

우리나라의 희귀 및 멸종위기식물의 보전을 위한 복원계획의 필요성

金用植¹, 李惟美², 田承勳³, 全正壹³, 金善姬³
(영남大學 造景學科 教授¹, 광릉樹木園², 서울大學 農生大 附屬樹木園³)

Necessity of Recovery Plan for the Conservation of Rare and Endangered Plants in Korea

Yong Shik Kim¹, You Mi Lee², Seung Hoon Chun³, Jeong Ill Jeon³, Sun Hee Kim³
(Prof. Dept. of Landscape Architecture, Yeungnam Univ.¹, Kwangnung Aboretum²,
The Aboretum, Coll. of Agric. and Life Sci., Seoul Nat'l Univ.³)

Summary

The conception of recovery plan for the conservation of rare and endangered plant species was presented in this paper. The conservation of rare and endangered plant species and their habitats are of essential importance in view of the present trends of species and habitat destructions. Therefore, the conception of recovery plan for plant conservation should be considered and applied before the projected recovery works start. As a case study, recovery plan for the *Abeliophyllum distichum* Nakai, Oleaceae, one of the Korean endemic, and a rare plant, was investigated, although this plan is on processing for the future project.

1. 서론

최근 인간 간섭의 확대에 의해 서식처 분획화(Habitat Fragmentation)와 더 나아가 서식처의 파괴가 급속화되고 있다. 따라서 우리나라에서는 이미 파괴되었거나 훼손된 원래의 특정 야생식물의 서식처에 도입하기 위한 자생지 복원 사업을 하고 있다. 이러한 자생지 복원 작업은 사업 대상지와 식물종에 대한 다각적인 검토가 없이 단지 해당 식물종을 대량으로 증식하여 원래의 훼손된 자생지에 식재하는 것만이 전부인 형편이다.

앞으로 우리나라에서는 이러한 훼손지에 대한 복원 사업이 보다 증가될 것으로 전망하고 있다. 따라서 앞으로 우리나라에서 이러한 복원 작업을 할 경우에 "복원"이라는 원래의 의미에 합당하도록 사업을 진행하는 것이 보다 타당하다는 점에서 최근에 들어 선진국에서 진행되고 있는 희귀 및 멸종위기식물에 대한 복원의 간단한 현황을 소개함으로써 장차 우리나라에서 이러한 사업을 할 경우 참고가 될 수 있도록 본 글을 작성하였다.

사례 연구로는 우리나라의 특산식물 중의 하나인 미선나무를 대상으로 작성한 복구 계획을 소개하였으며, 앞으로 희귀 및 멸종위기식물의 복원 사업을 위한 기초 자료로 활용토록 하고자 하

는 바람에서 작성하였다.

2. 희귀 및 멸종위기식물의 종 및 서식처 보전을 위한 복원계획 작성의 필요성

최근 우리나라에서도 특정 야생 동·식물의 종과 서식처의 보전에 대한 관심이 높아지고 있으며, 이들을 대상으로 하여 실제적인 복원 사업이 일부 종을 대상으로 하여 이루어지고 있다. 그러나 이러한 사업의 수행 시 우리가 현실적으로 직면하는 문제는 대개 두 가지로 요약된다. 첫째로 훼손된 종의 유전적인 측면까지를 포함하여 원래의 종과 동일한 개체나 집단을 어느 정도까지 찾아낼 수 있을 것인가와 둘째로는 어떻게 하는 것이 이미 훼손된 서식처를 원래의 모습대로 복원할 수 있을 것인가 하는 문제이다. 그러나 심각한 문제는 우리가 복원하려고 하는 식물종과 서식처에 대하여 너무 무지하다는 점이다. 이것은 복원 대상이 되는 식물종에 대해 우리나라에서 발표된 문헌이 너무 제한되어 있으며, 만일 있다고 해도 필요로 하는 자료를 얻기가 매우 어렵다는 점을 염두에 둔다면 쉽게 수궁이 간다. 이러한 측면에서 복원 사업의 시작 전에 대상종의 형태학적, 생태학적 및 생물학적인 개념을 포괄한 의미에서의 종/집단생물학적인 특성을 규명하는 일이 매우 중요하다.

Recovery Plan(여기에서는 복원계획이라 칭한다)이란 현재 희귀 및 멸종위기식물로 규정된 식물종 및 집단을 대상으로 적절한 관리를 통하여 이들이 앞으로 더 이상 위협 상태에 놓이지 않게 하거나 궁극적으로는 멸종을 방지하고자 하는 적극적이고 종합적인 종 및 서식처 관리 기술의 일종이다. 또한 Recovery Plan은 자생지의 파괴뿐만 아니라 자생지의 규모가 점차 감소하는 경우에 새로운 집단을 도입시켜서 보다 활력 있는 집단으로 유지·관리하고자 할 때도 필요하다. 따라서 복원계획은 인간 본위의 자생지 복원이 아니라 식물 자체로서의 관점에서 우리들이 알아낼 수 있는 모든 점들을 파악하여, 실제로 식물들이 보다 활력 있는 집단을 유지할 수 있도록 한다는 점에서 그 의미와 중요성이 있다.

희귀 및 멸종위기식물은 일반적으로 식물생태학적 및 종 생물학적 특성이나 이들 자생지의 현재 상황으로 미루어 볼 때에 매우 열악한 상태에 놓여 있다. 따라서 인간의 간섭이 증대될수록 훼손되는 서식처나 종의 숫자는 증가될 것이고, 경우에 따라서는 이들의 서식처도 완전히 파괴되어 결국에는 멸종에 이르게 될 것이다. 따라서 훼손된 자생지의 복원 시 대상종이 지니는 생태적인 요구 조건들을 반드시 평가해야 한다. 이때 평가되는 내용은 복원계획의 작성 내용에 의한다.

우리나라에서는 지금까지 희귀 및 멸종위기식물의 자생지 복원에 있어서 대상이 되는 식물종의 분류학 및 생태학적 특성을 고려하지 않고, 동일한 식물종을 이용하여 이식(Transplanting)하는 수준에 머물러 있다. 예를 들면, 1970년대 초에 미선나무의 복원을 시작으로 지리산 제석봉의 구상나무의 복원이나 덕유산의 주목림 복원, 울릉도의 고추냉이 자생지 복원 등 지금까지 많은 희귀 및 멸종위기식물을 대상으로 복원 사업이 이루어지고 있다. 그러나 현재 우리는 이러한 식물들에 대해 얼마나 많은 정보를 축적하고 있는 것일까 하는 의문이 있다.

식물이란 서식처 환경의 절대적인 지배를 받으며 살아간다는 사실을 미루어 본다면, 식물 자체의 관점에서 자연적 복원작업은 동일 종에 있어서도 이들의 산지(Provenance)를 포함한 종생물학적, 분류학적 및 생태학적인 제반 문제를 충분히 검토한 후 복원 사업을 하는 것이다.

복원계획의 작성 목적은 결과적으로 보전 대상이 되는 식물종에 대한 분류학적, 생태학적, 생리학적인 면뿐만 아니라, 나아가서 종생물학적인 특성까지를 과학적으로 면밀히 조사하여, 복구가 필요할 때 기본 자료로 활용할 수 있도록 함이다. 따라서 이러한 사전 조사들은 어느 날 갑자기 해 낼 수 있는 일이 아니며, 인접 학문 분야와의 밀접한 연계 하에 장기적인 측면에서 접근할 때

에만이 가능하다. 특히 이러한 측면에서 앞으로 우리나라에서 보전 대상이 되는 특정식물종을 연구할 경우, 이러한 측면을 고려하여 연구 접근을 하는 방법도 바람직하다.

3. 복원계획의 일반적인 작성 내용

복원계획(Recovery Plan)이란 각종 위협 요인으로부터 생물종이나 군집의 쇠퇴를 막기 위하여 필요로 하는 연구 및 실행 관리에 관한 계획이라 할 수 있으며 이는 대상 생물종이 자연상태에서 그 생존이 극대화될 수 있도록 하기 위한 적극적인 조치이다.

위와 같은 목표를 달성하기 위하여 복원계획은 다음과 같은 내용들을 참고로 하는 것이 필요하다. 첫째로 복원계획 실행의 완수를 통하여 궁극적으로는 생물종이나 군집이 위협으로부터의 해소와 같은 달성할 목표에 대한 서술이 필요하며, 둘째로 생물종이나 군집의 활성집단(Viable Population)의 분포 및 개체수 등의 기록과 같은 달성 목표에 대한 기준의 언급이 필요하며, 셋째로 이러한 기준이 제시될 경우 이 기준을 만족시킬 수 있는 실행 계획에 대한 명시와, 넷째로 생물종이나 군집의 생존에 아주 주요한 서식처의 보호에 필요한 실행 계획에 대한 제시, 다섯째로 전반적인 복원사업의 진행에 소요되는 시간과 경비의 명시 등이 필요하다.

일반적으로 작성되는 복원계획의 개괄적인 내용은 다음과 같다.

1) 표지(Title Page)

항상 독립된 쪽으로 작성하며, 제목, 저자 등을 밝힌다.

2) 내용에 대한 목차 (Content)

항상 독립된 쪽으로 작성하며, 복원계획에서 다룬 내용의 제목을 차례대로 정리한다.

3) 요약 (Summary)

복원계획의 중요 내용을 요약한 부분이다. 이 항목에 주로 포함되는 내용은 다음 7가지 내용을 대상으로 간략히 요약하여 반드시 독립된 쪽으로 작성한다.

- (1) 복원대상종이 처한 현재의 상황(Current Species Status)
- (2) 복원 대상종의 서식처 요구 조건 및 제한 요인(Habitat Requirements and Limiting Factors)
- (3) 복원사업의 목표(Recovery Objectives)
- (4) 복원사업 완료 후의 기대 효과(Recovery Criteria)
- (5) 복원계획 수립 시 필요한 사항들(Actions Needed)
- (6) 복원사업 시 필요한 예산(Estimated Cost of Recovery)
- (7) 복원사업 후 생물다양성 측면에서의 기대 효과(Biodiversity Benefits)

4) 서론(Introduction)

이 항목에서는 다음과 같은 6가지의 내용을 포함한다.

- (1) 복원 대상종에 대한 일반적인 서술 (Description of species/community/ecosystem)
종의 분류학적인 위치, 종에 대한 간단한 형태학적인 특성에 대한 서술, 과거의 연구 기록 등에 대한 내용을 간단히 요약한다.
- (2) 복원대상종의 분포에 대한 사항(Distribution: past and present)
이 항목에서는 과거의 식물상 조사 기록, 집단에 대한 기록 등을 반드시 출처의 소개와 함께 정밀하게 서술한다.
- (3) 복원대상종의 서식처에 대한 내용(Habitat)
복원대상종이 자생하는 서식처가 처한 현재의 생태학적인 상황, 실제 및 잠재적인 위협 요인 등에 대한 내용을 정확하게 서술한다. 필요하면 인용문헌을 제시할 수도 있다.

(4) 복원대상종의 생활사 및 생태(Life history/ecology)

환경으로부터의 영향, 개화 및 결실 상황, 뿌리의 생육 특성, 지상부의 생육 특성 및 상황 등에 대한 내용을 서술한다.

(5) 위협 요인과 영향(Threats and Impacts)

현재 종 및 군집이 직면하고 있는 위협 상황과 그 영향에 대하여 사실대로 서술한다.

(6) 분류기준의 근거(Reasons for Listing)

이 항목에는 일반적으로 현재의 보전 상황, 복원대상종의 감소 추세, 위협 정도/요인과 복원대상종을 보다 자세하게 이해하는데 필요한 내용에 대해 서술하거나, 주제 등을 열거한다.

(7) 복원대상종의 현재 보전 상황(Existing conservation measures)

이 항목에는 국가적, 지역적인 맥락에서 본 현재의 보전 실태와 그 문제점을 자세히 기술한다. 필요하다면 참고문헌을 제시하는 것이 바람직할 것이다.

5) 복원 (Recovery)

이 항목 역시 반드시 독립된 쪽(Page)으로 작성함을 원칙으로 한다. 이 항목은 복원사업의 목표와 근거, 장기적인 모니터링과 새로운 개체나 집단 추적, 연구, 보호, 재조성 등에 대한 복원사업의 실행 계획이다. 본 항목은 복원사업의 가장 핵심적인 내용이 되기 때문에 복원대상종에 대해 현재까지 알려져 있는 모든 지식을 동원해서 작성하는 것이 바람직할 것이다.

(1) 목표 및 기준(Objective and criteria)

복원계획의 목표 제시 및 복원대상 생물종의 보전 분류기준을 명시한다.

(2) 복원실행에 대한 서술(Descriptions of recovery actions)

복원계획에 필요한 제반 연구 내용에 대하여 자세히 서술한다.

(3) 복원에 필요한 선행 연구(Research)

복원에 필요한 선행 연구에 대하여 자세히 기록한다.

6) 실행계획 (Implementation Schedule)

복원계획을 성공적으로 완수하기 위하여 필요로 하는 연간 계획, 연간 업무 계획, 인력 동원 계획 및 이들을 성공적으로 수행하는데 필요한 예산에 관한 것과 아울러 복원 사업 시 필요한 협조 사항 및 내용에 대한 서술이다.

7) 감사의 글 (Acknowledgement)

감사를 표해야 할 사람들의 명단이나, 이들에 대한 감사의 글을 서술 식으로 작성한다.

8) 인용 및 참고문헌 (Literature Cited or Bibliography)

복원계획을 수립하는데 인용하였거나 참고하였던 문헌을 소개한다.

4. 사례 연구의 대상수종: 우리나라의 미선나무 자생집단 (Appendix I)

1) 사례 연구의 배경

최근 우리나라에서는 훼손된 희귀 및 멸종위기식물의 종 및 서식처 수준에서의 합리적 보전을 위한 노력이 계속되고 있다. 그러나 이들 대상종에 대한 구체적인 자료의 부족과 복원 기술의 미천함으로 이 분야에 대한 새로운 기술의 도입이 요구되고 있다. 따라서 우리나라의 대표적인 특산종이며, 아울러 자생지의 훼손이 가속화되고 있는 미선나무를 대상으로 선진국에서 수행하고 있는 훼손지 복원의 제반 방법론을 적용해 봄으로서 장차 합리적인 훼손지 복구 방법을 모색하고자 한다.

2) 사례 연구의 목적

본 사례 연구는 우리나라에 자생하는 미선나무 집단을 대상으로 하여 자생지 파괴시 복구 계획

을 마련하기 위하여 최근 선진국에서 활발히 이루어지고 있는 복원계획을 이 수종을 대상으로 하여 작성한 것이다. 본 복원계획의 완수를 위해서는 앞으로 많은 시간과 인력 및 경비가 필요하리라 판단되나, 선진국의 보전 기구에서 일반적으로 행해지고 있는 방법이기에는, 우리에게도 많은 시사점을 주리라 생각된다.

3) 사례 연구 대상수종

미선나무는 세계 유일종이며, 우리나라의 대표적인 희귀 및 특산종이다. 현재 우리나라에서 알려진 자생지는 그 수가 그리 많지 않고, 매우 제한적이거나 아직 보고되지 않은 집단의 수는 더욱 늘어날 것으로 예측된다. 현재 우리나라의 미선나무 자생지는 모두 천연기념물로 지정되어 국가의 보호를 받고 있으나, 각 지역의 자생지는 산업화 및 불법적인 채취 행위로 점차 훼손이 더해가고 있다.

우리나라의 미선나무는 최초 발견된(Nakai 1919) 이후 곧바로 미국 하버드대학 아놀드 수목원으로 보내졌고, 이후 영국의 왕립 큐식물원을 비롯하여 유럽지방으로 확산되어 주로 원예용으로 이용되고 있으나, 우리나라에서는 그 이용이 외국과 비교하여 그리 활발하지 않은 실정이다.

다음에 소개(Appendix I)되는 미선나무의 복원계획은 British Council의 지원 하에 1994년부터 5년간의 계획으로 영남대학교와 영국의 왕립 큐식물원(Royal Botanic Gardens, Kew)간 장기 공동 연구의 일환으로 작성된 것이다. 본 연구를 수행할 수 있도록 필요한 경비 지원과 연구 시설을 이용하는데 많은 도움을 준 British Council, Royal Botanic Gardens, Kew 및 University of Reading의 관계자 여러분들에게 깊은 사의를 표한다.

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Appendix I.

Draft
Provisional Recovery Plan
For
Abeliophyllum distichum Nakai
in
Republic of Korea

Prepared by
Yeungnam University
&
Royal Botanic Gardens, Kew

February 1995

Yong Shik Kim & Mike Maunder

**Draft Provisional Recovery Plan
for *Abeliophyllum distichum* Nakai
in
Republic of Korea**

**Prepared by
Yeungnam University
&
Royal Botanic Gardens, Kew**

Yong Shik Kim & Mike Maunder

February 1995

Disclaimer

This recovery plan has been prepared using current knowledge of *Abeliophyllum distichum* in the Republic of Korea. The recovery plan may therefore be subject to modification at any time as dictated by new knowledge of the species, changes in the species' conservation status, budgetary constraints or the completion of the recovery program. It was prepared by the Yeungnam University, Kyongsan, Republic of Korea and the Royal Botanic Gardens, Kew, Richmond, Surrey, United Kingdom.

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Summary

Current species status. "A monotypic genus restricted to the Republic of Korea, records from North Korea require verification. Only five extant populations are known to exist: one population in Yong-dong, one in Pu-an, and three populations in Koe-san. A population at Chin-chon was recorded on 1969, but removed from the list of Korean Natural Monuments."

Current species status

An endemic to the Republic of Korea, is found to be five known populations: one population in Yongdong, one in Puan, and the other three populations in Koesan-gun Area. Most wild populations have a few number of individual plants. All known five populations are protected under the Korean Natural Monument Acts. One population of Chinchon was extinct in the wild in 1969, and discarded from the list of the Korean Natural Monuments.

Habitat requirements and limiting factors

Distributed in scattered populations in the central part of South Korea. Grows as an understory shrub in mixed deciduous woodland. Current threats include: road and dam construction, visitor pressure and illegal collections of plants. There are no reasons to assure that any of these threats diminish. A study on ecology of the species is necessary, because there is little evidence of seedling recruitment in wild populations, due to overshadowing and competition.

Recovery plan objectives

To identify main ecological factors impacting upon *Abeliophyllum* in the wild, is necessary to allow practical *in situ* management for survival of existing populations.

Recovery criteria

Locate and record all extant populations. Initiate monitoring and management trials. All five legally protected populations to be managed according to an agreed management plan incorporating results of initial research. All recored populations to be given legal protection. All extant populations to be secured, population decline reserved and seedling regeneration to be established.

Actions needed

- a. Establish Recovery Team incorporating expertise in conservation biology, plant ecology, protected areas management, population genetics, plant propagation, *etc.*
- b. Undertake field surveys.
- c. Intitiate genetic surveys.
- d. Initiate monitoring programme and trial habitat management.
- e. Implement agreed recovery plan incorporating *in situ* management, the establishment of *ex situ* collections and re-introduction.

Total estimated costs of recovery (1996~2005)

Full costs will only be available once the Recovery Team has been established and insitutional responsibilities have been established. A preliminary estimate of the research costs is presented.

| | |
|---------------------------------------|------------------------|
| 1. Biology of Plants | £ 22,200 (₩27,168,138) |
| 1) Flowering Characteristics | £ 20,200 (₩24,720,558) |
| 2) Germination Tests | £ 1,000 (₩1,223,790) |
| 3) Viability Tests | £ 1,000 (₩1,223,790) |
| 2. Monitoring and Searching | £ 24,850 (₩30,411,182) |
| 1) Monitoring of All Populations | £ 20,400 (₩24,965,316) |
| 2) Searching for New Populations | £ 4,450 (₩5,445,866) |
| 3. Research | £ 22,800 (₩27,902,412) |
| 1) Canopy Removal Trials | £ 15,500 (₩18,968,745) |
| 2) Monitoring the Trials Sites | £ 7,300 (₩8,933,667) |
| 4. Total Expected Budget for 10 Years | £ 69,850 (₩85,481,732) |

Biodiversity benefits

The conservation of *Abeliophyllum distichum* introduction and development.

Introduction

1. Description and Taxonomy

Abeliophyllum distichum Nakai (Oleaceae) is restricted to the Korean Peninsula is recognised in Korea as a threatening species.

Abeliophyllum distichum was described by Nakai(1919). A small upright, deciduous shrub reaching about one metre or slightly more in height, with erect branches arising from the base and spreading or arching over towards the apices, lateral branches curved and pendent; young shoots very slender, quadrangular, dark purple at first becoming brown and finally grey with loosely fissured bark which is exfoliated with age. Leaves thin, opposite, lanceolate to ovate-oblong, base rounded or widely cuneate, apex acute to attenuate-acute, 6~10 cm long, 3~4.5 cm wide. Inflorescens laterally borne on leafless shoots of previous year. Flowers varied from white to pink, fragrant, subulate, 3~5 mm long, pedicles 4~5 mm long, dark purple. Fruit a laterally compressed, circular samara (Cotton 1948). Several forms and cultivars have been reported (Lee 1976; Lord 1990), and made some notes on the below;

Abeliophyllum distichum roseum

Abeliophyllum distichum for. *lilacinum* Nakai

: Corolla purpurea in albabastro, ubi patens lilacina, calyce ut in typica.

Abeliophyllum distichum for. *viridicalycinum* T. Lee

: Corolla viridi-alba et calyce viridia, cetera ut in typica.

Abeliophyllum distichum for. *eburneum* T. Lee

: Corolla eburnea, calyce ut in typica.

Abeliophyllum distichum var. *obtusicarpum* T. Lee

: Differta typica frutibus vel truncatibus et minoribus, petiolis et nervis internis patentibus trichomatibus, corolla lilacina, calyce ut in typica.

2. Distribution

Abeliophyllum distichum is restricted to the Korean Peninsula. The main population appears to be restricted to the central area of the Republic of Korea (Fig. 1). Herbarium were collected from Mt Changsoo and Nanam from North Korea (Lee and Kil 1991), however no information is available on the wild status of the species in North Korea.

A review of existing literature followed by a field survey in the spring of 1993 has established distributions and status of the species in the Republic of Korea. There appear to six disjunct localities: occurs mainly in the middle part of South Korean territory (Fig. 1); three populations at the Koesan-gun area, one population at Seoul, one at Yongdong-gun, and the other population at Puan-gun of Chollapuk-do. Existing Documented herbarium specimens were collected from Mt Changsoo and Nanam, both in North Korea (Lee and Kil 1991), no data on living germplasm materials are provided yet.

It is known from wild populations that there are six disjunct localities: three localities in Koesan-gun, one locality in Chinchon-gun which is designated as a Natural Monument No. 14, one locality in Yongdong-up, Chungchongpuk-to, and one locality in Puan-gun,

Chollapuk-do. The two populations of Yongdong and Puan were only recently discovered in 1990 and 1992, respectively. Another population was discovered in 1973, by Yong No Lee & Yong Ja Oh, both Korean botanists, and Schneider, in Hyoja-ri, Sindo-myon, Koyang-gun, Kyonggi-do, in the vicinity of the Seoul metropolitan area (Lee and Kil 1991). There is no documented information to date. Lee(1987) also investigated herbarium specimen of *Abeliophyllum distichum* at Kyoto University Herbarium and reported that thies specimens were collected by Japanese botanists, Koizumi in 1935, at Mt Changsoo, Hwanghae-do, and by Japanese botanist, Saito at Nanam, Hamkyongnam-do of North Korea(Lee and Kil 1991).

1) The Songdok-ni Population, Changyon-myon, Koesan-gun, Chungchongpuk-do:

This population occurs by the edge of the road on land which slopes slightly to the north. The centre of the site is rocky with scattered boulders. The population covers an area of ca. 9,900 m^2 . The dominant tree on the site is *Pinus densiflora* Sieb. et Zucc. Trees of *Quercus myrsinaefolia* Carr. have been pollarded in the recent past and are sprouting vigorously.

2) The Chujom-ni Population, Changyon-myon, Koesan-gun, Chungchongpuk-do:

This population is located in woodland above an area of rice paddy fields. This site is steeply sloped with boulders scattered in the middle part of the site. The population covers an area of ca. 7,800 m^2 . No estimate of the total number of individuals was obtained. It is suspected that serious damage is caused by the annual heavy clearing of scrub for conservation purposes in early spring.

3) The Yulchi-ri Population, Changyon-myon, Koesan-gun, Chungchongpuk-do:

This population on this area is located in the vicinity of cultivated fields, and close to the village. The population covers an area of ca. 14,000 m^2 , and is protected by a fence. One of the the dominant species of the forest is *Quercus myrsinaefolia*. Small channels through the centre of the habitat suggest erosion is taking place flooding occurs. The heavy clearing of scrub for conservation purposes is carried out every early spring. Lee(1976) reported that there were 9 individuals in the population. The population has increased to ca. 30 individuals.

4) The Yongdong Population, Yongdong-up, Chungchongpuk-do:

This population was recently discovered, within a county park. The topography of the site is rather steep on the northside. The dominant forest species is *Quercus myrsinaefolia*. This site is well preserved because access from the paths is difficult. At this site, the species is not immediately threatened. The population covers an areas of ca. 20,000 m^2 .

5) The Puan Population, Chunggyae-ri, Sannae-myon, Puan-gun, Chollapuk-do:

These populations are scattered along the Chiksochon and Paekchon Streams. The largest population is on the hillside, just alongside the road. This population covers an area of ca. 2,300 m^2 . Most of the populations in this area were destroyed by the dam construction.

Long-term threats include dam construction, possible illegal collections and road traffic.

The ownership of the wild populations of the species varies; the populations at Songdok-ni, Chujom-ni, Yulchi-ri in Koesan-kun are privately owned, while the wild population in Yongdong-up belongs to the Yongdong-gun County, and the Puan population belongs to both private authorities and Puan-gun County.

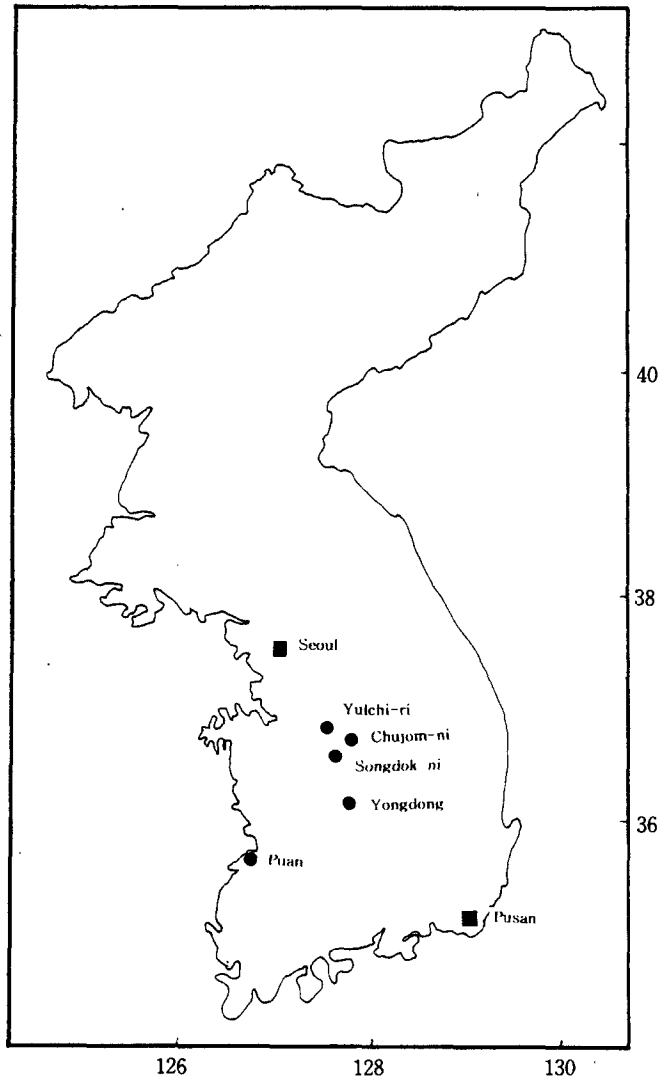


Fig. 1. The map of wild localities of *Abeliophyllum distichum* Nakai in Korea

Plant numbers in most wild populations are only estimates as it is difficult to determine the exact number of individuals as the species is difficult to locate when not in flower because it is covered with other shrub species nearby.

3. Habitat

Abeliophyllum distichum is a shrub layer component of mixed and deciduous woodland, growing in dappled or half shaded situations. It grows in association with *Pinus densiflora* and *Quercus acutissima*, and on rocky sites with *Securinega suffruticosa*.

It shows a geological preference grows amongst other low shrub species on the gravelly

soils in shade or half-shade. It shows geological preference slightly within its range but is restricted at individual sites such as the populations of Songdok-ni, Chujom-ni, Yulchi-ri, and Puan. For example, the habitat of the Songdok population is covered almost 90% of the coverage with the boulders. It grows mainly under the upper layers of *Pinus densiflora* or *Quercus acutissima* and amongst with other shrub species such as *Securinega suffruticosa* on the rocky soils.

The majority of rainfall occurs during the summer season (July and August). It is very hot in summer, and very dry and cold in winter (Table 1).

Most of habitat of the species has been considerably disturbed as the shrub layers are forcibly removed every early in the spring. Only two wild populations, Puan-gun and Yongdong-gun are not subject to scrub clearance.

4. Ecology & Reproductive Biology

The plant forms a low shrub, seldom exceeding 1.5 metres in height. Most of the observed regeneration is through vegetative "suckering" rather than from seed.

Abeliophyllum distichum has a very short flowering period of about one or one and half weeks in late March or early April. Plants growing in sunny sites flower earlier than those in shaded sites. Individuals vary in the many number of flowers they produce. A given plant may not produce flowers every year. For the same reason, seed yields are low in some years.

Table 1. Monthly meteorological data of the studied areas (1961~1990).

| Sites | Month Factors | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sept. | Oct. | Nov. | Dec. | Mean |
|----------|------------------------|--------|-----------------------|------|------|------|-------|-------|-------|-------|------|------|-------|-------|
| | | Koesan | Mean temperature (°C) | 4.2 | 1.7 | 3.7 | 10.9 | 16.2 | 20.7 | 23.9 | 24.2 | 18.4 | 11.8 | 4.9 |
| | Maximum temp.(°C) | 8.8 | 12.7 | 19.1 | 26.1 | 29.6 | 31.9 | 33.5 | 33.5 | 29.8 | 25.4 | 19.8 | 13.8 | 23.7 |
| | Minimum temp.(°C) | -19.5 | 16.3 | 9.9 | 4.4 | 2.1 | 9.2 | 15.0 | 14.9 | 4.4 | 3.0 | -9.2 | -15.8 | 2.7 |
| | Mean Precipitation(mm) | 29.2 | 32.9 | 51.0 | 88.2 | 89.4 | 148.4 | 315.2 | 240.7 | 128.7 | 48.1 | 47.7 | 30.1 | 104.1 |
| | Mean Rel. Humidity(%) | 73.0 | 71.0 | 68.0 | 65.0 | 68.0 | 75.0 | 82.0 | 81.0 | 81.0 | 77.0 | 76.0 | 74.0 | 74.3 |
| Yongdong | Mean temperature (°C) | 2.7 | 0.8 | 4.5 | 11.8 | 17.1 | 20.9 | 24.1 | 24.5 | 19.3 | 13.2 | 6.3 | 0.1 | 11.5 |
| | Maximum temp.(°C) | 9.6 | 13.5 | 19.6 | 26.0 | 29.8 | 31.8 | 33.6 | 33.5 | 29.9 | 25.3 | 20.1 | 13.8 | 23.9 |
| | Minimum temp.(°C) | 13.6 | 12.2 | 6.7 | 1.3 | 4.9 | 10.5 | 16.1 | 16.4 | 7.7 | 0.6 | -5.8 | -11.5 | 0.4 |
| | Mean Precipitation(mm) | 26.3 | 36.2 | 57.7 | 88.0 | 81.8 | 132.0 | 269.7 | 204.2 | 128.1 | 49.5 | 50.8 | 24.8 | 95.8 |
| | Mean Rel. Humidity(%) | 65.0 | 64.0 | 61.0 | 61.0 | 63.0 | 73.0 | 82.0 | 82.0 | 79.0 | 72.0 | 70.0 | 67.0 | 69.9 |
| Puan | Mean temperature (°C) | 0.8 | 0.5 | 4.6 | 11.0 | 16.4 | 20.9 | 24.7 | 25.7 | 21.0 | 15.0 | 8.2 | 2.2 | 12.5 |
| | Maximum temp.(°C) | 9.6 | 12.1 | 17.9 | 24.4 | 27.3 | 29.8 | 33.3 | 33.3 | 29.9 | 25.6 | 19.6 | 14.4 | 23.1 |
| | Minimum temp.(°C) | 10.6 | 9.2 | -4.3 | 1.0 | 7.5 | 13.7 | 18.2 | 18.8 | 11.4 | 4.2 | -2.8 | 7.9 | 3.3 |
| | Mean Precipitation(mm) | 34.5 | 35.6 | 50.7 | 90.3 | 91.1 | 136.3 | 254.2 | 226.3 | 130.6 | 49.9 | 56.9 | 33.8 | 99.2 |
| | Mean Rel. Humidity(%) | 73.0 | 72.0 | 72.0 | 73.0 | 75.0 | 80.0 | 85.0 | 82.0 | 78.0 | 74.0 | 74.0 | 74.0 | 76 |

Pollination is likely to be affected by non-specific insect pollinators, but proper field investigations have not been made. Observations indicate that mature collection of ripening pods produces few if any seeds.

5. Threats and Impacts

The populations, although all protected by the National Monument legislation, are under the management of a variety of authorities. All these populations, except Yong-dong population occur on private land.

All populations are protected by fences. Although this control public access it may also pose a problem for site management. Several of the sites are subject to scrub clearance, this is intended to promote the *Abeliophyllum distichum* populations. This has been undertaken without any experimental trials and its value as a conservation management tool has not yet to be conferred.

Most of the populations of *Abeliophyllum distichum* occur as small remnants of individuals, which are susceptible to disturbances, such as destructutions of the habitat by illegal collections and annual clearcuttings of the scrub. The populations have not been monitored regularly and the current condition of many is unknown. For example, Lee(1976) reported that the wild population of Chinchon, one of the first designated populations of as a Natural Monument was extinct in 1969, but data were not documented. Populations in Puan-gun are threatened by dam construction. One population near roadside was transplanted in 1994, because of submergance alongside by water, by the Experimental Forest, Chonpuk National University, Chonju. But a severe problem remained due to the lack of eco-genetic investigations.

Populations of Puan-gun are located inside the Pyonsanpando National Park and a part of the Chonpuk Experimental Forest. One of habitats within the population was completely destroyed recently by ongoing dam construction. A possible changed micro-environment.

Although this species has long been used as an ornamental tree in foreign countries, the Koreans have only recently realized its ornamental qualities. In fact, the landowners of the Koesan-gun populations have conducted illegal collections for personal uses. A population of *Abeliophyllum distichum* in Chinchon-gun, which was a Natural Monument No. 14, have been removed from the Natural Monument List in 1969 (Lee 1976).

6. Justification for a recovery plan

1) Current Conservation Status

The species is classified as Endangered in Korea, it is currently inadequately managed. A review of the status of *Abeliophyllum distichum* suggests as a threatened species:

(1) It is a geographically localised species, with only 6 locations, with a possibility of 2 or 3 unrecorded wild populations.

(2) Populations have been lost or severly depleted. The Chinchon-gun population is recorded as extinct by 1969 and has been deleted from the Naturall Monument listing. The population of Puan-gun was completely destroyed by dam construction. The Koesan-gun population was translocated to avoid destruction (Lee and Kil 1989).

(3) Although all populations are designated as Natural Monuments they are inadequately managed to ensure long term survival. The effect of scrub clearance around populations is

unknown.

(4) The preliminary investigation suggests that the population structure is skewed towards mature plants and there is little evidence for seedling regeneration from wild populations. The Yulchi-ri population is subjected to localised erosional problems.

(5) The species is subject to illegal collection and damage from off-road vehicles.

2) Evidence of Population Decline

Although there were no intensive investigations on the habitats, the individual trees were remained with old, and the fruiting irregular. *Abeliophyllum distichum* is perfectly hardy, but flowering as it does so early in the year (Cotton 1948), so the harvesting should be poor. Partly for this reason, it is not easy to find seedlings or saplings nearby, only individuals which are propagated by root can be rarely seen. This fact is supported by that the populations in Koesan-gun area was propagated and artificially planted (Lee and Kil 1989). But the information, in detail, on the propagation and artificial planting are unavailable at the moment.

3) Threats

Future threats to the species are associated with the unproper management practices at the populations in the areas of Koesan-gun, Chungchongpuk-do. The small and swallow ditch runs into the Yulchi population, and may cause erosion in heavy showers.

Long-term threats are expected by the dam construction nearby in Puan-gun populations. Caging of all populations of *Abeliophyllum distichum* brought habitat island.

The major management issue is protection from human collections for ornamental purposes.

7. Existing Conservation Measures

Most of the wild populations of the species in Korea are protected as a Natural Monument (Refers Korean Natural Monuments Nos 14, 147, 220, 221, 364 and 370); the first one was designated as a Natural Monument on April 30, 1958. All the populations are protected by fence.

Very little specific protection or management exists for *Abeliophyllum distichum* populations at the present time. There has been no intensive research on the species.

The only possible and practical conservation measures at present is the prevention of further habitat clearance and some protection from illegal collections for ornamental purposes. The Yongdong population is the most intact habitat of all known populations in Korea.

But no proper management is applied based on the biological and ecological aspects.

8. Recovery

1) Protect populations.

(1) Protect publicly owned populations managements agreements etc.

- (2) Protect and secure plants on private property.
- 2) Assess and preserve existing genetic diversity.
- 3) Monitor populations to determine population trends and develop management protocols.
- 4) Search for additional populations.
- 5) Re-establish populations and augment populations at protected sites, if deemed necessary.
- 6) Use management techniques to maintain and/or enhance populations.
- 7) Educate public and conservation professionals.

Recovery: proposed research phase

1. Objective and Criteria

The main objective of this Recovery Plan is to ensure that *Abeliophyllum distichum* survives as viable population in the wild habitat based on the protection existing wild populations at each of the localities. Furthermore it is to establish an *ex situ* collection of living materials which adequately covers the known genetic resources of the species. Furthermore it is to manage the habitats necessary to sustain healthy populations.

Abeliophyllum distichum is considered as Endangered (EN) which evaluated under the New IUCN Categories of Threat (Kim 1994).

To achieve above items, we should secure all existing populations and establish new viable wild populations:

- 1) an increase in the nature of existing plants to at least 250 individuals per population,
- 2) each existing population is demographically secure and regenerating,
- 3) results achieved from research into the ecology and regeneration incorporated into management plans and implemented.

In order to achieve these objectives, information will be obtained regarding distribution, ecology, phenology, biology of growth, flowering seed set and germination, propagation techniques and threatening factors.

2. Description of Recovery Actions

1) Monitoring and Searching

(1) Monitoring at All Priority Sites

The aim of this is to assess whether or not *Abeliophyllum distichum* is decreasing. Sites selected to allow research on site management and ecology. For this, we will visit selected site(s) in March/April when flowering, and in August/September when fruiting, and count individuals, and assess the reproductive biology of the populations.

(2) Searching for New Populations

The aim of this is to locate any possible wild populations not yet recorded so that they may be protected in Korea to allow incorporation within Recovery Programme. It is possible that undiscovered populations of *Abeliophyllum distichum* exist. For the progress of it, we need to search for potential site(s) in appropriate counties and localities. This is best

undertake in March/April.

Community vegetation to classify known habitat-forest types based on multivariate analysis, and subsequent ordination/correlation with geology, soil and topography would precede field searches of other areas.

3. Research

1) Objectives and Criteria

The recovery plan objectives are to achieve an increase in the current level of understanding of the ecology of *Abeliophyllum distichum*, as well as the implementation of management criteria that will aid in the increase in the number of individuals in known wild populations in Korea. For this, a series of works are proposed.

2) Field Survey Methodologies

The sites which will be surveyed will cover the full range of topographic locations, soil types and vegetation types in which the species is known to occur, and the existing conservation status of the species will be reviewed under the Draft IUCN Categories of Threat for Species (Mace *et al.* 1993).

3) Design of Experiment

At one of the proposed research areas, we would like to identify the impact of human disturbances. For this research, we will carry out the impacts from different Canopy Removal Trials. The aim of this trial is to assess the impact of canopy removal on growth and reproduction of *Abeliophyllum distichum*.

For the installment of field experimental blocks, the size of 20m x 20m quadrat will be applied to assess the disturbances by human activities. For the layout of experimental blocks, the long-term monitoring will be carried out in the quadrat. Three threateners such as No Intervention, Canopy Removal, and Canopy and Scrub Removal will be applied. The latter two trials will utilize existing managed plots. No new woodland areas will be thinned or cleared.

From the series of an experiments, extension growth, number of inflorescens, seed set and seedling occurrence will be annually monitored.

4) Research Categories

(1) Ecology and Phenology

A detailed survey will be performed initially to determine accurately the extent and locations of remnant populations of *Abeliophyllum distichum*. A permanent monitoring plot will be installed at key locations to follow population dynamics over five years. Data collected at these sites will include vegetation associations, soil, climatic information and plant numbers.

(2) Biology

In order to determine factors limiting seedling recruitment, a phenological study will be

performed. This will be done during flowering/seed set each year for three years. Seed set rates will be determined and seed dehiscent and dispersal mechanisms studied. Seed will be collected when mature, and germination and viability tests performed in the laboratory.

3) Further Prerequisite Research Areas Into *Abeliophyllum distichum* Ecology

(1) Monitoring and elimination of threats to wild populations

- ① Eliminate the suppression of disturbance factors
- ② Eliminate threat from the collecting of plants
- ③ Prevent loss due to development or construction
- ④ Prevent loss due to off-road vehicle impact for the population of Puan

(2) Conduct systematic surveys for additional naturally occurring populations and suitable habitats for establishing new populations.

(3) Monitor populations and conduct research to determine species life history, minimum viable population parameters, habitat requirements, and management criteria.

- ① Monitor the status and trend of each population
- ② Determine the effects of canopy removal and other disturbance factors as management techniques
- ③ Determine the parameters required for a minimum viable population
- ④ Determine genetic variability

(4) Reintroduce populations in areas of historic occurrence and introduce new populations in suitable habitat within the species range

(5) Maintain seed source and genetic variability in an artificial seed bank.

Implementation schedule

1. Biology of Plants: £ 22,200

1) Flowering Characteristics

Costs: £ 20,200

Salary: £ 200 x 6 months x 10 years = £ 12,000

Travel: £ 100 x 4 days/ 1 year x 10 years = £ 4,000

Field Study Gears:

- ① Driving vehicles: £ 30 x 4 days/ 1 year x 10 years = £ 1,200
- ② Accommodation: £ 100 x 3 days/ 1 year x 10 years = £ 3,000
- ③ Accessories: £ 20

2) Germination Test

Costs: £ 1,000

- ① Accessories: £ 1,000 x 1 year = £ 1,000

3) Viability Test

Costs: £ 1,000

- ① Accessories: £ 1,000 x 1 year = £ 1,000

2. Monitoring and Searching: £ 24,850

1) Monitoring of all populations

Costs: £ 20,400

Salary: £ 200 x 6 months x 10 years = £ 12,000

Travel: £ 100 x 4 days x 10 years = £ 4,000

Field Study Gears:

① Driving vehicles: £ 30 x 4 days x 10 years = £ 1,200

② Monitoring gears: £ 20 x 10 years = £ 200

③ Accommodations: £ 100 x 3 days x 10 years = £ 3,000

2) Searching New Populations

Costs: £ 4,450

Salary: £ 200 x 4 months x 1 year = £ 800

Travel: £ 100 x 15 days x 1 year = £ 1,500

Field Study Gears:

① Driving vehicles: £ 30 x 15 days x 1 year = £ 450

② Monitoring gears: £ 20 x 10 years = £ 200

③ Accommodations: £ 100 x 15 days x 1 year = £ 1,500

3. Research: £ 22,800

1) Canopy Removal Trials

Costs: £ 15,500

Salary: £ 200 x 4 months x 10 years = £ 8,000

Travel: £ 100 x 5 days x 10 years = £ 5,000

Field Study Gears:

① Driving vehicles: £ 30 x 5 days x 10 years = £ 1,500

② Accessories: £ 100 x 10 years = £ 1,000

2) Monitoring the Trials Sites

Costs: £ 7,300

Salary: £ 200 x 6 months x 5 years = £ 6,000

Travel: £ 100 x 2 days x 5 years = £ 1,000

Field Study Gears:

① Driving vehicles: £ 30 x 2 x 5 = £ 300

Expected Total Budget: £ 69,850

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