapted Lee-Colley review package was the focus of this research. The main conclusion was that the quality of the EIA reports on the release of biological control agents for the control of *Lantana camara* (lantana) was poor by the standards of the review package, the literature reviewed, and the legal requirements. The main deficiencies in the EIA reports related to impact identification, impact evaluation, scoping, mitigation measures and monitoring programmes, while the project descriptions, non-technical summaries and layout and presentation of information in the reports were of good quality. These results correspond to reports in literature that affirms that essential information about impact identification and evaluation and subsequent mitigation and monitoring, the crux of the EIA, is mostly insufficient in EIA reports.

CONTENTS

Chapter 1: Introduction

1.1 Setting the scene

Natural environments tend to be balanced, with organisms dependent on one another and also constrained by one another through competition for resources or by parasitism, predation or causing diseases (Deacon, 2006:1). Human influences may upset these balances and it is most evident when an alien organism (a species that is not an indigenous species (National Environmental Management: Biodiversity Act (10/2004) (NEMBA)) is introduced intentionally or unintentionally into a new environment. Alien species that become established in a new environment and then proliferate and spread in ways that are destructive to human interests are considered invasive alien species (McNeely *et al.*, 2001:2). Invasive alien species are recognised as one of the greatest biological threats to our planet's environmental and economic well being (McNeely *et al.*, 2001:2) and most detrimental pests, crop diseases and invasive weeds are the result of intentional and unintentional introductions of organisms alien to an area (Deacon, 2006:1). As a result nations are grappling with complex and costly invasive species problems.

In South Africa invading alien plants have become established in over 10 million hectares of land (WfW, 2006:1) and the cost of controlling invasive plant species is an estimated R600 million per year. Taking into consideration that only 200 of the ± 9000 introduced plant species are considered invasive (WfW, 2006:1), the potential costs associated with invasive species control is enormous. The eradication and control of invasive alien species therefore requires the implementation of integrated pest management strategies of which biological pest control is one component (Hoffmann & Frodsham, 1993:1).

Biological pest control is the practice or process by which an undesirable organism is controlled by means of another (beneficial) organism (Deacon, 2006:1). The aim of biological control is to manipulate natural enemies (parasitoids, predators, pathogens) in an attempt to reduce the pest numbers and keep them at much

reduced levels (Integrated Pest Management Resource Centre, 2006:6). The 'manipulation' can involve either the introduction of natural enemies into a region where they previously did not exist to counter accidentally introduced pests of crops (classical biological control) or the use of indigenous natural enemies to augment existing populations (e.g. mass release of sterile males of the target species' natural enemy) or to alter the environment to improve conditions for enhanced natural enemy activity (Integrated Pest Management Resource Centre, 2006:6; McNeely *et al.*, 2001:27).

Unfortunately, biological pest control does not always work. An example of biological control gone wrong was the introduction of the cane toad (*Bufo marinus*) to Australia in 1935 to control two insect pests of sugar cane (Australian Department of the Environment and Heritage, 2005:4). This biological control effort was a failure as it did not control the insects and the cane toad itself became an invasive species.

Furthermore, the discipline of biological control can be perceived as being subject to a series of tensions due to differences in philosophy, different needs, and different practices. These include the view that biological control is environmentally friendly and desirable *vs* the view that any organism alien to a particular habitat should be considered an undesirable invasive; the need to protect non-target species *vs* the need to introduce the most effective biological control agent; and the need to know what an agent might attack under normal field conditions *vs* the restrictive nature of current testing procedures (Briese, 2005:208).

Cognisant of the above, it is extremely important to undertake stringent tests and controls to ensure biological control agents are effective, host specific and that the species used for biological control does not in turn become invasive (McNeely *et al.*, 2001:27). In this regard assessment regimes such as risk assessment and environmental impact assessment (EIA) have been widely used internationally as pro-active decision support tools to avoid or minimize the potential impact associated with the introduction of biological pest control agents (Arnett & Louda, 2002:4; Baars *et al.*, 2003:10; Berner & Bruckart, 2005:10; Briese, 2005:7; Louda *et al.*, 2005:1; Sheppard *et al.*, 2005:12; Wright *et al.*, 2005:4; Ding, *et al.*, 2006:14).

1.2 The South African context

South Africa is classified among the three world leaders in the field of biological control of invasive plants (Klein, 2002:1). Since 1914, the Agricultural Research Council's (ARC) Plant Protection Research Institute (PPRI) and its predecessors have released more than 80 species of biological control agents, e.g. beetles, wasps, moths and fungi, to control 35 invasive alien plant species in South Africa. According to Klein (2002:1) remarkable successes have been achieved with either controlling, or reducing the invasive potential of many invasive alien plants.

Despite the successes achieved, the release of biological control agents is associated with environmental risks that should be considered prior to release. Due to the potential detrimental impact of biological control agents, "*the release of any organism outside its natural area of distribution to be used for biological pest control*" was identified as an activity in terms of Section 21 of the Environment Conservation Act, 1989 (ECA) (73/1989) (South Africa, 1997a) that may have a substantial detrimental effect on the environment. In terms of Section 22 of the ECA (73/1989) an activity identified in terms of Section 21 may not be undertaken without written authorisation issued by the Minister or a competent authority. The authorization will only be issued after consideration of reports concerning the impact of the proposed activity and of alternatives to the proposed activities on the environment (ECA, 73/1989). The requirements relating to the EIA process and content of the EIA reports are prescribed in regulations in terms of ECA (73/1989) (South Africa, 1997b). The promulgation of new EIA regulations in terms of the National Environmental Management Act (107/1998) (NEMA) repealed the provisions in terms of ECA (73/1989), but the release of any organism outside its natural area of distribution to be used for biological pest control is still listed as an activity (activity number 22) in terms of Government Notice R. 386 (South Africa, 2006a) and a basic assessment is required (South Africa, 2006b).

1.3 Introducing the lantana challenge

The focus of this research is on the quality of environmental impact assessment (EIA) reports for a specific invasive alien plant species, namely *Lantana camara*

(Lantana) (Figure 1). *Lantana camara* is a floriferous, prickly, thicket-forming shrub that originates from tropical and sub-tropical South and Central America (Stirton, 1977 as quoted by Baars & Neser, 1999:21). It is an aggressive, vigorously growing weed that tolerates a wide variety of environmental conditions (Baars & Neser, 1999:21). It furthermore, out-competes indigenous vegetation by preventing the regeneration of indigenous vegetation through the secretion of allelopathic chemicals (Gentle & Duggin, 1997).

Lantana has an invasive status of a "Transformer" (Henderson, 2001:118). Transformers are plants which can as mono-species dominate or replace any canopy or sub-canopy layer of a natural or semi-natural ecosystem, thereby altering its structure, integrity and functioning (Henderson, 2001:253). The most serious environmental weeds are classified as transformers and lantana is rated as one of the world's worst weeds (Holm *et al.*, 1977, as quoted by Baars & Neser, 1999:21).

Figure 1: *Lantana camara* (Lantana) (Iziko Museums of Cape Town, 2004)

Lantana is also listed as a "Declared weed" in terms of Regulation No. R. 280 of the Conservation of Agricultural Resources Act, 1983 (43/1983) (CARA). Specific provisions in terms of CARA, aim to combat and control weeds, such as lantana.

Despite the large number of natural enemies that have been established on lantana since the 1960s, it still remains one of the most vigorously growing, invasive weed species in South Africa (ARC-PPRI, 2006:2). Van Wilgen *et al.* (2004) calculated the potential condensed area that is suitable for invasion by *Lantana camara* in South

Africa, to be 44 663 km^2. By the year 2000, lantana had already invaded 18 414 km^2 (41.3%) of its potential range. This is despite ongoing control measures such as mechanical, chemical and biological control. Unless additional efforts are employed to reduce the invasiveness of this weed, its economic, social and environmental impacts can potentially become progressively more severe.

Biological control, as an alternative or supplementary control method, is considered as a cost-effective, environmentally friendly, long-term solution. Unfortunately, despite the establishment of several biological control agents on lantana, the biological control programme for lantana has largely been unsuccessful (Baars & Neser, 1999:21; Sheppard, 2003:17). This is not only true for South Africa, according to Sheppard (2003:17), the biological control programme against *Lantana camara* is the largest and longest running and thus far, the least successful biological control of weeds programme in Australia and probably the world. A total of twenty nine biological control agents have been released in Australia and thirty six species worldwide with limited success (Julien & Griffiths, 1998, as quoted by Sheppard, 2003:17).

The lack of success has been attributed to a large extent to the genetic diversity of lantana, which has made it an extremely variable target weed and this diversity of varieties presents the biological control agents with several morphological and physiological barriers to utilisation (Baars & Neser, 1999:25). According to Baars & Neser (1999:21) the success of the biological control programme for lantana will depend on the establishment of a suite of biological control agents, attacking several parts of the weed and which are able to cope with the extreme variability and wide distribution of lantana in South Africa.

1.4 Problem statement and research aim

Biological control of invasive organisms is unique in that the biological control agent is not the only alien organism in the equation. The environmental and economic risks of introducing an alien control agent need to be considered in the context of the risks posed by the alien invader should no control be imposed. This is precisely the reason why "*the release of any organism outside its natural area of distribution*

to be used for biological pest control" was identified as an activity, which may have a substantial detrimental effect on the environment in terms of Section 21 of ECA (73/1989; South Africa, 1997a) and why it was retained as an activity in terms of the new EIA regulations promulgated in terms of NEMA (107/1998). An EIA is therefore required for the release of biological control agents into the South African environment.

As highlighted in previous sections one of the main invader species in South Africa, for which biological pest control has been pursued, is *Lantana camara*. Since 1997 a total of seven EIA reports for the release of biological control agents for *Lantana camara* have been compiled by the ARC's PPRI for the Department of Water Affairs and Forestry and submitted to the Department of Environmental Affairs and Tourism (DEAT) for consideration and authorisation. The evaluation of the EIA reports for the release of biological control agents has been problematic, mainly due to the following reasons:

- *Lack of expertise* in and knowledge of this specific field: The evaluator does not know what potential environmental impacts should be considered in the EIA and whether all issues are addressed in the reports.
- *No guidelines* are available relating to the review of applications for the authorisation of this specific activity: Available guidelines relating to the review of EIA reports are focussed on "development" scenarios (e.g. residential development, industrial development, mining, etc.), while the criteria for the evaluation of EIA reports for biological control agents will be considerably different.
- The information and knowledge "gap" created by the current *legislative framework*: The "gap" in the existing legislative framework is the "unregulated" import of the potential biological control agents. At present, permits are issued by Department of Agriculture (DoA) to import the species and to keep them in quarantine in laboratories. No risk assessment, as envisaged in terms of the National Environmental Management: Biodiversity Act (10/2004), is required before the import is authorised and an EIA is only required when the applicant applies for authorisation in terms of ECA (73/989) to release the organism into

the environment. This implies that the EIA is the main, and at this stage, the only decision support tool used to evaluate the release of organisms.

In view of the latter it is evident that a need exists to develop knowledge support and guidelines in order to strengthen EIA as the main decision making tool for the release of biological pest control. Taking into consideration the risks associated with the release of these organisms, the quality of these reports is an important consideration in the decision-making process and is an aspect that has not been researched before. An indication of the quality of EIA reports on the release of biological control agents could assist authorities in improving the decision making process. The main aim of the research is thus:

To evaluate the quality of EIA reports on biological pest control for *Lantana camara* (Lantana) with a view to provide decision support and guidelines for future decision making.

EIA reports for the following six (of the seven) released biological control agents were evaluated:

- *Falconia intermedia* (Mirid bug)
- *Mycovellosiella lantanae* var *lantanae* (Leaf spot fungus)
- *Ophiomyia camarae* (Herringbone leaf-mining fly)
- *Coelocephalapion camarae* (Lantana petiole weevil)
- *Leptostales ignifera* (Mexican leaf-feeding inch-worm)
- *Longitarsus bethae* (Root-feeding flea beetle)

The evaluation of the quality of these reports by means of a multiple case study strategy, which includes cross case analysis, enabled the researcher to identify tendencies, gaps / inadequacies / weaknesses and strengths of the various reports. Recommendations could then be made on how these deficiencies / inadequacies could be addressed to increase the overall quality of the reports. In order to achieve the overall research aim the following research questions had to be answered.

1.5 Research questions

The following four key research questions had to be addressed in order to achieve the main research aim:

Research question 1: Can an existing review package be adapted to review the quality of EIA reports on the release of biological control agents for lantana in a conceptually justified, methodologically sound and practically viable manner?

Research question 2: What are the international perspectives and debates relating to EIA report review?

Research question 3: What are the environmental aspects to consider with regards to the release of biological control agents?

Research question 4: What is the quality of EIA reports on the release of biological control agents for *Lantana camara* (Lantana)?

1.6 Structure of the mini-dissertation

To allow for easy interpretation of results the mini-dissertation is structured in five chapters, each linked to particular research questions.

Chapter 2 describes the **research design and methodology** and addresses research question 1.

Chapter 3 deals with the **literature review** component and answers research questions 2 and 3.

Chapter 4 provides the **data analysis** on the quality of the EIA reports. The results addresses research question 4 through the application of the research design and methods described in chapter 2.

Finally the **discussion and conclusions** are reflected in *chapter 5*. The chapter demonstrates that the research aim described in section 1.4 has been addressed.

This chapter also make proposals to deal with the inadequacies identified as well as for future research and further debate.

CHAPTER 2: RESEARCH DESIGN AND METHODOLOGY

This chapter aims to address research question 1:
Can an existing review package be adapted to review the quality of EIA reports on the release of biological control agents for lantana in a conceptually justified, methodologically sound and practically viable manner?

The chapter consists of six sections. The first section briefly describes the research design and approach. Secondly an overview of existing literature on EIA report quality review methods is provided. The third section describes in detail the adapted Lee Colley review package with specific reference to structure of the protocol, scales for quality measurement and the adaptation of review areas and categories to deal with biological pest control. The fourth section describes the data gathering and analysis for each single case followed by sections five and six explaining the pilot study review as well as the multiple case study analysis.

2.1 Research design

The main research aim as well as the research questions posed in Chapter 1 was addressed by conducting so-called 'evaluation research' using a multiple case study design (Robson 2002; Yin 2003). Evaluation research should not be seen as a unique research approach but rather a one with a particular focus. In recent years case study research has become particularly popular as a research strategy for evaluation research (Maxwell, 2000; Yin, 2003) because it deals well with the associated detail and complexities. The selection of the number of cases depends on the certainty you want about your results (the greater certainty lies with the larger number of cases) (Yin, 2003:51). This research supports the view of Eisenhardt (2002:27) who concludes that,

> *"Finally, while there is no ideal number of cases, a number between 4 and 10 cases usually works well. With fewer than 4 cases, it is often difficult to generate*

theory with much complexity, and its empirical grounding is likely to be unconvincing, ... With more than 10 cases, it quickly becomes difficult to cope with the complexity and volume of data."

It is thus agreed that analytical conclusions independently arising from more than one case study are more powerful than those coming from a single case (Yin, 2003:53). However, in this regard an important consideration is that the multiple case study approach is not following so-called 'sampling' logic (Yin, 2003:47). The cases studies are not 'sampling units'; and should rather be considered through 'replication' logic with the different cases representing multiple experiments, which are replicated (Yin, 2003:32). The aim is to compare multiple cases against similar criteria to distil trends and / or patterns (in report quality).

As will be shown in the following sections, six EIA reports that were conducted specifically for biological pest control of a single invasive alien species, namely *Lantana camara*, were selected. In view of the fact that only seven reports have been prepared in South Africa to date since the inception of EIA legislation, the replication potential, certainty and validity of the conclusions reached were increased. It furthermore enabled the researcher to investigate trends through cross case analysis, thereby strengthening the internal and external validity of the research (Yin, 2003).

2.2 EIA report quality review

It is recognised that a systematic review of report quality should form part of any well functioning EIA system (Asplund and Hilding-Rydevik, 1996; Sadler, 1996; Curran *et al.*, 1998; Bonde and Cherp, 2000; Lee and George, 2000). In terms of reviewing the quality of environmental statements / reports for EIA, various review packages and guidelines have been developed (Lee and Colley, 1992; European Commission - EC, 1994; Glasson, 1996; Institute for Environmental Assessment - IEA, 1996; Lawrence, 1997). Review packages were also developed to review specific aspects of reports such as scientific accountability (Devuyst, 1994) and typographic quality (Gallagher and Jacobson, 1994).

Thus report quality review has been very widely and successfully applied to assess the status and standard of project level EIA (Jones and Bull, 1997; Thompson *et al.*, 1997; Weston *et al.*, 1997). The Lee-Colley package (Lee and Colley, 1992) is probably the most well-known and widely applied in developed and developing countries due to its adaptability and because it provides a systematic and structured approach to quality review (Ibrahim, 1992; Rout, 1994; Mwalyosi and Hughes, 1998; Sandham *et al.*, 2005).

The adaptation of the Lee-Colley EIA package for application to South Africa has also been done by Sandham *et al.* (2004). This adapted package was tested on specific case studies in South Africa and it was concluded that it sets a sufficiently high yet practically achievable standard for EIA reports. It has thus been fully recognised that the package can not be generically imported to deal with all contexts, but that the review criteria will have to be adapted for different sectors and EIA focus areas (Sandham *et al.*, 2004).

2.3 Adaptation of Lee-Colley package to deal with biological pest control

The Lee-Colley review package was identified as providing a systematic and structured approach to the quality review of reports. In order to review the quality of the EIA reports on biological pest control for Lantana the Lee Colley review package had to be adapted (Lee and Colley, 1992).

2.3.1 Structure of the review package

The adapted version did not change anything fundamentally regarding the structure of the review package. The review was done in a hierarchical / pyramidal manner (Lee *et al.*, 1999:10), commencing with the review at the lowest level, the base of the pyramid, which contains simple criteria (sub-categories). Drawing upon the assessment of the sub-categories, the reviewer progressively moved upwards to the next level (categories), which involves more complex criteria. Subsequent to that, review areas were evaluated based on the review of the categories. The overall

assessment of the EIA report was completed through the review of the review areas. A schematic presentation is provided in Figure 2.

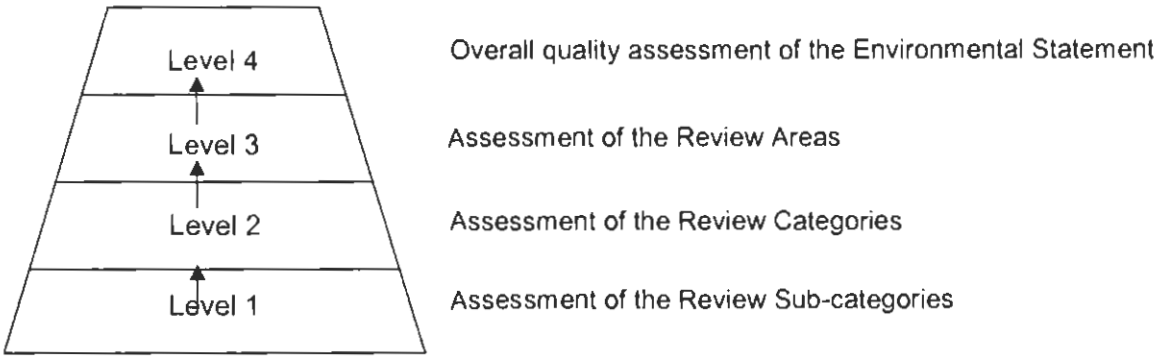

Figure 2: The Hierarchical/Pyramidal Structure of the Lee-Colley Review Package (Lee *et al.*, 1999:10)

2.3.2 Scales for quality measurement

An important aspect of the review package is that a standard list of symbols is used in the evaluation of the sub-categories, categories and areas (Table 1). 'Letters' rather than 'numbers' are used as symbols to discourage reviewers from crude aggregation to obtain assessments at the higher levels in the pyramid (Lee *et al.*, 1999:10). In this regard the symbols used in the original package as been retained for this research.

Table 1: *List of assessment symbols*

Symbol	Explanation
A	Relevant tasks well performed, no important tasks left incomplete.
B	Generally satisfactory and complete, only minor omissions and inadequacies.
C	Can be considered just satisfactory despite omissions and/or inadequacies.
D	Parts are well attempted but must, as a whole, be considered just unsatisfactory because of omissions or inadequacies.
E	Not satisfactory, significant omissions or inadequacies.
F	Very unsatisfactory, important task(s) poorly done or not attempted.
NA	Not applicable. The Review Topic is not applicable or it is irrelevant in the context of this Statement.

2.3.3 Adaptations of the review areas and categories

Although the structure and assessment symbols were retained form the original package, the review areas, categories and sub-categories had to be adapted to represent criteria relevant to the assessment of biological control agents proposed to be released into the environment. Except for general criteria relating to the communication of information, consideration of mitigation measures and alternatives, the criteria for the evaluation of EIA reports on the release of biological control agents are considerably different from the criteria used by Lee *et al.* (1999:38). The following literature were analysed to adapt the review criteria (review areas, categories and sub-categories):

- *Legal requirements* in terms of the ECA (73/1989), and the associated regulations (South Africa, 1997b).
- *Existing guidelines* and toolkits. For example, Integrated Environmental Management Information Series (Department of Environmental Affairs and Tourism, 2004); Invasive alien species: A Toolkit of Best Prevention and Management Practices (Wittenberg & Cook, 2001).
- *Peer reviewed publications* relating to biological control, which will guide the amendment of criteria for evaluation. Publications include scientific articles that discuss among others the evaluation of risks of biological control introductions; the ecological effects of biological control; and the indirect effects of release.

The review areas, categories and sub-categories, as adapted for the review of EIA reports on biological control agents are reflected in Annex 1. The main review areas are:

- Description of the proposed activity, namely the release of the biological control agent, the receiving environment, the proposed pest/target species, the baseline conditions and the anticipated result of the release.
- Identification and evaluation of key impacts.
- Alternatives and mitigation of impacts.
- Communication of results.

2.3.3.1 Legal compliance

Compliance with legal requirements is the most important consideration in evaluating the quality of an EIA report. The EIA report is used as the basis for decision making and the minimum information as specified in legislation must therefore be provided. Transposition of exact legal requirements into review topics, however, is problematic, particularly as it could be argued that the exact nature of the information required varies from case to case. Taking into consideration the specialist nature of biological control and the fact that EIA legislation is mostly focused on "development" scenarios, this task was challenging.

The minimum information required for an EIA report is specified in the EIA regulations (South Africa, 1997b) issued in terms of the ECA (73/1989). In terms of Section 8 of the regulations (South Africa, 1997b), an EIA report must contain the following minimum set of information:

(a) a description of each alternative, including particulars on-
    (i) the extent and significance of each identified environmental impact; and
    (ii) the possibility for mitigation of each identified impact;
(b) a comparative assessment of all the alternatives; and
(c) appendices containing descriptions of-
    (i) the environment concerned;
    (ii) the activity to be undertaken;
    (iii) the public participation process followed, including a list of interested and affected parties and their comments;
    (iv) any media coverage given to the proposed activity; and
    (v) any other information included in the accepted plan of study.

Three of the reports evaluated were scoping reports and therefore the legal requirements for scoping reports (South Africa, 1997b) were also taken into consideration. The requirements for a scoping report are contained in Section 6 of the regulations (South Africa, 1997b):

(a) a brief project description;
(b) a brief description of how the environment may be affected;

(c) a description of environmental issues identified;
(d) a description of all alternatives identified; and
(e) an appendix containing a description of the public participation process followed including a list of interested parties and their comments.

The regulation's minimum requirements (Section 8 of regulations South Africa, 1997) broadly correspond to the following review sub-categories:

(a) (i) 2.1.1; 2.3.1; 2.3.3; 2.4.1
(ii) 3.2.1
(b) 3.1.1; 3.1.3
(c) (i) 1.2.1; 1.3.1
(ii) 1.1.1; 1.1.6
(iii) 2.2.1; 2.2.2

If all of the above sub-categories are assessed, at least 'satisfactory', i.e. (A, B or C) or 'not applicable' (NA), the EIA report in question is likely to comply with the minimum legal requirements. The estimation of the extent to which this has been achieved was one of the principal objects of this review process, and therefore coincides with the final judgement of the review. Thus, broad compliance was taken to mean that the EIA report has met the minimum legal requirements as interpreted above and furthermore that each review area has been assessed as, at least, "satisfactory", i.e. A, B or C.

2.3.3.2 Other requirements

Requirements relating to the compilation and structure of the EIA report were also taken into consideration during the review process. Certain sub-categories in the review package relate to these and include requirements for a good EIA report (DEAT, 2004:2):

- tightly focussed on in the important issues;
- scientifically and technically sound, with feasible and legally defensible findings;
- clearly and coherently organised and presented, to enable its contents to be easily understood ;

- timely; and
- free from bias, and emotive language.

2.4 Data gathering and analysis

This section describes how data were gathered and captured (i.e. the review components and review procedure). It also reflects on how the data were analysed and final conclusions reached.

2.4.1 Components of the review package

The adapted review package is in the form of a self-contained package with the following components (Lee *et al.* 1999:9):

- A list of criteria (review areas, categories and sub-categories) to be used to evaluate each EIA report (Annex 1);
- A collation sheet on which the findings should be recorded (Annex 2).
- Advice for reviewers (i.e. necessary background information and guidance on the use of review criteria) (Annex 3)

2.4.2 Review procedure

In order to conduct the review, the reviewer must undertake the following eleven steps sequentially (adapted from Lee *et al*, 1998:34-37):

(i) Read the **Advice for Reviewers** (Annex 3) to ensure he/she has an understanding of the review package and what it will entail.

(ii) Read through the **List of Review Topics** (Areas, Categories, and Sub-categories – Annex 1) to familiarise him/her with them and the data required in each review topic.

(iii) Read the EIA report to be evaluated quickly to familiarise him/her with the layout and the arrangement of essential information.

(iv) Study the **List of Assessment Symbols** (listed in Table 1). The appropriate assessment symbol should be chosen based on the way the tasks relating to

the sub-category are performed throughout the EIA report. Before deciding on the symbol it may be helpful to refer to the wording of the Review Sub-Category and to recall the strategy of review as described in point (v) & (vi) below.

(v) Read the first review category (1.1) and its component sub-categories (1.1.1-1.1.5). Remember that the sub-categories refer to actions which must be undertaken or information that must be provided, in order to meet the requirements as described in the review category (1.1).

(vi) Assess each of the sub-categories (1.1.1-1.1.5) referring closely to the EIA report, while being cognisant of the fact that the required information will not all be located in the same place in the report for any one review topic.

(vii) Decide which assessment symbol is appropriate for each sub-category and record it on the **Collation Sheet** provided in (Annex 2). Note that a task should be assessed as having been satisfactorily handled if there is sufficient information provided in the EIA report on the topic / category / sub-category concerned, to allow a decision-maker to make an informed decision without having to seek further advice. It is the *appropriateness* and *quality*, and not the *volume* of information provided which is the relevant consideration. Where data on a particular topic / category / sub-category is not explicitly provided but is, nevertheless, implicit in the treatment of other topics, the reviewer may decide that it should be assessed as adequate. Such instances should be recorded in the summary that is discussed in point 11 below.

(viii) Use the assessments of sub-categories 1.1.1-1.1.6, and any other information gained from the EIA report which he/she considered relevant, to assess the review category 1.1. Note that the assessment of the review category should not be derived by a simple averaging of the assessments of the component sub-categories. The evaluation of both the relative importance of these sub-categories and any information in the EIA report not covered by them should also be taken into account.

(ix) Proceed to the next review category (1.2) and evaluate it in the same way as review category 1.1. Continue until all categories in the review area have also been assessed in the same manner.

(x) The evaluations of the review categories can then be used to assess the review area in the same way in which they themselves were derived from the review sub-category assessments (see point (vii) above). Thus, for example, the assessment of review area 1 is to be based upon the assessments of categories 1.1-1.3.

(xi) When all Review Areas have been assessed the EIA report as a whole can be assigned an assessment symbol. This overall judgement should, however, be supplemented with a brief summary of the EIA report's strengths and weaknesses and a consideration of whether, for example, it meets minimum requirements as specified in terms of legislation or guidelines.

The review topics form a hierarchy (or pyramidal structure) that is used by the reviewer to assess the quality of the EIA report starting from the base of the pyramid, namely the review sub-categories, followed by the review categories and ultimately the review areas. The assessment of higher levels (e.g. review categories) is done by using the lower levels' assessment (e.g. assessment of review sub-categories) and any other impressions gained from the report, which the reviewer feel are relevant. Ultimately the quality of the overall EIR is summarised in a brief summary of its main strengths and weaknesses. A schematic diagram of this hierarchy is presented in Figure 3.

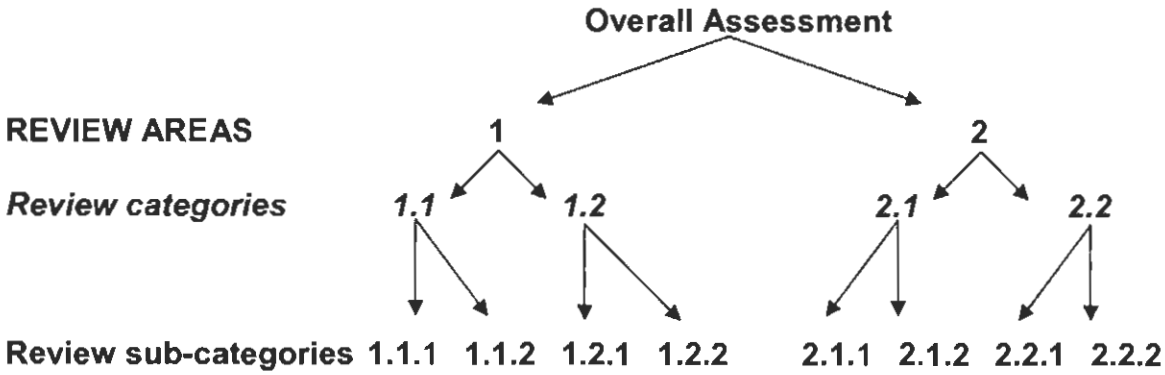

Figure 3: Schematic representation of the Review Topic hierarchy

The final judgement of the EIA report's quality was summarised in one or two paragraphs subsequent to assigning an assessment symbol to the report as a whole and checking compliance with the regulations (South Africa, 1997b). This summary

lists the main strengths and weaknesses of the EIA report, especially those omissions which should be rectified before impacts can be satisfactorily assessed or evaluated. It also records whether the EIA report complied with the minimum legal requirements.

2.5 Testing validity - pilot study review

Yin (2003:57;79) recommends that a pilot case study be conducted in preparation of the multiple case studies as it is formative and will assist in conceptually improving or clarifying the research design. In this instance a pilot study review was done to facilitate the refinement of the adapted review package (Annex 1 and 2).

A pair of independent reviewers evaluated an EIA report for the release of the biological control agent, *Falconia intermedia*, with the adapted review package. In order to conduct the pilot study review, each reviewer was requested to first independently undertake the review by reading the Advice for Reviewers in Annex 3 and then evaluating the quality of the EIA report by using the adapted review package and collation sheet in Annex 1 and Annex 2 respectively. The review of the quality of the EIA report included the consideration of whether the minimum legal requirements were met.

Subsequent to the review, the two pilot study reviewers were requested to compare their review findings as recorded on their collation sheets and to record any review area / category / sub-category that were unclear. Shortcomings in the different areas / categories / sub-categories should also have been recorded to facilitate the refinement of the review package. Differences in their assessments at sub-category, category or area level should have been jointly re-examined with a view of clarifying why different findings were made.

Based on the results of the pilot study (Annex 4), it was not required to amend the review package because both reviewers found the criteria easy to understand and to use. The researcher therefore used the adapted review package (Annex 1 & 2) to review the remaining five reports.

2.6 Multiple case study review

The remaining five EIA reports (excluding the pilot study) on the following species were reviewed by the researcher with the adapted review package:

- *Mycovellosiella lantanae* var *lantanae* (Leaf spot fungus)
- *Ophiomyia camarae* (Herringbone leaf-mining fly)
- *Coelocephalapion camarae* (Lantana petiole weevil)
- *Leptostales ignifera* (Mexican leaf-feeding inch-worm)
- *Longitarsus bethae* (Root-feeding flea beetle)

Each report was evaluated individually (Annex 5) and subsequent to that cross case analysis was done by comparing the different scores in a matrix format. From this, patterns and trends could be identified and generalisations made.

CHAPTER 3: LITERATURE REVIEW

This chapter aims to address research questions 2 and 3:

What are the international perspectives and debates relating to EIA report review?

What are the environmental aspects to consider with regards to the release of biological control agents?

The chapter is divided into three sections. The first two deals with the literature related to EIA report quality review and the third section deals with the environmental aspects that need to be considered with regard to the release of biological control agents.

3.1 Quality of EIA reports

The evaluation of the quality of an EIA report is one of the main "checks and balances" built into the EIA process (UNEP, 2002:349). It assists the authorities by providing them with a tool to verify that the information submitted in the report is credible; the information is sufficient for decision-making purposes; and it imparts public confidence in the EIA process.

The evaluation of the quality of EIA reports by means of review packages is one of a range of methods that can be used to assess the quality and adequacy of EIA reports (UNEP, 2002:358):

- General checklist – compliance with EIA legislation or guidelines is the starting point when checklists are used;
- Project specific checklist – these can be based on a general or a sectoral checklist, with further adaptations to suit the requirements of the specific project and its terms of reference;
- EIA review frameworks that are similar to review packages;
- Expert and accredited reviewers;

- Public hearings; and
- Comprehensive review of the whole EIA process.

The use of the above mentioned tools to determine the quality of EIA reports has lead to the realisation that in spite of the important role information plays in the EIA approval process, the quality of EIA reports is highly variable (Glasson, *et al.*, 1995: 153; Asian Development Bank, 1997:1; Barker & Wood, 1999:387; Morrison-Saunders *et al.*, 2001:325; Simpson, 2001:83; Bankwatch, 2003:36; Almansa *et al.*, 2004:224).

Most EIA reports have a sound theoretical basis and thorough descriptions of the proposed projects are provided, but the scientific and technical information that determine the levels and significance of potential impacts and which forms the basis for decision making is often inadequate. The reasons for the poor quality EIA reports are mainly unqualified and/or inexperienced environmental assessment practitioners, insufficient time and finances to obtain the relevant and adequate information, inadequate terms of reference or plan of study for the EIA undertaken, and decision-making authorities that do not force continual improvements (Asian Development Bank, 1997:1; Barker & Wood, 1999:387; Morrison-Saunders *et al.*, 2001:325; Simpson, 2001:83; Bankwatch, 2003:36; Almansa *et al.*, 2004:224).

3.2 Considerations and evaluation criteria for EIA reports

The main considerations in the evaluation of an EIA report are what Sadler (1996) calls the triple A-test:

- Appropriateness (coverage of key issues and impacts),
- Adequacy (of impact analysis), and
- Actionability (does the report provide the basis for informed decision making?).

The triple A-test can be rephrased to provide three main review criteria that should be satisfied by an EIA report (Asian Development Bank, 1997:1):

- Completeness and conformance with the relevant legal requirements and the terms of reference or plan of study for the specific project,

- Accuracy, reliability and acceptability of scientific criteria and information used in the report, and the use of acceptable methods for the assessment of environmental impacts and to determine the significance of those impacts; and
- Clear descriptions of environmental impacts, recommended mitigation measures, environmental monitoring plan, and environmental management plan.

The above mentioned main criteria should however be sub-divided into more specific criteria to determine the quality of an EIA report that address a specific project type, e.g. the release of a biological control agent. The only other consideration, once the criteria have been determined, is the method to be used to evaluate the quality of the EIA report with the use of the specific criteria. As mentioned in section 3.1 various methods have been developed. The effective implementation of these methods, not only by the decision making authority, but also by the environmental assessment practitioners before reports are submitted to the authority, can assist in improving the quality of the EIA reports.

The Lee Colley review package (Lee and Colley, 1992) was selected as the review tool for this specific research proposal as it has been successfully adapted to review other environmental assessment reports, including strategic environmental assessment (Simpson, 2001:4; Sandham *et al.*, 2004). The Lee-Colley review package is quick, easy to understand and the criteria used in the evaluation can easily be adapted to reflect requirements of the specific EIA report type to be evaluated (Simpson, 2001:4). The details relating to the review package and the adaptations made for the review of EIR reports on the release of biological control agents are discussed in detail in chapter 2 (Research Design and Methodology).

3.3 Aspects to consider with regard to biological control agents

3.3.1 Host specificity testing

Host specificity testing is one main aspect that must be addressed adequately in an EIA report on the release of a biological control agent. Unfortunately, host specificity testing philosophies have been inconsistently defined and testing approaches inconsistently applied in the past (Sheppard, *et al.*, 2005:3), which lead to decision

making authorities losing confidence in the outcomes of these tests. It is therefore not strange that host specificity testing is the subject about which researchers, who are testing biological control agents, interact the most with decision makers, who have to authorise the release of the biological control agents (Briese, 2005:1). The main reason for this subject being so controversial is the need for more certainty about the biological control agent's host-range in an open environment (in field conditions), but researchers are compelled to test host specificity primarily under highly restricted laboratory conditions that are completely different from the conditions the biological control agent will be exposed to once it is released in the new environment.

Several aspects relating to host specificity testing must be addressed in an EIA report on the release of a biological control agent:

- The method of selecting the test plants (potential hosts) to be tested with the target weed to determine host-range,
- The methodology used to perform the host specificity tests,
- The interpretation or analysis of the results obtained from the host specificity tests, and
- The effective communication of these results to the decision making authority.

Since 1974, the method of choice of selecting the test plants (potential hosts) to be tested with the target weed to determine host range has been the centrifugal phylogenetic method (Wapshere, 1974 as quoted by Briese, 2005:4). This involves the investigation of the evolutionary history of the target weed, with the investigation commencing with the nearest relatives of the target weed within the family and proceeding to less closely related plants in other families in the same order (Wapshere, 1974). According to Briese (2005:4) the procedure is fixed in a period of time when there was less knowledge about host-choice behaviour and the relationship of plants. This resulted in huge numbers of test plants being included from as many related taxa as possible. Briese (2005:4) proposes that the centrifugal phylogenetic method should be adapted by including the latest published data on plant phylogenetic relationships, and making use of the better understanding of agent behaviour and drivers of host-usage by specialist agents. This will result in plants being selected primarily on the basis of their phylogenetic relationship to the

target weed, but with ecological and biogeographic filters applied to ensure that plants tested are those with the highest risk profiles (Briese, 2005:4). This is supported by Sheppard *et al.* (2005:5) who expands on the proposal by Briese (2005:4) and proposes the inclusion of test plants that are indigenous and economic species in the same order or in other orders with some morphological or biochemical similarity with the target plant, or any plant on which congeners of the agent have been previously found to feed and reproduce.

Once the test plants are identified and selected to be tested with the target plant, the host specificity tests must help predict the field host specificity on these test plants (non-target hosts) relative to the target plant (van Klinken, 2000 as quoted by Sheppard *et al.*, 2005:6). There are three basic host specificity test design types, each prone to behavioural induced outcome (Marohasy, 1998 as quoted by Sheppard *et al.*, 2005:6):

- No-choice tests

  With this test all life stages of the biological control agent are confined onto one species at a time (single test species) (Hill, 1999). The biological control agent is confined to a test plant until death or at least for sufficient time to reach a highly deprived state. This test is also done as starvation tests for feeding. This test effectively excludes possible effects of prior experience and learning and maximise the motivation levels (van Klinken & Heard, 2000 as quoted by Sheppard *et al.*, 2005:9).
- Choice tests

  There are two distinct forms of choice test, the traditional choice test in which the choice includes the target host and the 'choice-minus-target' test where multiple non-target test plants are presented to the biological control agent without the target host (multiple test species)(Heard & van Klinken, 1998 and Marohasy, 1998 as quoted by Sheppard *et al.*, 2005:7). These tests allow assessment of how motivation, prior experience, and learning affect preference, but should not be done alone as they may inaccurately predict field host range (Haines *et al.*, 2004). Choice tests are the preferred method for highly mobile discriminatory life stages or where the test plants are small and where test plant phenology can be synchronised (Sheppard *et al.*, 2005:7).

- Field tests

  Field test are choice tests carried out in the country of origin of the biological control agent and are usually carried out to screen multiple potential biological control agents or to get clarification or refinement of results from other types of tests (Sheppard *et al.*, 2005:7).

Deciding on the optimal host specificity test methodology requires the researcher to clearly define and understand the life stages of the biological control agent that will require testing; the biological control agent's host selection behaviour; and effects of motivation, prior learning and experience (Sheppard *et al.*, 2005:5). Based on that, the host range of the various life stages of the biological control agent should be determined by making use of no-choice tests, choice tests or field tests or a combination of the three types of tests.

The life-stage(s) most likely to pose a threat to non-target plants include all the stages that select host plants (Sheppard *et al.*, 2005:8). These are usually mobile fecund adult females in the case of arthropods (also males if the adult feeding is significant) or dormant and wind-dispersed spore stages for pathogens (Sheppard *et al.*, 2005:8). In the case of arthropods, basic understanding of how these stages detect, select, and start damaging a new host is needed, and for pathogens, how the spores are dispersed, and the environmental conditions required for spore germination and host penetration (Sheppard *et al.*, 2005:8).

If the biological control agent is an arthropod, studies of host perception and acceptance behaviours for oviposition or feeding is required, as the biological control agents do not choose between hosts but undergo a sequence of behavioral steps which lead either to acceptance or rejection of each potential host encountered (Sheppard *et al.*, 2005:8). Damaging life stage(s) either through the infective growth stages of pathogens or direct feeding by usually the immature and adult stages in arthropods requires testing. The only exception, where further testing is not required, is when discriminatory stages are non-feeding and have been shown to be extremely specific to the target species so there is no opportunity for evolutionary change in host range following release (Sheppard *et al.*, 2005:8). In other cases, however, it is not sufficient to consider only the discriminatory stages of

potential agents even if the most damaging stages do not move between hosts because, at least in arthropods, host preference is not always correlated with agent performance.

The environment in which the host specificity tests are done and the new environments into which the biological control agent will be released also have an influence on the biological control agent. New environments can modify host perception and acceptance behaviours, leading to rapid evolutionary changes in host preference within the host range (Sheppard *et al.*, 2005:8). Behavioural response or virulence of the biological control agent can be affected by environmental conditions and this is a major constraint for the accuracy of the host specificity tests that are done in controlled conditions in the laboratory (Sheppard et al., 2005:5).

The last, but crucial step in the host specificity testing is the interpretation of the results. An important consideration in the evaluation of host specificity tests is that the results do not provide definitive predictions on whether or not a particular agent will be "safe" (Briese, 2005:4). Screening plants for safety would be very hard to achieve without testing all plant species within the expected host range of a potential agent. Host specificity testing is an assessment tool for predicting the likelihood of non-target damage based on all potential non-targets available in the new environment, rather than a means to define whether or not a particular plant or group of plants will be safe from damage.

The host specificity test is therefore a tool to determine fundamental host range and based on that the field host range of the biological control agent can be predicted. The fundamental host range defines the absolute limits of a species host range and is a broader concept than the "physiological host range" as it acknowledges the need for appropriate behavioural stimuli for host acceptance rather than just meeting simple physiological requirements (Sheppard *et al.*, 2005:4). Fundamental host range includes all hosts that, given synchronous phenology, are used by a potential biological control agent when no alternative is offered, i.e. independent of any environmental setting and determined through no-choice tests.

Louda *et al.* (2005:3) performed quantitative retrospective analyses on ongoing biological control projects and highlighted the importance of ecological host range, which is a prediction of host use under the range of physical and biotic conditions in the new environment. Although ecological host range is recognised as important, quantification is usually based on extrapolation from observed field occurrences and the list of hosts within the country of origin of the biological control agent (Louda *et al.*, 2005:3). The quantitative estimation of the magnitude and impact of the use of alternative host species by the biological control agent can only be determined post-release as a retrospective analysis as was done by Louda *et al.*(2005:1).

While the differences between fundamental, ecological and field host ranges in plant pathogens can be largely explained by host quality or environmental differences between the laboratory settings of the tests and the field situation, in arthropods, a number of causes have been recognized that relate to arthropod behaviour and other ecological factors (Sheppard *et al.*, 2005:10):

- Incorrect characterization of fundamental host range – host specificity tests over-estimated or under-estimated field host range.
- Ecological causes for contrasting fundamental and field host ranges
    - Absence of target species (host) – non-target species (potential hosts) do not or only partly support the biological control agent's lifecycle under natural conditions and therefore biological control agents can not maintain a positive growth rate.
    - Presence of target species (host) – spill-over effect resulting in the use of non-target species (potential hosts) in the presence of the target species (host). Or susceptible non-target species (potential hosts) may not be acceptable if their preference rank is lower than other hosts present.
    - Asynchrony – susceptible stages of the target species (host) or non-target species (potential hosts) may be asynchronous with the activity period of the agent.
    - Geographical incompatibility – habitat or climate preferences of the biological control agent that do not concur with the habitat or climate in which the target species (host) or non-target species (potential hosts) are found.

The analysis done by Louda *et al.* (2005:1) quantified the fact that host range and preference from host specificity tests are not sufficient to predict ecological impact, if the introduced biological control agent is not strictly monophagous, i.e. a species which only uses one species as a host plant. An implicit assumption is made when the host specificity data are used in risk assessment, and that assumption is that population impacts are proportional to relative preference and performance, the two key components of host specificity. However, in concert with shifting awareness in the field, the studies done by Louda *et al.* (2005:1) demonstrate that the environmental influences can alter host use and population growth, leading to higher than expected direct impacts on the less preferred indigenous non-target host species at several spatial scales and that straightforward, easily anticipated indirect effects, on intraguild foragers (foragers that use identical and potentially limited resources and thus compete for it) as well as on the less preferred indigenous non-target host plant species, can be both widespread and significant.

Taking the above into consideration, predicting field specificity, the level of damage on non-target species relative to the target plant, and the likely ecological non-target impacts of that damage, is a real challenge and it is understandable that no clear black-or-white answer will be forthcoming from the process. Researchers involved in biological control agents use risk analysis to determine the magnitude of the threat (predicted host specificity) and the likelihood of such threats occurring (predicting impacts) (Arnett & Louda, 2002:4; Baars *et al.*, 2003:10; Berner & Bruckart, 2005:10; Briese, 2005:7; Louda *et al.*, 2005:1; Sheppard *et al.*, 2005:12; Wright *et al.*, 2005:4 Ding, *et al.*, 2006:14). The results obtained from the risk analysis must be communicated and risk communication is as important as the risk analysis as it requires the interpretation of information in a manner that is understandable (Briese, 2005:7). Linked to risk analysis and risk communication, is risk management, which requires the researcher to propose management options to negate the risks identified.

Based on the literature referenced above, the environmental assessment tool being used to determine the suitability and acceptability of a biological control agent, considered for release into the environment, is a risk assessment. In terms of South Africa's legislation, as mentioned in chapter 1, an EIA is requested for the release of

a biological control agent (ECA, 73/1989; NEMA, 107/1998) and in terms of NEMBA (10/2004) a risk assessment must be done before a restricted activity involving an alien species, which includes biological control agents, can be carried out. The legislative framework therefore facilitates the assessment tools used with regard to biological control agents. The reports evaluated for this research topic were compiled in compliance with ECA (73/1989) and therefore the EIA process was followed. Despite the difference in the assessment tool being used, the information, methodology, risk analysis, risk communication and risk management as discussed above should be included in an EIA report on the release of biological control agents.

3.3.2 Indirect ecological effects of host specific biological control agents

In sub-section 3.3.1 the importance of host specificity tests were highlighted and their importance in predicting field host specificity, but studies indicate that even highly host specific biological control agents can impact non-target species through indirect effects (Pearson & Callaway, 2005:1), making it an important aspect to be addressed in an EIA on the release of a biological control agent.

Pearson & Callaway (2005:2) found that indirect non-target effects of host specific biological control agents are derived from the nature and strength of the interaction between the biological control agent and its target pest and therefore the only way to prevent indirect non-target effects, is to ensure the biological control agent is not only host specific, but also efficacious. Biological control agent efficacy refers to the capacity of a biological control agent population to suppress their host population, more effective biological control agents being those that more quickly suppress their hosts either by attaining very high damage levels or by attacking host stages where relatively small amounts of damage lead to relatively large changes in the dynamics of the target host (Sheppard, 2003:11).

Biological control agents that greatly reduce their target species, while remaining host specific, will reduce their own populations through density-dependent feedbacks, thereby minimizing risks to non-target species (Pearson & Callaway, 2005:1). The challenge is therefore to find natural enemies (biological control

agents) that will be effective in limiting the density of the target species in its new environment, and do so without initiating ecological ripple effects with long-term consequences for the recipient community (Louda *et al.*, 2005:2).

Unfortunately, biological control programmes have over-emphasized host specificity as the most important consideration in selecting biological control agents for introduction, with the main aim to avoid undesirable non-target effects. The outcome has been that the total biological control evaluation process operates under the assumption that non-target effects arise only when biological control agents directly attack non-target species, or conversely that host specific biological control agents are "safe" (Pearson & Callaway (2005:3). The emphasis on host specificity has diverted attention from other potential sources of risk to non-target species that has contributed, at least in part, to certain biological control strategies like the "lottery approach" (Myers, 1985 as quoted by Pearson & Callaway 2005:3), which may unnecessarily elevate non-target risk, especially indirect non-target risk. The lottery approach is a multiple release strategy in classical biological control that promotes the deployment of multiple host specific biological control agents for each target pest (Myers, 1985 as quoted by Pearson & Callaway, 2005:3; Sheppard, 2003:12). This is the approach used by South African scientists involved in biological control as can be seen from this study where EIA reports on the release of multiple biological control agents on one specific target weed, namely lantana, were evaluated.

The lottery approach places great emphasis on host specificity of individual biological control agents, but does not weigh efficacy as heavily, due to the assumption that the most effective biological control agent or combination of biological control agents will emerge from the milieu of introductions (Pearson & Callaway, 2005:3). The lottery approach is one of the multiple release strategies in biological control that has been most criticised because relative to other approaches it depends the most on chance and the least on explicit knowledge of community interactions in the introduction (McEvoy and Coombs, 2000 as quoted by Pearson & Callaway, 2005:3; Sheppard, 2003:12).

The introduction of any individual biological control agent will present some risk to non-target species, the degree of risk will increase with increasing numbers of biological control agents. By applying community ecology theory to biological control, many ways in which biological control agents can indirectly impact on non-target species are uncovered (Pearson & Callaway, 2005:4). Pearson & Callaway (2005:5) identified three categories of indirect non-target effects that can arise from highly host specific biological control agents:

- Ecological replacement – this occurs when an established invader replaces / displaces indigenous species in such a way that other indigenous species become dependent on the invader. Successful control of the invader by the biological control agent results in negative impacts on the indigenous species that have become dependent on the invader.
- Compensatory responses – this occurs when the target host compensates by displacing the negative impact of the biological control agent by, for example, increasing relative growth rates, competitive effects, inducing the production of chemicals that might harm other species or stimulates the release of root exudates, thereby increasing the negative impact of the target species on indigenous species.
- Food-web interactions – this can arise when generalist consumers or other generalist natural enemies exploit a host specific biological control agent. This indirect non-target effect includes enrichment that is described below.

An example of indirect non-target effects arising from the introduction of a highly host specific biological control agent is enrichment (Holt & Hochberg, 2001 as quoted by Pearson & Callaway, 2005:4), where the biological control agent becomes sufficiently abundant to subsidise populations of generalist natural enemies, capable of exploiting the biological control agent. This interaction indirectly affects other organisms that are also attacked by the generalist natural enemy.

An intriguing but not well explored set of non-target interactions with the introduction of a new species into a community involves the potential niche overlap of the introduced herbivore with the indigenous insect herbivores dependent upon the indigenous non-target host plants (Louda *et al.*, 2005:5). The potential for both direct and indirect negative effects exists and the retrospective studies done by Louda *et*

al. (2005) and the studies done by Pearson & Callaway (2005) suggest that these potential interactions can and should be assessed in risk assessments prior to the introduction of the new biological control agent. These potential interactions should therefore be addressed in an EIA report on the release of a biological control agent.

3.3.3 Impact of biological control agent on target species

Although it is almost taken for granted that the selection of a potential biological control agent is based on the impact it will have on a target species, it is an aspect that warrants further investigation during the evaluation process. Although scientists involved in biological control agree that improving the selection of effective agents prior to release is a key to minimizing the number of agents necessary for successful control and maximising success rate, biological control agent selection remains one of the least science-based activities in biological control (Sheppard, 2003:11). The increase in knowledge with regard to population ecology and more specifically, natural enemy-plant interactions has lead to the use of ecological theory and the development of experimental tools for assessing biological control agent efficacy prior to release (Waage, 1991 as quoted by Sheppard, 2003:11).

Studying the ecology and population dynamics of the invasive weed (target host) in its country of origin, to estimate the key population parameters and life stage transitions is the first step to understanding which factors are most likely to suppress weed populations and provides a scientific basis for developing integrated weed management strategies that includes biological control (McFadyen, 2003:5; Sheppard, 2003:13). These studies also provide the baseline data against which the impacts of biological control agents or other weed management strategies can be evaluated (Sheppard, 2003:13).

The aim of ecological studies on both the target weed and the potential biological control agent is to (McFadyen, 2003:5):

- Identify weak points in the target weed where the impact of certain types of damage could significantly reduce the weed's population; and
- Identify factors determining probable effectiveness of the biological control agent in the new environment.

McFadyen (2003:5) describes an effective biological control agent as an agent that establishes in the new environment, reaches and maintains a sufficient population size and causes significant damage to critical stages of the target weed's life cycle.

Louda *et al.* (2005:2) emphasize the importance of evaluating the population growth potential of the prospective biological control agent and the likely impact on both targeted host species and non-target species. According to Simberloff & Stiling (1996) as quoted by Louda *et al.* (2005:2) few pre-release studies have actually quantified these ecological traits for prospective biological control agents prior to release into new environments. Evaluation of population growth potential and likely impacts in new environments requires investigation and understanding of the factors influencing population dynamics, growth, spread, and direct impact on host species at various resource levels and with varied resource mixes (Louda *et al.*, 2005:2).

According to McFadyen (2003:5) a small proportion of biological control agents, 10% – 20% fail to establish in the new environment, despite best practice in mass rearing and release. The ability to predict this failure must be improved, if the selection of biological control agents is to improve, as a biological control agent that fails to establish after detailed testing and considerable release effort is perhaps the greatest waste of resources (McFadyen, 2003:5).

If a biological control agent has the ability to establish itself successfully in the new environment, the potential and actual impact of the biological control agent on the target weed is the next important consideration. The impact on the target weed is dependent on the interaction of agent abundance and damage caused and although potential damage or impact is usually well understood prior to the release of a biological control agent, the actual impact on the target weed's population is influenced by the magnitude, duration and timing of the damage caused by the successfully established biological control agent, which is harder to predict and depends on the biological control agent's population size throughout the year (McFadyen, 2003:6). In turn the population size of the biological control agent is affected by several factors that include parasitism, predation and impact of climate (McFadyen, 2003:6).

Based on the information above, it is clear that information relating to ecological aspects, such as the biological control agent's ability to establish, proliferates and causes damage to crucial life stages of the target weed, should be included in an EIA report on the release of a biological control agent. These ecological aspects determine the success of the biological control agent once released into the environment and should therefore be investigated, addressed and reflected in EIA reports on the release of biological control agents to facilitate informed decision making.

CHAPTER 4: DATA ANALYSIS

This chapter aims to address research question 4:

What is the quality of EIA reports on the release of biological control agents for *Lantana camara* (Lantana)?

This chapter deals with data analysis and is divided into six sections. The first section deals with the overall cross case analysis, after which sections 2 to 5 explores the specific categories and sub-categories for review area 1 to 4 in more detail. The chapter concludes with the analysis of the legal compliance achieved by the EIA reports.

4.1 Multiple case study analysis

The overall results of the evaluation of the quality of the six EIA reports are reflected in Table 2 (also see Annexes 4 & 5). The overall quality of the reports is poor and four of the six reports were evaluated as just unsatisfactory (D) with parts well attempted, but with omissions and inadequacies. The remaining two EIA reports with the lowest assessments, (F – very unsatisfactory) (*Falconia intermedia*) and (E – not satisfactory) (*Mycovellosiella lantanae* var *lantanae*) were some of the first reports submitted in compliance with the ECA regulations (South Africa, 1997b). In this regard it might be argued that the quality of reports improved marginally over time.

Two broad patterns emerged from the above data with review areas 1 and 4 and 2 and 3 showing similar results. Review areas 2 and 3 are the areas with the most weaknesses and the lowest assessments. These areas represent the requirements relating to impact identification and the consideration of alternatives, mitigation measures and monitoring provision, which are all minimum legal requirements.

Review areas 1 and 4 are the areas that require information relating to the overall project application, including detailed information relating to the target weed and the

proposed biological control agent to be released, and requirements relating to the lay-out of the report and the presentation of information in the report.

Table 2: *Summary of EIA report quality*

EIA Reports (Cases 1-6)	Overall Quality	Review Area 1	Review Area 2	Review Area 3	Review Area 4
***Case 1 :** *Falconia intermedia* (Mirid bug)	F	D	F	E	C
Case 2 : *Mycovellosiella lantanae* var *lantanae* (Leaf spot fungus)	E	D	F	E	C
Case 3 : *Ophiomyia camarae* (Herringbone leaf-mining fly)	D	D	E	D	B
Case 4 : *Coelocephalapion camarae* (Lantana petiole weevil)	D	B	D	D	C
Case 5 : *Leptostales ignifera* (Mexican leaf-feeding inch-worm)	D	C	D	D	C
Case 6: *Longitarsus bethae* (Root-feeding flea beetle)	D	C	D	D	C

Notes:

Review Area 1: Description of the biological control agent proposed for release, the receiving environment, the proposed pest/target species and the anticipated result of the release.

Review Area 2: Identification and evaluation of key impacts.

Review Area 3: Alternatives and mitigation of impacts.

Review Area 4: Communication of results.

*Served as case study and was reviewed by two additional external reviewers

Review area 4 was generally considered just satisfactory (C) and represents the area of best performance in all the EIA reports. Review area 1 was evaluated as unsatisfactory (D) for cases 1 to 3 and just satisfactory (C) and generally satisfactory (B) for cases 4 to 6. The reason for the unsatisfactory quality in cases 1

to 3 might be due to the fact that these were the first reports compiled in terms of the ECA regulations (South Africa, 1997b).

The EIA reports on the release of biological control agents for the control of Lantana that were evaluated, contained adequate information on the target weed, the biological control agent proposed for release and the host specificity tests and the information was communicated satisfactorily (review areas 1 and 4). All the reports, however, had major deficiencies with regard to the identification of impacts, mitigation measures and monitoring provisions, resulting in the evaluation of review areas 2 and 3 as mainly unsatisfactory.

However, a more detailed analysis is required to unpack the overall results. A more comprehensive identification of specific positive aspects and deficiencies were obtained from an analysis of the categories and sub-categories of all the review areas of the review package (see Tables 4, 5, 6 & 7).

4.2 Analysis of review area 1

Review area 1 contains criteria for the evaluation of information that must be provided about the biological control agent proposed for release, the receiving environment, the proposed target species and the anticipated result of the release. This provides the background information about the whole project and the reasons for the proposed release of the biological control agent. The analysis of the categories and sub-categories of review area 1 are reflected in Table 3.

Category 1.1 (description of the biological control agent proposed for release) was evaluated as just satisfactory (C) for the EIA reports on the release of *Falconia intermedia*, *Mycovellosiella lantanae* var *lantanae*, *Leptostales ignifera* and *Longitarsus bethae*, while the EIA reports on the release of *Ophiomyia camarae* and *Coelocephalapion camarae* were evaluated as generally satisfactory (B). The reason the two EIA reports were evaluated as generally satisfactory (B) was that both these reports provided adequate information for sub-categories 1.1.1 – 1.1.5, which included information relating to taxonomy, origin of the species, damage caused by the proposed biological control agent and previous releases.

Table 3: Analysis of category and sub-category levels in review area 1 (Description of the biological control agent proposed for release, receiving environment & target species)

EIA Report	Category		
	1.1	1.2	1.3
Case 1 * *Falconia intermedia*	C	F	C
Case 2 *Mycovellosiella lantanae* var *lantanae*	C	F	D
Case 3 *Ophiomyia camarae*	B	F	D
Case 4 *Coelocephalapion camarae*	B	D	B
Case 5 *Leptostales ignifera*	C	D	B
Case 6 *Longitarsus bethae*	C	D	B

EIA Report	Sub-category													
	1.1.1	1.1.2	1.1.3	1.1.4	1.1.5	1.1.6	1.2.1	1.2.2	1.2.3	1.2.4	1.3.1	1.3.2	1.3.3	1.3.4
Case 1 *	B	B	A	B	B	F	E	F	F	F	C	F	C	D
Case 2	B	C	B	A	C	F	E	E	F	F	A	C	D	E
Case 3	A	B	B	A	B	F	F	F	F	F	A	D	D	F
Case 4	A	B	A	A	B	F	B	F	F	F	A	B	A	B
Case 5	A	A	B	B	E	F	B	F	F	F	A	B	B	C
Case 6	A	A	B	B	E	F	B	F	F	F	A	B	B	C

Notes:

Category 1.1: Description of the biological control agent proposed for release.

Category 1.2: Receiving environment.

Category 1.3: The proposed target invasive alien plant species / pests.

*Served as case study and was reviewed by two additional external reviewers

In three of the other reports, *Mycovellosiella lantanae* var *lantanae*, *Leptostales ignifera* and *Longitarsus bethae* a deficiency was the lack of information relating to prior releases of the species (sub-category 1.1.5). No indication was given in the reports whether prior releases took place or not. Information relating to prior releases can assist authorities in making a decision relating to the release of the biological control agent. Retrospective studies as done by Louda *et al.* (2005) and discussed in section 3.3, emphasizes the benefit of assessing the direct and indirect effects of a biological control agent that has been released into the environment.

It is interesting to note that sub-category 1.1.6 (the number of biological control agents to be released & the frequency of release) was evaluated as very unsatisfactory (F) for all the EIA reports. This is because none of the reports provided information relating to the numbers of biological control agents to be released or the frequency of the releases. Either the applicant did not consider it as important information or it has not been determined and therefore not included in the report. Taking into consideration the importance of the establishment and proliferation of the biological control agent in determining its efficacy (McFadyen, 2003:5; Louda *et al.*, 2005:2), the omission of this information is a major deficiency in the report, even more so because sub-category 1.1.6 represents a minimum legal requirement.

The evaluation of category 1.2 (receiving environment) resulted in the EIA reports on the release of *Falconia intermedia, Mycovellosiella lantanae* var *lantanae* and *Ophiomyia camarae* being evaluated as very unsatisfactory (F), while the following three EIA reports were evaluated as just unsatisfactory (D); *Coelocephalapion camarae*, *Leptostales ignifera* and *Longitarsus bethae*.

The analysis of the sub-categories provides more information regarding the reasons for these evaluation results. Sub-category 1.2.1 (description of area proposed for release) was evaluated as generally satisfactory (B) for three of the reports (EIA reports on *Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae).* These three EIA reports included maps and some general information on where the proposed biological control agent will be released, based on the occurrence of the target weed. The other three EIA reports (EIA reports on the

release of *Falconia intermedia, Mycovellosiella lantanae* var *lantanae* and *Ophiomyia camarae*) were evaluated as not satisfactory (E) and very unsatisfactory (F) because of the lack of information relating to the proposed area where the release would take place. These three reports were compiled when the ECA regulations (South Africa, 1997b) just came into effect and therefore inexperience and limited understanding of the requirements in terms of the legislation could have been the reason for the omission of this information. This aspect is however important, as mentioned before, because it represents a minimum legal requirement.

Sub-category 1.2.2 (proximity of potential non-target indigenous species which were utilized by biological control agent during host specificity tests), 1.2.3 (land uses of surrounding areas) and 1.2.4 (potential spread of species from the release sites) were all evaluated as very unsatisfactory (F) with the exception of one report (EIA report on the release of *Mycovellosiella lantanae* var *lantanae*) that was evaluated as not satisfactory (E) for sub-category 1.2.2. The results for the evaluation of sub-category 1.2.2, 1.2.3 and 1.2.4 are due to the absence of information regarding these issues in all the reports.

These results are quite concerning as the results of the host specificity testing done for the proposed biological control agents indicated that they utilize an indigenous *Lippia* species. According to the applicant the degree of utilization and damage to the *Lippia* species was minimal compared to that on its natural host, lantana, and the *Lippia* species is highly unlikely to sustain populations of biological control agents in the field over time. The applicant states that the reason the biological control agents utilize the *Lippia* species is probably due to the fact that the *Lippia* species and *Lantana camara* have at least one secondary chemical in common (Van Wyk *et al.*, 2002 as quoted in the EIA report on *Coelocephalapion camarae*). The applicant however justifies the release of the proposed biological control agents by stating in at least three of the EIA reports (EIA report on the release of *Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*) that: *"the degree of possible suppression of Lippia species by the biological control agents is far less than the threat that is posed by the target species, Lantana camara, invading the natural habitat of these indigenous species".*

Although the negative impact of lantana on the environment is the reason biological control agents are considered as a control option for this invasive species, the fact that multiple biological control agents have already been released for the control of lantana, causes real concerns regarding the cumulative impacts of all these biological control agents on non-target indigenous species, like the *Lippia* species.

With regard to sub-category 1.3 (information on the target species) three reports were evaluated as generally satisfactory (B); *Coelocephalapion camarae*, *Leptostales ignifera* and *Longitarsus bethae* and one report (EIA report on the release of *Falconia intermedia* as just satisfactory (C). Adequate information was provided in the above mentioned four EIA reports relating to the target species, its status and distribution (sub-category 1.3.1 and 1.3.2), its impact on biodiversity and economy (sub-category 1.3.3) and other biological control agents released for the control of the target species (sub-category 1.3.4). Two of the EIA reports (release of *Mycovellosiella lantanae* var *lantanae* and *Ophiomyia camarae*) were evaluated as just unsatisfactory (D) and, as mentioned before, this could be due to the applicants not being familiar with all the information required for EIA reports.

4.3 Analysis of review area 2

The requirements in review area 2 reflect one of the most important aspects of an EIA, namely the identification and evaluation of key impacts. If this area is flawed, the report resulting from the EIA process can not be considered adequate or satisfactory.

The analysis in Table 4 indicates that category 2.3 (the prediction of the extent and intensity of the impacts) as well as sub-category 2.4.1 (the assessment of the significance of an impact, taking into consideration appropriate national and international quality standards) was generally done satisfactory in the reports. Category 2.3 and sub-category 2.4.1 were evaluated as satisfactory due to the fact that they relate to host specificity testing and risk analysis to determine host range and to predict the extent and impact of the potential biological control agent on the target and possible non-target species.

Table 4: Analysis of category and sub-category levels in review area 2 (Identification and evaluation of key impacts)

EIA Report	Category			
	2.1	2.2	2.3	2.4
Case 1 * *Falconia intermedia*	E	F	F	F
Case 2 *Mycovellosiella lantanae* var *lantanae*	F	F	C	E
Case 3 *Ophiomyia camarae*	E	E	B	E
Case 4 *Coelocephalapion camarae*	D	D	C	D
Case 5 *Leptostales ignifera*	D	D	B	C
Case 6 *Longitarsus bethae*	D	D	B	D

EIA Report	Sub-category												
	2.1.1	2.1.2	2.1.3	2.1.4	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3
Case 1 *	D	D	F	E	F	F	F	F	F	F	F	F	F
Case 2	F	F	F	F	F	E	F	D	C	C	D	F	E
Case 3	E	E	F	E	F	E	E	B	B	A	C	F	F
Case 4	D	D	F	D	C	D	D	B	C	C	C	E	D
Case 5	D	D	F	D	C	D	E	B	B	B	B	D	D
Case 6	D	D	F	E	C	D	E	B	B	B	B	D	D

Notes:
Category 2.1: Definition and identification of impacts.
Category 2.2: Scoping.
Category 2.3: Prediction of the extent and intensity of the impacts.
Category 2.4: Assessment of impact significance.
*Served as case study and was reviewed by two additional external reviewers

The methodology used by the applicant to do the host specificity tests and the risk assessment was adequate and in line with international best practices (see section 3.3). The method used to select the test plants to be tested with the target weed to determine host and host specificity is the centrifugal phylogenetic method originally developed by Wapshere in 1974 (Wapshere, 1974 as quoted by Briese, 2005:4). All the biological control agents tested and reported on in the EIA reports utilized an indigenous *Lippia* species to some extent and the method used to select the test plants did therefore result in the detection of a non-target species being impacted on by the biological control agents.

As seen from literature, host specificity testing has been over-emphasized as the most important consideration when assessing a potential biological control agent for release (Pearson & Callaway, 2005:3) and the EIA reports evaluated in this study support that finding with category 2.3 (prediction of the extent and intensity of impacts) evaluated as satisfactory and categories 2.1 (definition and identification of impacts) and 2.2 (scoping) evaluated as unsatisfactory. There is however, concern about the interpretation of the results of the host specificity tests as discussed in the analysis of review area 1.

The other two sub-categories in category 2.4, sub-categories 2.4.2 (mitigation measures) and 2.4.3 (standards, assumptions and value systems used to assess significance) were evaluated as unsatisfactory. The reasons for the low assessments were:

- Mitigation measures, which are fundamental to any EIA, were not included in the EIA reports even thought the host specificity tests indicated that an indigenous non-target species was utilized by the biological control agents,

- The applicant decided without apparent justification that the only significant impacts were host range and host specificity, resulting in no further investigation or consideration of indirect and cumulative impacts. This is explicitly stated in at least three of the EIA reports (reports on the release of *Coelocephalapion camarae, Leptostales ignifera,* and *Longitarsus bethae)*: "*the only issue is whether and to what extent the potential biological control agent is capable of attacking non-target species once it is released*", and
- The applicant's interpretation of the results of the host specificity tests, resulting in the potential impact of the release of the biological control agents on non-target indigenous species (*Lippia* species) not being considered as an impact that should be further investigated and mitigated.

The low quality of the EIA reports with regard to sub-categories 2.4.2 and 2.4.3 relates to the evaluation of categories 2.1 (definition and identification of impacts) and 2.2 (scoping) that were both evaluated as unsatisfactory due to the following reasons:

- No indirect, secondary, cumulative or spatial effects were considered in the EIA report, with the focus of the report only on host specificity, and
- Limited public participation, resulting in no public opinion or even the opinion of the decision-maker being solicited in the identification and selection of potential impacts for further investigation and the applicants' unilateral decision that host range and host specificity are the only significant impacts to be investigation further.

Based on the literature review in chapter 3, the assessment of indirect effects are extremely important and should be included in the assessment of a biological control agent proposed for release. Furthermore, cumulative effects of the release of multiple biological control agents for the control of lantana, is a real concern, specifically because it relates to the impact on the indigenous non-target *Lippia* species that were utilized during the host specificity tests.

An interesting result is that of all the sub-categories, only sub-category 2.1.3 (consideration of impacts that might arise from non-standard release conditions), were evaluated as very unsatisfactory (F) for all the reports and this is due to the

fact that this aspect was omitted from all the reports. The consideration of impacts arising from non-standard release conditions is important because it is linked to the management of the release of the biological control agents.

4.4 Analysis of review area 3

Review area 3 represents the criteria relating to the consideration of alternatives and mitigation measures in the EIA reports. The consideration of alternatives and mitigation measures are legal requirements in terms of the ECA regulations (South Africa, 1997b) and should therefore be included in the EIA process and the report.

The information reflected in Table 5 indicates that category 3.1 (the consideration of alternatives), were done satisfactory (B and C) for five of the six reports (EIA reports on the release of *Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus Mycovellosiella lantanae* var *lantanae*, *Ophiomyia camarae*, *Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*) while category 3.3, that represents the commitment of the applicant to carry out mitigation measures were considered very unsatisfactory (F) for all the reports. Category 3.2 was evaluated as just unsatisfactory (D) for three of the reports (EIA reports on the release of *Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*) and very unsatisfactory (F) and not satisfactory (E) for the other reports.

The differences in results for category 3.1 and categories 3.2 and 3.3 are due to the fact that although the applicant discussed alternatives to biological control, namely mechanical and chemical control, satisfactorily, mitigation measures and monitoring programmes were not addressed satisfactorily in any of the reports. In fact, none of the reports included a monitoring programme, explaining why sub-category 3.3.2 (monitoring programmes) was evaluated as very unsatisfactory (F) for all the reports. This is a huge concern because monitoring programmes are the only way of obtaining information post-release. The information obtained through monitoring programmes enables the applicant and the authorities to determine the success of the biological control agent as well as other direct effects on non-target species, indirect - and cumulative effects.

Table 5: Analysis of category and sub-category levels in Review Area 3 (Alternatives and mitigation of impacts)

EIA Report	Category		
	3.1	3.2	3.3
Case 1 * *Falconia intermedia*	F	F	F
Case 2 *Mycovellosiella lantanae* var *lantanae*	C	E	F
Case 3 *Ophiomyia camarae*	B	F	F
Case 4 *Coelocephalapion camarae*	B	D	F
Case 5 *Leptostales ignifera*	B	D	F
Case 6 *Longitarsus bethae*	B	D	F

EIA Report	Sub-category							
	3.1.1	3.1.2	3.1.3	3.2.1	3.2.2	3.2.3	3.3.1	3.3.2
Case 1 *	F	F	F	F	F	F	F	F
Case 2	C	C	F	E	E	E	F	F
Case 3	A	B	C	E	F	F	F	F
Case 4	B	B	C	D	D	D	E	F
Case 5	B	B	B	D	D	D	E	F
Case 6	B	B	C	D	D	D	E	F

Notes:

Category 3.1: Alternatives.

Category 3.2: Scope and effectiveness of mitigation measures.

Category 3.3: Commitment to mitigation.

*Served as case study and was reviewed by two additional external reviewers

The lack of mitigation measures in the reports and the resulting poor quality of review area 3 is linked to the poor quality of review area 2 (Identification and evaluation of key impacts) that was also done unsatisfactory. The applicant

considered host specificity as the only impact to be investigated and even when the results from the host specificity tests indicated that an indigenous non-target species are utilised by the biological control agents, it was argued that the risk is low or negligible, resulting in no mitigation measures being proposed.

4.5 Analysis of review area 4

The requirements in review area 4 relate to the communication of results and focus on the layout of the EIA report, the presentation of information in the report, the emphasis of the report and the quality of the non-technical summary. A good EIA report that communicates information effectively has the following attributes (DEAT, 2004:2):

- tightly focussed on the important issues;
- clearly and coherently organised and presented, to enable its contents to be easily understood ; and
- free from bias, and emotive language.

Based on the information reflected in Table 6, criteria in category 4.1 (layout) was well performed with no important tasks left incomplete (A) for five of the six reports (reports on the release of *Mycovellosiella lantanae* var *lantanae, Ophiomyia camarae, Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*) with only the EIA report on the release of *Falconia intermedia* evaluated as generally satisfactory (B). The layout of all the EIA reports were of a good quality and it facilitated data and resource referencing.

Category 4.4 (non-technical summary) was evaluated as well performed with no important tasks left incomplete (A) for four of the six EIA reports (*Ophiomyia camarae, Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*). The EIA report on *Mycovellosiella lantanae* var *lantanae* was evaluated as generally satisfactory (B) and only the EIA report on the release of *Falconia intermedia* was evaluated as just unsatisfactory (D) due to the lower quality of the non-technical summary.

Table 6: Analysis of category and sub-category levels in review area 4 (Communication of Results)

EIA Report	Category			
	4.1	4.2	4.3	4.4
Case 1 * *Falconia intermedia*	B	C	E	D
Case 2 *Mycovellosiella lantanae* var *lantanae*	A	C	D	B
Case 3 *Ophiomyia camarae*	A	C	E	A
Case 4 *Coelocephalapion camarae*	A	C	D	A
Case 5 *Leptostales ignifera*	A	C	D	A
Case 6 *Longitarsus bethae*	A	C	D	A

EIA Report	Sub-category										
	4.1.1	4.1.2	4.1.3	4.1.4	4.2.1	4.2.2	4.2.3	4.3.1	4.3.2	4.4.1	4.4.2
Case 1 *	B	A	B	A	B	D	B	F	F	D	E
Case 2	A	B	N/A	A	C	C	B	E	D	A	D
Case 3	A	B	N/A	A	B	E	B	E	E	A	A
Case 4	A	A	N/A	A	B	F	B	C	D	A	A
Case 5	A	A	N/A	A	B	E	B	D	D	A	A
Case 6	A	A	N/A	A	B	D	C	D	D	A	A

Notes:
Category 4.1: Layout.
Category 4.2: Presentation.
Category 4.3: Emphasis.
Category 4.4: Non-technical summary.
*Served as case study and was reviewed by two additional external reviewers

Category 4.2 (presentation) was rated as just satisfactory (C) due to the low assessment for sub-category 4.2.2, which requires that technical terms should be defined. None of the reports had definitions and it is up to the evaluator to interpret the terms, which may cause misunderstandings and incorrect interpretation of information especially if the evaluator is not very familiar with biological control terminology.

Category 4.3 (emphasis) was evaluated as not satisfactory (E) for the EIA reports on the release of *Falconia intermedia* and *Ophiomyia camarae* and as just unsatisfactory (D) for the following reports; *Mycovellosiella lantanae* var *lantanae*, *Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*. This result is linked to the low assessment of review areas 2 and 3, where the applicant made a seemingly unfounded decision relating to the significant impacts and the justification for diminishing the risks to indigenous non-target species. The reports therefore do not seem to be objective.

A reason might be that the EIA reports were compiled by the same organization that performs the host specificity tests, namely the ARC-PPRI and not an independent person or organisation. In terms of the ECA regulations (South Africa, 1997b) the applicant must appoint an independent consultant that must comply with all the provisions in the regulations, i.e. perform the EIA and compile the EIA report in compliance with the regulations. While it is understandable that very specific technical expertise is required to perform the host specificity testing, a competent, independent person or organization should have evaluated the findings and compiled the report or as a minimum a review should have been done by a competent, independent person or organisation. Another reason why ARC-PPRI is not regarded as independent is the fact that it is stated in their EIA reports that the

Department of Water Affairs and Forestry (the applicant) is one of the funding organisations for the ARC-PPRI.

An interesting result is the evaluation of sub-category 4.1.3 (chapter summaries) as not applicable by the researcher and as generally satisfactory (B) by the pilot study reviewers. The chapters in the reports were fairly short and the non-technical summaries (sub-category 4.4) were of a good quality and therefore the researcher considered chapter summaries and the associated criteria redundant.

4.6 Minimum legal requirements for EIA reports

As part of the assessment, the researcher evaluated whether the EIA reports met the minimum legal requirements for EIA reports (ECA, 73/1989; South Africa, 1997b). The results are summarised in Table 7.

None of the EIA reports complied with all the minimum legal requirements. The following four sub-categories (representing minimum legal requirements) were evaluated as not satisfactory (D, E & F assessment symbols) for all the reports:

- **2.1.1(a)(i)** - Adequate descriptions of the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the release of the biological control agent were not provided.
- **3.2.1(a)(ii)** - The mitigation of all significant adverse impacts was not considered adequately and no specific mitigation measures were put forward. Any residual or unmitigated impacts were not indicated.
- **1.1.6(c)(ii)** - The number of biological control agents to be released was not provided, nor the frequency of the proposed releases.
- **2.2.2(c)(iii)** - Key impacts were not identified in an appropriate manner and therefore only one impact was selected for more intense investigation. Consultation with the relevant authorities did not take place and general public participation was very limited.

Table 7: Minimum legal requirements for EIA reports

	Minimum legal requirements (Section 8 Regulations 1183)												
	(a) (i)				(a) (ii)	(b)		(c) (i)		(c) (ii)		(c) (iii)	
Sub-categories	2.1.1	2.3.1	2.3.3	2.4.1	3.2.1	3.1.1	3.1.3	1.2.1	1.3.1	1.1.1	1.1.6	2.2.1	2.2.2
EIA report													
Case 1 * *Falconia intermedia*	D	F	F	F	F	F	F	E	C	B	F	F	F
Case 2 *Mycovellosiella lantanae* v. *lantanae*	F	D	C	D	E	C	F	E	A	B	F	F	E
Case 3 *Ophiomyia camarae*	E	B	A	C	E	A	C	F	A	A	F	F	E
Case 4 *Coelocephalapion camarae*	D	B	C	C	D	B	C	B	A	A	F	C	D
Case 5 *Leptostales ignifera*	D	B	B	B	D	B	B	B	A	A	F	C	D
Case 6 *Longitarsus bethae*	D	B	B	B	D	B	C	B	A	A	F	C	D

Notes :

(a) a description of each alternative, including particulars on-

  (i) the extent and significance of each identified environmental impact; and

  (ii) the possibility for mitigation of each identified impact;

(b) a comparative assessment of all the alternatives; and

(c) appendices containing descriptions of-

  (i) the environment concerned;

  (ii) the activity to be undertaken;

  (iii) the public participation process followed, including a list of interested and affected parties and their comments.

*Served as case study and was reviewed by two additional external reviewers

Sub-category 1.3.1 (the description of the target species), is one of the sub-categories that represents compliance with legal requirement (c)(i) and this sub-category was evaluated as well performed, with no important tasks left incomplete (A) for five of the EIA reports. Only the EIA report on the release of *Falconia intermedia* was evaluated as just satisfactory (C). Similarly, Sub-category 1.1.1, the description of the biological control agent proposed for release that is one of the sub-categories that represents compliance with legal requirement (c)(ii) was evaluated as well performed, with no important tasks left incomplete (A) for four of the six reports (EIA reports on the release of *Ophiomyia camarae, Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*), with the reports on the release of *Falconia intermedia* and *Mycovellosiella lantanae* var *lantanae* evaluated as generally satisfactory and complete (B).

An interesting result is the difference in assessment for sub-category 2.2.1 (actions taken to contact the general public and specialist interest groups to inform them of the proposed release and its implications), that represents compliance with legal requirement (c)(iii). Three of the EIA reports, the reports on the release of *Falconia intermedia, Mycovellosiella lantanae* var *lantanae* and *Ophiomyia camarae* were assessed as very unsatisfactory (F) due to the fact that no public participation process took place or was reported on. The remaining three reports (EIA reports on the release of *Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*) were assessed as just satisfactory despite omissions and / or inadequacies (C). The reason could be, as mentioned before, that the applicant was not very familiar with the legal requirements when the three reports assessed as very unsatisfactory (F) were compiled. These reports were the first EIA reports on the release of biological control agents that were compiled and submitted in terms of the ECA regulations (South Africa, 1997b).

The three reports evaluated as just satisfactory (C) (EIA reports on the release of *Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*) are reports that have been submitted to the decision-making authority in 2005 and were therefore prepared more recently. The public participation reported on in these three reports was very limited. Only one newspaper advertisement was placed in two newspapers (Sunday Times and Rapport) notifying the public about the proposed

release of all the biological control agents considered for release, not only those for which EIA reports were evaluated in this study. Public participation should be more focussed depending on the biological control agent being considered for release.

CHAPTER 5: DISCUSSION AND CONCLUSION

This chapter demonstrates that the following overall research aim has been addressed:

To evaluate the quality of EIA reports on biological pest control for *Lantana camara* (Lantana) with a view to provide decision support and guidelines for future decision making.

The chapter is divided into five sections. The first section highlights the main result in relation to the overall research aim. This is followed by section two where the main strengths and weaknesses of the EIA reports are summarised. Section three makes proposals for aspects to be considered in EIA decision making related to biological pest control and lastly sections four and five deal with the way forward and proposals for future research.

5.1 Main conclusion

The evaluation of the six EIA reports on the release of biological control agents for the control of lantana by means of the adapted Lee-Colley review package (Lee *et al.*, 1999) suggests that there are a number of deficiencies relating to the content of the EIA reports. The EIA report on the release of *Falconia intermedia* for the control of lantana was evaluated as very unsatisfactory (F); the EIA report on the release of *Mycovellosiella lantanae* var *lantanae* was evaluated as not satisfactory (E); and the EIA reports on the release of the following biological control agents were evaluated as just unsatisfactory (D) (Table 2):

- *Ophiomyia camarae*
- *Coelocephalapion camarae*
- *Leptostales ignifera*
- *Longitarsus bethae*

Thus the main conclusion to reach in relation to the overall research aim is that the quality of the EIA reports on the release of biological control agents for the control of *Lantana camara* (lantana) was poor by the standards of the review package, the literature reviewed, and the legal requirements.

5.2 Strengths and weaknesses

Weaknesses were identified in each of the four review areas, but these weaknesses are relatively greater in review areas 2 and 3. The main deficiencies in these two areas relate to impact identification, impact evaluation, scoping and mitigation measures and monitoring programmes.

In the same way, strengths were identified in all the review areas, but these were relatively greater in review areas 1 and 4. The issues that were addressed adequately in the EIA reports include:

- the description of the project, which includes the description of the biological control agent proposed for release and the target species,
- the non-technical summary, and
- the layout of the reports and the presentation of the information in the reports.

These results correspond to information in literature that affirm that the description of the project itself is usually done adequately, but the identification and analysis of potential impacts, the ranking in terms of significance and the mitigation measures to address these impacts are mostly inadequately addressed (Asian Development Bank, 1997:1; Barker & Wood, 1999:387; Morrison-Saunders *et al.*, 2001:325; Simpson, 2001: 83; Bankwatch, 2003:36).

The review area that had the highest evaluation, review area 4 (communication of results) is the area that does not represent any legal requirements, while the areas reflecting most of the legal requirements were not evaluated as satisfactory (review areas 2 and 3). These results lead to the conclusion that effective communication is not significant in the EIA process if the information being communicated is flawed or inadequate. The EIA reports evaluated in this study all reflect attributes of a good report (DEAT, 2004:2), but they all significantly lack adequate and appropriate

content required to make an informed decision regarding the release of biological control agents.

5.3 Issues to be considered during decision making

Three of the EIA reports, *Falconia intermedia, Mycovellosiella lantanae* var *lantanae* and *Ophiomyia camarae*, that were evaluated as very unsatisfactory (F), unsatisfactory (E) and just unsatisfactory (D), respectively, and that did not comply with the minimum legal requirements, were all issued positive records of decision by the authority and the biological control agents were subsequently released into the environment. This is disconcerting especially if the overall absence of monitoring programmes and mitigation measures for direct, indirect and cumulative effects are taken into consideration. There is no provision for information gathering post-release and no mitigation measures to counteract impacts resulting from direct, indirect or cumulative effects. The other three EIA reports (*Coelocephalapion camarae, Leptostales ignifera* and *Longitarsus bethae*) are currently being reviewed by the decision-making authority with final decisions pending. The fact that biological control agents were released based on information provided in EIA reports of very poor quality, can only lead to the conclusion that not only should the quality of these reports be improved considerable, but the decision making process should be improved considerably.

Based on information found in literature and the evaluation of the quality of the EIA reports on the release of biological control agents for the control of lantana, the following aspects were identified as important for the proper evaluation of applications to release potential biological control agents into the environment:

- The adaptation to the centrifugal phylogenetic method to select the test plants to be tested with the target weed to determine host and host specificity (Briese 2005:4).
- Direct, indirect and cumulative effects (Louda *et al.*, 2005:2; & Callaway, 2005:4; Sheppard *et al.*, 2005:10).
- Mitigation measures to prevent or minimise the impacts resulting from direct, indirect and cumulative effects.

- Efficacy of the proposed biological control agent, including the influence the new environment may have on the efficacy of the biological control agent (McFadyen, 2003:5).
- Monitoring programmes that will facilitate retrospective analysis (Louda *et al.*, 2005:4).
- The independence and objectivity of the person or organisation compiling the EIA report or an independent review of the EIA report before submission to the authority.

5.4 The way forward

It is expected that the implementation of the alien provisions in terms section 65 of NEMBA (10/2004) will faciliate improvements in decision-making in terms of the EIA process. This is due to the fact that a risk assessment is required to carry out a restricted activity involving an alien species (a non-indigenous species, including biological control agents, or an indigenous species translocated or intended to be translocated outside its natural distribution range). The definition for restricted activity is very broad and include the activities associated with biological control programs, i.e. import into the Republic, growing, breeding or in any way propagating, having in possession and moving or conveying. Therefor, a risk assessment will have to be done to import potential biological control agents and to perform the appropriate tests in laboratories. This is in line with current international best practice, where researchers involved in biological control programmes use risk assessment as the tool to evaluate the suitability of biological control agents (Arnett & Louda, 2002:4; Baars *et al.*, 2003:10; Berner & Bruckart, 2005:10; Briese, 2005:7; Louda *et al.*, 2005:1; Sheppard *et al.*, 2005:12; Wright *et al.*, 2005:4 Ding, *et al.*, 2006:14).

The risk assessment process in terms of NEMBA (10/2004) will provide much needed information and will address the gap in the current process, that is the result of import and laboratory test being subject to authorisation by the Department of Agriculture, while only the release of biological control agents are subject to authorisation by the Department of Environmental Affairs and Tourism (DEAT). The current EIA process itself, is also flawed and that contributes to the poor quality of

the EIA reports. The authority (DEAT) receives applications and EIA reports without any prior consultation taking place between the authority and the applicant and without a plan of study for scoping being submitted to the authority. Consultation meetings between the authority and the applicant to discuss a plan of study for scoping will provide the authority with an opportunity to inform the applicant about the legal requirements as well as the specific issues that should be addressed in an EIA report on the release of a biological control agent. This will lead to an increase in the quality of the EIA reports; it will ensure compliance with minimum legal requirements; and it will facilitate the evaluation of the EIA report by the authority.

The preliminary findings highlighted some deficiencies common to all the reports and the following basic recommendations are made to improve the quality of the EIA reports, especially with regard to meeting minimum legal requirements:

- The centrifugal phylogenetic method to select the test plants to be tested with the target weed to determine host and host specificity should be adapted and the details relating to these adaptation provided.
- Direct, indirect and cumulative effects of biological control agents should be considered, discussed and included in the risk assessment.
- Mitigation measures to prevent or minimise the impacts resulting from direct, indirect and cumulative effects must be included or well-motivated reasons why mitigation measures were not needed.
- The efficacy of the proposed biological control agent should be analysed and special attention should be paid to the effect the new environment might have on the efficacy.
- Monitoring programmes must be included in the EIA report and should be a condition to the approval for release. This will facilitate retrospective analysis of the impact of biological control programmes on target species.
- An independent and objective person or organisation should compile the EIA reports or as a minimum the EIA reports should be reviewed by a competent independent person or organization before submission to the authority.
- Consultation meetings with the authority are essential to ensure all issues will be addressed adequately.

5.5 Areas for future research

The adapted Lee-Colley review package (Lee & Colley, 1992) provides an effective quality review tool because it sets a high standard for the contents of the EIA reports; it verifies compliance with minimum legal requirements; and can be used to compare the quality of various reports enabling the researcher to identify potential trends or general weaknesses and strengths in reports focused on a specific activity, e.g. the release of biological control agents for the control of lantana. To test the review package further, and to improve its robustness, wider application to a greater number of EIA reports on the release of biological control agents will be required.

Lastly, general remarks are made and although not directly linked to the quality of the EIA reports reflect aspects of central significance to the rationale for evaluating report quality. These aspects may warrant further scrutiny in subsequent studies:

- The biological control strategy used by the South African researchers for the control of lantana is what Myers (1985) refers to as the "lottery approach" (Myers, 1985 as quoted by Pearson & Callaway 2005:3). It is a multiple release strategy in classical biological control that promotes the deployment of multiple host specific biological control agents for each target pest. The concern about this strategy, especially for the control of lantana, is that the biological control agents proposed for release, are not monophagous and the host specificity tests reported on in the EIA reports indicated that an indigenous *Lippia* species were utilised by the biological control agents in the controlled environment. The cumulative effects of the release of multiple biological control agents on the indigenous *Lippia* species is therefore a concern as well as the potential indirect effects these multiple biological control agents may cause.
- The success of biological control of lantana remains largely ineffectual. Twelve biological control agents were established on lantana by 2002, but the combined impact of these biological control agents remains insufficient to reduce the weed to acceptable levels and the biological control of the weed is considered negligible (Baars *et al.*, 2003:2). The question arises: *"How many alien organisms, all with the inherent potential to have a detrimental impact on*

biodiversity, are we going to introduce into the environment before we concede that the biological control programme for lantana is not working?"

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ANNEX 1

List of Review Criteria for the evaluation of the quality of EIA reports on the release of organisms outside their natural area of distribution for biological pest control

1. Review Areas, Categories & Sub-categories

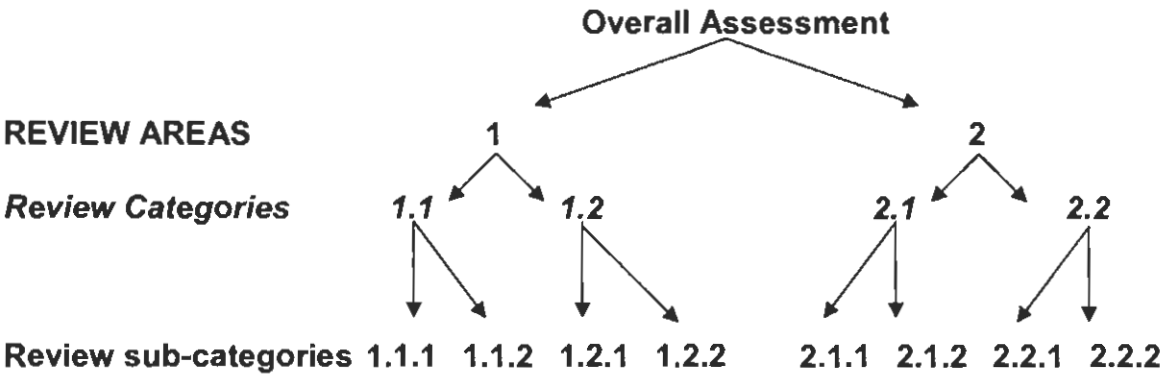
The list of review criteria is a list of hierarchically arranged topics for reviewing the quality of environmental impact assessment reports on the release of organisms outside their natural area of distribution for biological pest control, an activity listed as a scheduled activity in terms of the Environment Conservation Act regulations (South Africa, 1997a).

In section 2 a list of Review Topics are arranged in a hierarchical manner. These are:

- ***Review Areas***
  These are the four major areas of an environmental assessment and are preceded by **one digit** in the list of Review Topics (section 2), e.g. **4. Communication of Results**. The following four **Review Areas** were identified for the environmental impact assessment of the release of an organism outside its natural area of distribution:
  - Description of the proposed activity, namely the release of the biological control agent, the receiving environment, the proposed pest/target species, the baseline conditions and the anticipated result of the release.
  - Identification and evaluation of key impacts.
  - Alternatives and mitigation of impacts.
  - Communication of results.
- ***Review Categories***
  These are the categories of an environmental assessment activity which must be undertaken within each Review Area and represent more complex criteria to broader tasks and procedures in the process. They are preceded by **two digits** in the list of Review Topics (section 2), e.g. **4.2 Presentation.**
- ***Review Sub-categories***
  These comprise the detailed Review Sub-categories within each Review Category and contain simple criteria relating to specific tasks and procedures. They are preceded by **three digits** in the list of Review Topics (section 2), e.g. **4.2.1 Information should be .....**

The Review Topics form a hierarchy (or pyramidal structure) that is used by reviewers to assess the quality of the EIA report starting from the base of the pyramid, namely the Review Sub-categories, followed by the Review Categories and ultimately the Review Areas. The assessment of higher levels (e.g. Review Categories) is done by using the lower levels' assessment (e.g. assessment of Review Sub-categories) and any other impressions gained from the report, which the reviewers feel are relevant. Ultimately the quality of the overall EIA report is summarised in a brief summary of its main strengths and weaknesses. A schematic diagram of this hierarchy is presented in Figure 1.

Figure 1: Schematic representation of the Review Topic hierarchy



The assessment resulting from evaluating each sub-category, category and area is recorded by the reviewer on a Collation Sheet (Annex 2) using a standard list of assessment symbols as described in Table 1. 'Letters' rather than 'numbers' are used as symbols to discourage reviewers from crude aggregation to obtain assessments at the higher levels in the pyramid.

Table 1 – List of assessment symbols

Symbol	Explanation
A	Relevant tasks well performed, no important tasks left incomplete.
B	Generally satisfactory and complete, only minor omissions and inadequacies.
C	Can be considered just satisfactory despite omissions and/or inadequacies.
D	Parts are well attempted but must, as a whole, be considered just unsatisfactory because of omissions or inadequacies.
E	Not satisfactory, significant omissions or inadequacies.
F	Very unsatisfactory, important task(s) poorly done or not attempted.
NA	Not applicable. The Review Topic is not applicable or it is irrelevant in the context of this Statement.

2. Review Topics

1. Description of the biological control agent proposed for release, the receiving environment, the proposed pest/target species and the anticipated result of the release.

1.1 Description of the biological control agent proposed for release: The biological control agent proposed to be released should be described.

Information relating to the origin of the species to be used as biological control agent; the taxonomy; target species; method of impact on target species; prior releases in other areas and results of these releases; and the number of specimens to be released must be provided.

1.1.1 The biological control agent proposed for release should be described. This should include the following: taxonomic information, identification of the species (characteristics), method of reproduction, distribution of species and mobility of the species.

1.1.2 The origin of the species to be used for biological control should be described. This should include information relating to the natural enemies or other control methods of the species.

1.1.3 The full scope of identified and described target plants as well as potential target plants should be provided.

1.1.4 Details relating to the damage caused by the species to the target plants should be provided, e.g. herbivorous, leaf borer, seed eater as well as information relating to the amount of damage caused.

1.1.5 Information relating to prior releases in other areas or other countries should be provided. This should include information relating to the results of the releases, e.g. damage caused by biological control agent to target species as well as damage the agent caused to natural host in country of origin.

1.1.6 The number of biological control agents to be released should be provided as well as the frequency of the proposed releases.

1.2 Receiving environment: The release sites should be described as well as the surrounding environment, which will be affected by the release of the biological control agent.

1.2.1 The area proposed for release must be described and the location/s clearly indicated on a map.

1.2.2 The proximity of potential non-target indigenous species which were utilised by the biological control agent during laboratory trails should be indicated on maps.

1.2.3 The land uses of the surrounding areas should be described and the various land uses indicated on a map.

1.2.4 The potential spread of the species from the release sites should be indicated and mapped.

1.3 The proposed target invasive alien plant species / pests: The target plant species should be described and information relating to the spread of the species and the overall impact on South Africa's biodiversity and other environmental and economic implications should be provided.

1.3.1 The target species should be described. This should include the following: taxonomic information, characteristics of the species, method of reproduction, invasive status and distribution of the species (map).

1.3.2 The current status of spread of the species and the projected spread within the next five years, with and without the release of the biological control agent.

1.3.3 The impact of the target species on South Africa's biodiversity and other environmental and economic impacts caused by the target species should be described.

1.3.4 Details relating to other biological control agents released for the control of the target species should be provided. This should include the taxonomic information of these species, the method of impact on the target species and the results of the release of these species.

2. Identification and evaluation of key impacts.

2.1 Definition and identification of impacts: Potential impacts of the proposed release of the biological control agent should be investigated and described. Impact should be broadly defined to cover all potential effects on the environment, including potential impacts on non-target indigenous plant species and indigenous invertebrates and the potential of the biological control agent to become invasive.

2.1.1 A description should be provided of the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the release of the biological control agent.

2.1.2 The above types of effect should be investigated and described with particular regard to identifying effects on or affecting; human beings, flora and fauna, soil and water; and the interactions between these.

2.1.3 Consideration should not be limited to events which will occur under perfect release conditions. Where appropriate, impacts which might arise from non-standard release conditions, due to accidents or natural disasters (floods, etc), should also be described.

2.1.4 Impacts should be identified using a systematic methodology, such as project specific checklists, matrices, panels of experts. A brief description of the impact identification methods should be given as should the rationale for using them.

2.2 Scoping: Not all impacts should be studied in equal depth. Key impacts should be identified, taking into account the views of interested parties, and the main investigation centred on these.

2.2.1 Information relating to the actions taken to contact the general public and special interest groups to inform them of the proposed release and its implications should be provided.

2.2.2 Key impacts should be identified and selected for more intense investigation. This should have been done in consultation with the relevant authorities and stakeholders. Documentation should be provided to reflect the input from stakeholders and to indicate how their concerns will be addressed.

2.2.3 Impact areas not selected for thorough study should be identified and the reasons they require less detailed investigation should be given.

2.3 Prediction of the extent and intensity of the impacts: The magnitude of the key impacts of the proposed release of the biological control agent

on the environment should be described in exact terms wherever possible.

2.3.1 The data used to estimate the magnitude of the main impacts should be clearly described or their sources be clearly identified. Any gaps in the required data should be indicated and the means used to deal with them in the assessment should be explained.

2.3.2 The methods used to predict impact magnitude should be described and be appropriate to the size and importance of the projected impact (e.g. host specificity test trials should include appropriate numbers and varieties of plant species to identify the physiological host range of the species & information relating to the ecological host range should be provided, if available).

2.3.3 Predictions of the magnitude of the impacts should be provided and where possible, expressed in measurable quantities with ranges and / or confidence limits as appropriate. Qualitative descriptions, where these are used, should be as fully defined as possible.

2.4 Assessment of impact significance: The expected significance that the projected key impacts will have should be estimated. The sources of quality standards, together with the rationale, assumptions and value judgements used in assessing significance, should be fully described.

2.4.1 The significance of an impact should be assessed, taking into consideration appropriate national and international quality standards where available. Account should also be taken of the magnitude, location and duration of the impact in conjunction with national and societal values.

2.4.2 Where mitigating measures are proposed, the significance of any impact remaining after mitigation should be described.

2.4.3 The choice of standards, assumptions and value systems used to assess significance should be justified and any contrary opinions should be summarised.

3. Alternatives and mitigation

3.1 Alternatives: Feasible alternatives to the proposed release of the biological control agent should have been considered. These should be outlined in the report, the environmental implications of each presented, and the reasons for their rejection briefly discussed, particularly where the release is likely to have significant, adverse environmental impacts.

3.1.1 Alternative methods for the control of invasive alien plant species should have been considered where these are practicable and available to the applicant.

3.1.2 The main environmental advantages and disadvantages of alternative methods of control of invasive alien plant species should be discussed and the reasons for the final choice given.

3.1.3 Information relating to consideration of the "no-go" option should be included in the report.

3.2 Scope and effectiveness of mitigation measures: All significant adverse impacts should be considered for mitigation. Evidence should be presented to show that proposed mitigation measures will be effective when implemented.

3.2.1 The mitigation of all significant adverse impacts should be considered and, where applicable, specific mitigation measures should be put forward. Any residual or unmitigated impacts should be indicated and justification offered as to why these impacts should not be mitigated.

3.2.2 Mitigation methods considered should include, as a minimum, modification of the proposal to release the biological control agent to address the potential impacts, and control measures, should the biological control agent become invasive or detrimental to indigenous species.

3.2.3 It should be clear to what extent the mitigation methods will be effective when implemented. Where the effectiveness is uncertain or depends on assumptions about, among others, the release environment, the ability of the biological control agent to adapt to the environment and climatic conditions, data / information should be provided to justify the acceptance of these assumptions.

3.3 Commitment to mitigation: Applicants should be committed to, and capable of, carrying out the mitigation measures and should present plans on how they propose to do so.

3.3.1 There should be a clear record of the commitment of the applicant to the mitigation measures presented in the report. Details of how the mitigation measures will be implemented and function over the time span of which they are necessary should also be provided.

3.3.2 Monitoring programmes should be proposed to monitor the environmental impacts resulting from the release of the biological control agent and whether the actual impacts conform to the predictions within the report. Provision should be made to adjust mitigating measures where unexpected adverse impacts occur. The scale of the monitoring programmes should correspond to the likely scale and significance of deviations from expected impacts.

4. Communication of results

4.1 Layout: The layout of the report should enable the reader to find and assimilate data easily and quickly. External data sources should be acknowledged.

4.1.1 There should be an introduction briefly describing the project, the aims of the environmental assessment and how those aims are to be achieved.

4.1.2 Information should be logically arranged in sections or chapters and the whereabouts of important data should be signalled in a table of contents or index.

4.1.3 Unless the chapters themselves are very short, there should be chapter summaries outlining the main findings of each phase of the investigation.

4.1.4 When data, conclusions or quality standards from external sources are introduced, the original source should be acknowledged at that point in the

text. A full reference should also be included either with the acknowledgement, at the bottom of the page, or in a list of references.

4.2 Presentation: Care should be taken in the presentation of information to make sure that it is accessible to the non-specialist.

4.2.1 Information should be presented so as to be comprehensible to the non-specialist. Tables, graphs and other devices should be used as appropriate. Unnecessarily technical or obscure language should be avoided.

4.2.2 Technical terms, acronyms and initials should be defined, either when first introduced into the text or in a glossary. Important data should be presented and discussed in the main text.

4.2.3 The EIA report should be presented as an integrated whole. Summaries of data presented in separately bound appendices should be introduced in the main body of the text.

4.3 Emphasis: Information should be presented without bias and receive the emphasis appropriate to its importance in the context of the EIA report.

4.3.1 Prominence and emphasis should be given to potentially severe adverse impacts as well as to potentially substantial favourable environmental impacts. The EIA report should avoid according space disproportionately to impacts which have been well investigated or are beneficial.

4.3.2 The EIA report should be unbiased; it should not lobby for any particular point of view. Adverse impacts should not be disguised by euphemisms or platitudes.

4.4 Non-technical summary: There should be a clearly written non-technical summary of the main findings of the study and how they were reached.

4.4.1 There should be a non-technical summary of the main findings and conclusions of the study. Technical terms, lists of data and detailed explanations of scientific reasoning should be avoided.

4.4.2 The summary should cover all main issues discussed in the EIA report and contain at least a brief description of the project and the environment, an account of the main mitigation measures to be undertaken by the developer, and a description of any significant residual impacts. A brief explanation of the methods by which these data were obtained, and an indication of the confidence which can be placed in them, should also be included.

ANNEX 2

COLLATION SHEET

OVERALL ASSESSMENT:							
1		**2**		**3**		**4**	
1.1		**2.1**		**3.1**		**4.1**	
1.1.1		2.1.1		3.1.3		4.1.1	
1.1.2		2.1.2		3.1.2		4.1.2	
1.1.3		2.1.3		3.1.3		4.1.3	
1.1.4		2.1.4				4.1.4	
1.1.5							
1.1.6							
1.2		**2.2**		**3.2**		**4.2**	
1.2.1		2.2.1		3.2.1		4.2.1	
1.2.2		2.2.2		3.2.2		4.2.2	
1.2.3		2.2.3		3.2.3		4.2.3	
1.2.4							
1.3		**2.3**		**3.3**		**4.3**	
1.3.1		2.3.1		3.3.1		4.3.1	
1.3.2		2.3.2		3.3.2		4.3.2	
1.3.3		2.3.3					
1.3.4							
		2.4				**4.4**	
		2.4.1				4.4.1	
		2.4.2				4.4.2	
		2.4.3					

Minimum Requirements

Were minimum requirements met, taking into account whether or not the following Review Sub-categories were all performed satisfactorily, i.e. assessed A, B, or C?

(a) (i) 2.1.1; 2.3.1; 2.3.3; 2.4.1
(ii) 3.2.1
(b) 3.1.1; 3.1.3
(c) (i) 1.2.1; 1.3.1
(ii) 1.1.1; 1.1.6
(iii) 2.2.1; 2.2.2

YES NO

Broad Compliance

Were minimum requirements met, AND Review Areas 1, 2, 3 and 4 **all** performed satisfactorily, i.e. assessed A, B or C?

YES NO

Overall Quality

Assign an assessment symbol (A, B, C, D, E or F) to the Statement as a whole and summarise, in one or two paragraphs, the key factors which have determined your overall assessment.

ANNEX 3

Pilot Study Review

1. Advice for Reviewers

In order to conduct the pilot study review, each reviewer should first independently undertake the following steps sequentially (adapted from Lee *et al*, 1998:34-37):

1. Read the following instructions to ensure you have an understanding of the review package and what it will entail.
2. Read through the **List of Review Topics** (Areas, Categories, and Sub-categories) and familiarise yourself with them and the data required in each review topic.
3. Read the EIA report quickly to familiarise yourself with the layout and the arrangement of essential information.
4. Study the **List of Assessment Symbols** (listed in Table 1). The appropriate assessment symbol should be chosen based on the way the tasks relating to the Sub-category are performed throughout the EIA report. Before deciding on the symbol it may be helpful to refer to the wording of the Review Sub-Category and to recall the strategy of review as described in point 5 & 6 below.
5. Read the first Review Category (1.1) and its component Sub-categories (1.1.1-1.1.5). Remember that the Sub-categories refer to actions which must be undertaken or information that must be provided, in order to meet the requirements as described in the Review Category (1.1).
6. Assess each of the Sub-categories (1.1.1-1.1.5) referring closely to the EIA report. Be conscious of the fact that the required information will not all be located in the same place in the report for any one review topic.
7. Decide which assessment symbol is appropriate for each Sub-category and record it on the **Collation Sheet** provided in Appendix 1. Note that a task should be assessed as having been satisfactorily handled if there is sufficient information provided in the EIA report on the topic / category / sub-category concerned, to allow a decision-maker to make an informed decision without having to seek further advice. It is the *appropriateness* and *quality*, and not the *volume* of information provided which is the relevant consideration. Where data on a particular topic / category / sub-category is not explicitly provided but is, nevertheless, implicit in the treatment of other topics, the reviewer may decide that it should be assessed as adequate. Such instances should be recorded in the summary that is discussed in point 11 below.
8. Use the assessments of Sub-categories 1.1.1-1.1.5, and any other information gained from the EIA report which you considered relevant, to assess the Review Category 1.1. Note that the assessment of the Review Category should not be derived by a simple averaging of the assessments of the component Sub-categories. Your evaluation of both the relative importance of these Sub-categories and any information in the EIA report not covered by them should also be taken into account.

9. Proceed to the next Review Category (1.2) and evaluate it in the same way as Review Category 1.1. Continue until all categories in the Review Area have also been assessed in the same manner.
10. Your evaluations of the Review Categories can now be used to assess the Review Area in the same way in which they themselves were derived from the Review Sub-category assessments (see point 7 above). Thus, for example, the assessment of Review Area 1 is to be based upon the assessments of Categories 1.1-1.5.
11. When all Review Areas have been assessed the EIA report as a whole can be assigned an assessment symbol. This overall judgement should, however, be supplemented with a brief summary of the EIA report's strengths and weaknesses and a consideration of whether, for example, it meets minimum requirements as specified in terms of legislation or guidelines (refer to Section 2).

Finally the two pilot study reviewers should compare their review findings as recorded on their Collation Sheets and record any review area / category / sub-category that was unclear. Shortcomings in the different areas / categories / sub-categories should also be recorded to facilitate the refinement of the review package. Differences in your assessments at sub-category, category or area level should be jointly re-examined with a view of clarifying why different findings were made.

2. Deciding on compliance with the Regulations

The minimum information that an EIA report should contain, in any particular case, is specified in the EIA Regulations (Government Notice R. 1183) issued in terms of the Environment Conservation Act (Act 73 of 1989). In terms of Section 8 of Regulations 1183, an EIA report must contain the following minimum set of information:

(a) a description of each alternative, including particulars on-
(i) the extent and significance of each identified environmental impact; and
(ii) the possibility for mitigation of each identified impact;
(d) a comparative assessment of all the alternatives; and
(e) appendices containing descriptions of-
(d) the environment concerned;
(e) the activity to be undertaken;
(f) the public participation process followed, including a list of interested and affected parties and their comments;
(g) any media coverage given to the proposed activity; and
(h) any other information included in the accepted plan of study.

In terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), the minimum requirements of an EIA are:

a) Investigation of the environment likely to be significantly affected by the proposed activity and alternatives thereto;
b) Investigation of the potential impact, including cumulative impacts, of the activity and its alternatives on the environment, socio-economic conditions and cultural heritage, and assessment of the significance of that potential impact;

c) *Investigation of mitigation measures to keep adverse impacts to a minimum, as well as the option of not implementing the activity;*
d) *Public information and participation, independent review and conflict resolution in all phases of the investigation and assessment of impacts;*
e) *Reporting on gaps in knowledge, the adequacy of predictive methods and underlying assumptions, and uncertainties encountered in compiling the required information;*
f) *Investigation and formulation of arrangements for the monitoring and management of impacts, and the assessment of the effectiveness of such arrangements after their implementation;*

The reports to be evaluated are mostly Scoping reports and therefore the requirements in terms of Regulations 1183 for Scoping reports must be taken into consideration. The requirements for a Scoping report are contained in Section 6 of Government Notice R. 1183 (1997):
(i) a brief project description;
(j) a brief description of how the environment may be affected;
(k) a description of environmental issues identified;
(l) a description of all alternatives identified; and
(m)an appendix containing a description of the public participation process followed including a list of interested parties and their comments.

The above mentioned legal requirements are not vastly different from legal EIA reporting requirements in other countries and virtually all legal systems require that the EIA report to (DEAT, 2004:2):
- *present a non-technical summary of the findings of the EIA;*
- *describe the proposed activity and affected environment;*
- *forecast the significant impacts likely to result from the implementation of the activity;*
- *evaluate alternatives; and*
- *identify and evaluate the effectiveness of mitigation measures.*

Compliance with legal requirements is clearly an important consideration, in deciding the suitability and the quality of the EIA report. The EIA report is used as a decision making instrument and the minimum information as specified in legislation must therefore be provided in the EIA report. Translation of exact legal requirements into Review Topics is, however, problematic, particularly as it could be argued that the exact nature of the information required varies from case to case. Taking into consideration the specialist nature of biological control and the fact that EIA legislation (ECA and associated Regulations) and requirements as set out in the Guideline Document (DEAT, 1998:22–28) are mostly focused on "development / industry" scenarios, the translation to Review Topics are challenging.

The Regulation's minimum requirements (EIA report requirements in section 8 of Regulation 1183) broadly correspond to the following Review Sub-categories (see Annex 1):
(a) (i) 2.1.1; 2.3.1; 2.3.3; 2.4.1
(ii) 3.2.1
(b) 3.1.1; 3.1.3
(c) (i) 1.2.1; 1.3.1

(ii) 1.1.1; 1.1.6
(iii) 2.2.1; 2.2.2

If it is agreed by the reviewers that all of these Sub-categories are assessed, at least 'Satisfactory', i.e. (A, B or C) or 'Not applicable' (NA), the EIA report in question is likely to comply with the minimum requirements. However, reviewers should exercise judgement and check, for themselves, the content of the particular EIA report being reviewed against the actual Regulations to verify this.

The EIA report is in broad compliance with the requirements of the ECA Regulations if the minimum requirements were met. The estimation of the extent to which this has been achieved is one of the principal objects of this review process, and should therefore coincide with the final judgement of the review. Thus, broad compliance is taken to mean that the EIA report has met the minimum requirements of the Regulations as interpreted above and furthermore that each Review Area has been assessed as, at least, "satisfactory", i.e. A, B or C in each Review Area.

Furthermore, other requirements relating to the report itself should also be taken into consideration during the review process and certain sub-categories relate to these and include requirements for a good EIA report (DEAT, 2004:2):

- *tightly focussed on in the important issues;*
- *scientifically and technically sound, with feasible and legally defensible findings;*
- *clearly and coherently organised and presented, to enable its contents to be easily understood ;*
- *timely; and*
- *free from bias, and emotive language.*

3. Outcome of a review

The joint judgement of the EIA report quality must be summarised in one or two paragraphs subsequent to assigning an assessment symbol to the EIA report as a whole and checking compliance with the Regulations. This summary should list the main strengths and weaknesses of the EIA report, especially those omissions which should be rectified before impacts can be satisfactorily assessed or evaluated. It should also record whether the EIA report complies with minimum requirements and whether it complies more broadly with the Regulations as discussed above.

ANNEX 4

COLLATION SHEET

PILOT STUDY - Reviewer: PC Kershaw
Biological control agent: *Falconia intermedia*

OVERALL ASSESSMENT: F							
1	**D**	**2**	**F**	**3**	**E**	**4**	**C**
1.1	**C**	**2.1**	**E**	**3.1**	**F**	**4.1**	**B**
1.1.1	B	2.1.1	D	3.1.1	F	4.1.1	B
1.1.2	B	2.1.2	D	3.1.2	F	4.1.2	A
1.1.3	A	2.1.3	F	3.1.3	F	4.1.3	B
1.1.4	B	2.1.4	E			4.1.4	A
1.1.5	B						
1.1.6	F						
1.2	**F**	**2.2**	**F**	**3.2**	**F**	**4.2**	**C**
1.2.1	E	2.2.1	F	3.2.1	F	4.2.1	B
1.2.2	F	2.2.2	F	3.2.2	F	4.2.2	D
1.2.3	F	2.2.3	F	3.2.3	F	4.2.3	B
1.2.4	F						
1.3	**C**	**2.3**	**F**	**3.3**	**F**	**4.3**	**E**
1.3.1	C	2.3.1	F	3.3.1	F	4.3.1	F
1.3.2	F	2.3.2	F	3.3.2	F	4.3.2	F
1.3.3	C	2.3.3	F				
1.3.4	D						
		2.4	**F**			**4.4**	**D**
		2.4.1	F			4.4.1	D
		2.4.2	F			4.4.2	E
		2.4.3	F				

Minimum Requirements
Were minimum requirements met, taking into account whether or not the following Review Sub-categories were all performed satisfactorily, i.e. assessed A, B, or C?
(a) (i) 2.1.1; 2.3.1; 2.3.3; 2.4.1
(ii) 3.2.1
(b) 3.1.1; 3.1.3
(c) (i) 1.2.1; 1.3.1
(ii) 1.1.1; 1.1.6
(iii) 2.2.1; 2.2.2
~~YES~~ **NO**

Broad Compliance
Were minimum requirements met, AND Review Areas 1, 2, 3 and 4 **all** performed satisfactorily, i.e. assessed A, B or C?
~~YES~~ **NO**

Overall Quality
Assign an assessment symbol (A, B, C, D, E or F) to the Statement as a whole and summarise, in one or two paragraphs, the key factors which have determined your overall assessment.

Overall Assessment: F

- As this is an assessment of an EIA REPORT, information on the impacts (positive and negative) on the environment, including potential impacts on non-target indigenous plant species, indigenous vertebrates and the potential for the biological control agent to become invasive must be provided in the application.

  The application, to a large extent did not adequately provide for this. The application only focused on the results obtained during the controlled tests; no adequate data was provided for on the impacts occurring outside of controlled conditions;

- The minimum requirements were not met;

- No mitigating measures were provided. This is a serious omission.

COLLATION SHEET

PILOT STUDY – Reviewer: G A Moses
Biological control agent: *Falconia intermedia*

OVERALL ASSESSMENT: F							
1	**D**	**2**	**F**	**3**	**E**	**4**	**D**
1.1	**C**	**2.1**	**F**	**3.1**	**E**	**4.1**	**B**
1.1.1	C	2.1.1	E	3.1.1	D	4.1.1	B
1.1.2	C	2.1.2	F	3.1.2	D	4.1.2	A
1.1.3	A	2.1.3	F	3.1.3	F	4.1.3	B
1.1.4	B	2.1.4	F			4.1.4	A
1.1.5	F						
1.1.6	E						
1.2	**F**	**2.2**	**F**	**3.2**	**F**	**4.2**	**C**
1.2.1	F	2.2.1	F	3.2.1	F	4.2.1	B
1.2.2	F	2.2.2	F	3.2.2	F	4.2.2	C
1.2.3	F	2.2.3	F	3.2.3	F	4.2.3	C
1.2.4	F						
1.3	**C**	**2.3**	**F**	**3.3**	**F**	**4.3**	**E**
1.3.1	C	2.3.1	F	3.3.1	F	4.3.1	E
1.3.2	F	2.3.2	F	3.3.2	F	4.3.2	F
1.3.3	B	2.3.3	F				
1.3.4	E						
		2.4	**F**			**4.4**	**D**
		2.4.1	F			4.4.1	C
		2.4.2	F			4.4.2	E
		2.4.3	F				

Minimum Requirements
Were minimum requirements met, taking into account whether or not the following Review Sub-categories were all performed satisfactorily, i.e. assessed A, B, or C?
(a) (i) 2.1.1; 2.3.1; 2.3.3; 2.4.1
(ii) 3.2.1
(b) 3.1.1; 3.1.3
(c) (i) 1.2.1; 1.3.1
(ii) 1.1.1; 1.1.6
(iii) 2.2.1; 2.2.2
~~YES~~ **NO**

Broad Compliance
Were minimum requirements met, AND Review Areas 1, 2, 3 and 4 **all** performed satisfactorily, i.e. assessed A, B or C?
~~YES~~ **NO**

Overall Quality
Assign an assessment symbol (A, B, C, D, E or F) to the Statement as a whole and summarise, in one or two paragraphs, the key factors which have determined your overall assessment.

Overall Assessment: F

Strengths: The EIA REPORT provides relevant information regarding the proposed biocontrol agent and to a lesser degree the economic and environmental implications of the target species. Although not merely enough attention is paid to provide the required information in order to make a decision, the report is easy to read. Fair attempts were made to put the target species within the South African context.

Weaknesses: This report adopts the structure of a scientific paper and completely fails to consider the environmental concerns. A major weakness of this report is that the potential impacts of the release of the biocontrol agent on the natural and physical environment have not been identified or evaluated and therefore no mitigation measures have been proposed. The controlled environment / laboratory tests and associated suitability risk analysis is an extremely biased approach to investigate suitable alternatives. Furthermore, no public participation process was followed. It is evident that the EIA REPORT does not meet the minimum requirements and several important tasks were not even attempted which consequently hinders the effectiveness of the decision-making process.

ANNEX 5

COLLATION SHEET

Biological Control Agent: *Mycovellosiella lantanae* var. *lantanae*

OVERALL ASSESSMENT: E							
1	**D**	**2**	**F**	**3**	**E**	**4**	**C**
1.1	**C**	**2.1**	**F**	**3.1**	**C**	**4.1**	**A**
1.1.1	B	2.1.1	F	3.1.1	C	4.1.1	A
1.1.2	C	2.1.2	F	3.1.2	C	4.1.2	B
1.1.3	B	2.1.3	F	3.1.3	F	4.1.3	N/A
1.1.4	A	2.1.4	F			4.1.4	A
1.1.5	C						
1.1.6	F						
1.2	**F**	**2.2**	**F**	**3.2**	**E**	**4.2**	**C**
1.2.1	E	2.2.1	F	3.2.1	E	4.2.1	C
1.2.2	E	2.2.2	E	3.2.2	E	4.2.2	C
1.2.3	F	2.2.3	F	3.2.3	E	4.2.3	B
1.2.4	F						
1.3	**D**	**2.3**	**C**	**3.3**	**F**	**4.3**	**D**
1.3.1	A	2.3.1	D	3.3.1	F	4.3.1	E
1.3.2	C	2.3.2	C	3.3.2	F	4.3.2	D
1.3.3	D	2.3.3	C				
1.3.4	E						
		2.4	**E**			**4.4**	**B**
		2.4.1	D			4.4.1	A
		2.4.2	F			4.4.2	D
		2.4.3	E				

Minimum Requirements
Were minimum requirements met, taking into account whether or not the following Review Sub-categories were **all** performed satisfactorily, i.e. assessed A, B, or C?
(a) (i) 2.1.1 **(F)**; 2.3.1 **(D)**; 2.3.3 **(C)**; 2.4.1 **(D)**
(ii) 3.2.1 **(E)**
(b) 3.1.1 **(C)**; 3.1.3 **(F)**
(c) (i) 1.2.1 **(E)**; 1.3.1 **(A)**
(ii) 1.1.1 **(B)**; 1.1.6 **(F)**
(iii) 2.2.1 **(F)**; 2.2.2 **(E)**
~~YES~~ **NO**

Broad Compliance
Were minimum requirements met, **AND** Review Areas 1, 2, 3 and 4 **all** performed satisfactorily, i.e. assessed A, B or C?
~~YES~~ **NO**

Overall Quality
Assign an assessment symbol (A, B, C, D, E or F) to the Statement as a whole and summarise, in one or two paragraphs, the key factors which have determined your overall assessment.

- Overall Assessment: E
  The overall focus of the EIA report is on host specificity and the test relating to that. Only limited information is provided regarding the biological control agent to be introduced and the information is restricted to the damage to the target species. No information relating to indirect effects, other than those relating to host specificity, are provided. Alternatives are only mentioned briefly and mitigation measures and monitoring programmes are not addressed.

  No information is provided about the public participation process.

  Based on the above, the report is considered unsatisfactory.

COLLATION SHEET

Biological Control Agent: *Ophiomyia camarae*

OVERALL ASSESSMENT: D							
1	**D**	**2**	**E**	**3**	**D**	**4**	**B**
1.1	**B**	**2.1**	**E**	**3.1**	**B**	**4.1**	**A**
1.1.1	A	2.1.1	E	3.1.1	A	4.1.1	A
1.1.2	B	2.1.2	E	3.1.2	B	4.1.2	B
1.1.3	B	2.1.3	F	3.1.3	C	4.1.3	N/A
1.1.4	A	2.1.4	E			4.1.4	A
1.1.5	B						
1.1.6	F						
1.2	**F**	**2.2**	**E**	**3.2**	**F**	**4.2**	**C**
1.2.1	F	2.2.1	F	3.2.1	E	4.2.1	B
1.2.2	F	2.2.2	E	3.2.2	F	4.2.2	E
1.2.3	F	2.2.3	E	3.2.3	F	4.2.3	B
1.2.4	F						
1.3	**D**	**2.3**	**B**	**3.3**	**F**	**4.3**	**E**
1.3.1	A	2.3.1	B	3.3.1	F	4.3.1	E
1.3.2	D	2.3.2	B	3.3.2	F	4.3.2	E
1.3.3	D	2.3.3	A				
1.3.4	F						
		2.4	**E**			**4.4**	**A**
		2.4.1	C			4.4.1	A
		2.4.2	F			4.4.2	A
		2.4.3	F				

Minimum Requirements
Were minimum requirements met, taking into account whether or not the following Review Sub-categories were **all** performed satisfactorily, i.e. assessed A, B, or C?
(a) (i) 2.1.1 **(E)**; 2.3.1 **(B)**; 2.3.3 **(A)**; 2.4.1 **(C)**
(ii) 3.2.1 **(E)**
(b) 3.1.1 **(A)**; 3.1.3 **(C)**
(c) (i) 1.2.1 **(F)**; 1.3.1 **(A)**
(ii) 1.1.1 **(A)**; 1.1.6 **(F)**
(iii) 2.2.1 **(F)**; 2.2.2 **(E)**
~~**YES**~~ **NO**

Broad Compliance
Were minimum requirements met, **AND** Review Areas 1, 2, 3 and 4 **all** performed satisfactorily, i.e. assessed A, B or C?
~~**YES**~~ **NO**

Overall Quality
Assign an assessment symbol (A, B, C, D, E or F) to the Statement as a whole and summarise, in one or two paragraphs, the key factors which have determined your overall assessment.

- Overall Assessment: D
  The EIA report's focus is on host specificity and other indirect effects were not adequately addressed. The alternatives were mentioned in the report, but not adequately with regards to positive and negative impacts. Mitigation measures and monitoring programmes are not addressed. Public participation is not addressed and it seems that the applicant decided that the public will not be concerned about the release of this biological control agent.

  Minimum requirements are not met, but the report reads easily and is well-structured.

  Based on the above, the report is considered unsatisfactory.

COLLATION SHEET

Biological Control Agent: *Coelocephalapion camarae*

OVERALL ASSESSMENT: D							
1	**B**	**2**	**D**	**3**	**D**	**4**	**C**
1.1	**B**	**2.1**	**D**	**3.1**	**B**	**4.1**	**A**
1.1.1	A	2.1.1	D	3.1.1	B	4.1.1	A
1.1.2	B	2.1.2	D	3.1.2	B	4.1.2	A
1.1.3	A	2.1.3	F	3.1.3	C	4.1.3	N/A
1.1.4	A	2.1.4	D			4.1.4	A
1.1.5	B						
1.1.6	F						
1.2	**D**	**2.2**	**D**	**3.2**	**D**	**4.2**	**C**
1.2.1	B	2.2.1	C	3.2.1	D	4.2.1	B
1.2.2	F	2.2.2	D	3.2.2	D	4.2.2	F
1.2.3	F	2.2.3	D	3.2.3	D	4.2.3	B
1.2.4	F						
1.3	**B**	**2.3**	**C**	**3.3**	**F**	**4.3**	**D**
1.3.1	A	2.3.1	B	3.3.1	E	4.3.1	C
1.3.2	B	2.3.2	C	3.3.2	F	4.3.2	D
1.3.3	A	2.3.3	C				
1.3.4	B						
		2.4	**D**			**4.4**	**A**
		2.4.1	C			4.4.1	A
		2.4.2	E			4.4.2	A
		2.4.3	D				

Minimum Requirements
Were minimum requirements met, taking into account whether or not the following Review Sub-categories were **all** performed satisfactorily, i.e. assessed A, B, or C?
(a) (i) 2.1.1 **(D)**; 2.3.1 **(B)**; 2.3.3 **(C)**; 2.4.1 **(C)**
(ii) 3.2.1 **(D)**
(b) 3.1.1 **(B)**; 3.1.3 **(C)**
(c) (i) 1.2.1 **(B)**; 1.3.1 **(A)**
(ii) 1.1.1 **(A)**; 1.1.6 **(F)**
(iii) 2.2.1 **(C)**; 2.2.2 **(D)**
~~**YES**~~ **NO**

Broad Compliance
Were minimum requirements met, **AND** Review Areas 1, 2, 3 and 4 **all** performed satisfactorily, i.e. assessed A, B or C?
~~**YES**~~ **NO**

Overall Quality
Assign an assessment symbol (A, B, C, D, E or F) to the Statement as a whole and summarise, in one or two paragraphs, the key factors which have determined your overall assessment.

- Overall Assessment: D
  Parts of the EIA report are well attempted, e.g. the host specificity testing, but as a whole the report is considered unsatisfactory and minimum legal requirements were not met. There are major inadequacies with regard to the impact identification and determination of the significance. The applicant makes the decision almost unilaterally that there is only one impact to consider and that is host specificity. More information should be provided regarding alternatives and the lack of mitigation measures is linked to the "decision" by the applicant that the impact on non-target species is negligible. Public participation did take place to a limited extent.

COLLATION SHEET

Biological Control Agent: *Leptostales ignifera*

OVERALL ASSESSMENT: D							
1	**C**	**2**	**D**	**3**	**D**	**4**	**C**
1.1	**C**	**2.1**	**D**	**3.1**	**B**	**4.1**	**A**
1.1.1	A	2.1.1	D	3.1.1	B	4.1.1	A
1.1.2	A	2.1.2	D	3.1.2	B	4.1.2	A
1.1.3	B	2.1.3	F	3.1.3	B	4.1.3	N/A
1.1.4	B	2.1.4	D			4.1.4	A
1.1.5	E						
1.1.6	F						
1.2	**D**	**2.2**	**D**	**3.2**	**D**	**4.2**	**C**
1.2.1	B	2.2.1	C	3.2.1	D	4.2.1	B
1.2.2	F	2.2.2	D	3.2.2	D	4.2.2	E
1.2.3	F	2.2.3	E	3.2.3	D	4.2.3	B
1.2.4	F						
1.3	**B**	**2.3**	**B**	**3.3**	**F**	**4.3**	**D**
1.3.1	A	2.3.1	B	3.3.1	E	4.3.1	D
1.3.2	B	2.3.2	B	3.3.2	F	4.3.2	D
1.3.3	B	2.3.3	B				
1.3.4	C						
		2.4	**C**			**4.4**	**A**
		2.4.1	B			4.4.1	A
		2.4.2	D			4.4.2	A
		2.4.3	D				

Minimum Requirements
Were minimum requirements met, taking into account whether or not the following Review Sub-categories were **all** performed satisfactorily, i.e. assessed A, B, or C?
(a) (i) 2.1.1 **(D)**; 2.3.1 **(B)**; 2.3.3 **(B)**; 2.4.1 **(B)**
(ii) 3.2.1 **(D)**
(b) 3.1.1 **(B)**; 3.1.3 **(B)**
(c) (i) 1.2.1 **(B)**; 1.3.1 **(A)**
(ii) 1.1.1 **(A)**; 1.1.6 **(F)**
(iii) 2.2.1 **(C)**; 2.2.2 **(D)**
~~YES~~ **NO**

Broad Compliance
Were minimum requirements met, **AND** Review Areas 1, 2, 3 and 4 **all** performed satisfactorily, i.e. assessed A, B or C?
~~YES~~ **NO**

Overall Quality
Assign an assessment symbol (A, B, C, D, E or F) to the Statement as a whole and summarise, in one or two paragraphs, the key factors which have determined your overall assessment.

- Overall Assessment: D
  Parts of the EIA report are well attempted, e.g. the host specificity testing, but as a whole the report is considered unsatisfactory and minimum legal requirements were not met. The descriptions of the target weed and the biological control agent to be introduced is adequate, but the identification of the impacts is not. There is not adequate consideration for indirect effects and the applicant decides unilaterally, without using well-documented methodology what is the most important environmental consideration, namely host specificity. Public participation was done, but very limited.

COLLATION SHEET

Biological Control Agent: *Longitarsus bethae*

OVERALL ASSESSMENT: D							
1	**C**	**2**	**D**	**3**	**D**	**4**	**C**
1.1	**C**	**2.1**	**D**	**3.1**	**B**	**4.1**	**A**
1.1.1	A	2.1.1	D	3.1.1	B	4.1.1	A
1.1.2	A	2.1.2	D	3.1.2	B	4.1.2	A
1.1.3	B	2.1.3	F	3.1.3	C	4.1.3	N/A
1.1.4	B	2.1.4	E			4.1.4	A
1.1.5	E						
1.1.6	F						
1.2	**D**	**2.2**	**D**	**3.2**	**D**	**4.2**	**C**
1.2.1	B	2.2.1	C	3.2.1	D	4.2.1	B
1.2.2	F	2.2.2	D	3.2.2	D	4.2.2	D
1.2.3	F	2.2.3	E	3.2.3	D	4.2.3	C
1.2.4	F						
1.3	**B**	**2.3**	**B**	**3.3**	**F**	**4.3**	**D**
1.3.1	A	2.3.1	B	3.3.1	E	4.3.1	D
1.3.2	B	2.3.2	B	3.3.2	F	4.3.2	D
1.3.3	B	2.3.3	B				
1.3.4	C						
		2.4	**D**			**4.4**	**A**
		2.4.1	B			4.4.1	A
		2.4.2	D			4.4.2	A
		2.4.3	D				

Minimum Requirements
Were minimum requirements met, taking into account whether or not the following Review Sub-categories were **all** performed satisfactorily, i.e. assessed A, B, or C?
(a) (i) 2.1.1 **(D)**; 2.3.1 **(B)**; 2.3.3 **(B)**; 2.4.1 **(B)**
(ii) 3.2.1 **(D)**
(b) 3.1.1 **(B)**; 3.1.3 **(C)**
(c) (i) 1.2.1 **(B)**; 1.3.1 **(A)**
(ii) 1.1.1 **(A)**; 1.1.6 **(F)**
(iii) 2.2.1 **(C)**; 2.2.2 **(D)**
~~YES~~ **NO**

Broad Compliance
Were minimum requirements met, **AND** Review Areas 1, 2, 3 and 4 **all** performed satisfactorily, i.e. assessed A, B or C?
~~YES~~ **NO**

Overall Quality
Assign an assessment symbol (A, B, C, D, E or F) to the Statement as a whole and summarise, in one or two paragraphs, the key factors which have determined your overall assessment.

- Overall Assessment: D
  Parts of the EIA report are well attempted, e.g. the host specificity testing, but as a whole the report is considered unsatisfactory and minimum legal requirements were not met. The description of the target weed and the proposed biological control agent were adequate and alternatives were discussed although not in the detail it should be discussed. The potential for indirect effects were disregarded and the applicant focussed only on potential impact of biological control agent on non-target species. Public participation was very limited. The report is adequate with regard to host specificity testing, but that is only one area of concern when the release of a biological control agent is considered.