

**AN ASSESSMENT OF WATER RESOURCES DEPENDENCY OF SURROUNDING COMMUNITY, IMPACTS OF AQUATIC WEEDS AND EFFECTIVE WEED CONTROL METHODS OF THE WATER BODIES IN ANAWILUNDAWA WILDLIFE SANCTUARY AND RAMSAR WETLAND IN SRI LANKA**

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**ABSTRACT**

The Anawilundawa Wildlife Sanctuary (AWS) was established in June 1997 by the Department of Wildlife Conservation (DWC), Sri Lanka under the provisions of the FFPO. (Government Gazette number 97915 of 11 June 1997) Considering its biodiversity and Wetland values, the sanctuary was recognized as a wetland of International Importance by the Ramsar convention in 2002.

The AWS consists of a group of seven shallow cascading reservoirs including the around terrestrial landmass. The reservoirs are the heart of the sanctuary which depends on the balance of the wetland ecosystem. The people in and around, depend on the water resource of the sanctuary for their livelihoods. Therefore the reservoirs play a significant role for the balance of the wetland ecosystem as well as the dependencies of the surrounding community. But the reservoirs are covered with aquatic weeds.

The objective of the present study is to assess the impacts of the weeds and to propose management practices to control the aquatic weeds. The direct observations, interviewing the community, and several pilot practices had been conducted during the study.

The results reveal that, there is a seasonal pattern of water resource dependency in the study area. The extraction of non timber forest products takes place throughout the year. The water level of the sanctuary indicates a positive relationship with the water resources dependencies. There are about ten aquatic weeds in the AWS. The most impacts cause from Water hyacinth (*Eichhornia crassipes*), Salvinia (*Salvinia molesta*), and Water lettuce (*Pistia stratiotes*). The large leaf area of weeds leads to increased water loss through transpiration. It interfere with fish life by reducing oxygen level in water, producing toxic substances such as Hydrogen Sulphide and reducing phytoplankton population, prime food sources for fish. Weeds reduce the water flow and increase the siltation. When compared with the previous records, in the full capacity condition, the water capacity of the reservoirs are eight inches lower than that of 1995. Water hyacinth also downgrades recreational water facilities by reducing the water surface, creating offensive odors and tainting of water.

Mechanical control of weeds is one method, and removal of Salvinia by hand or machine is a practical control method. Biological control of Salvinia and Water hyacinth is a better method in this sanctuary as this is a protected area. In 1990, Agriculture Department of Sri Lanka has introduced Salvinia weevil to these water bodies. The DWC, the management authority of the sanctuary, organized a campaign for the removal of aquatic weeds May, 2005 during the peak drought. Surrounding community involved with this activity through their CBO. Prevention is the best form of weed control. The community can also help to prevent the spread of aquatic weeds by reporting the Department of Wildlife Conservation. Rehabilitation of water outlets of the reservoirs should be done immediately. Desilting of the water bodies is another important practice to increase the water capacity. Community participation for weed control, desiltation of the reservoirs, to control the illegal activities affecting the balance of the ecosystem of this study area could be suggested as some immediate site specific actions with appropriate strategies.

## INTRODUCTION

Sri Lanka has a golden history about Protected Area (PA) Management. The first PA, Mihintale Sanctuary was declared by king Devanampiyatissa the Great in about 200 B.C. After the Mihintale Sanctuary, Sri Lanka has 82 PAs including 3 Strict Natural Reserves, 17 National Parks, 4 Nature Reserves and 58 Sanctuaries. All these PAs are under the jurisdiction of the Department of Wildlife Conservation (DWC) which has the authority of Fauna & Flora Protection Ordinance (FFPO).

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The AWS consists of a group of seven shallow cascading reservoirs including the surrounding terrestrial landmass. The reservoirs are the heart of the sanctuary which depends on the balance of the wetland ecosystem. The sanctuary includes the state lands as well as private lands including home gardens and paddy fields. The people in and around, depend on the water resource of the sanctuary for their livelihoods. Therefore the reservoirs play a significant role for the balance of the wetland ecosystem as well as the dependencies of the surrounding community.

All seven reservoirs of the AWS are shallow with maximum depth not exceeding 4.0 meters during full storage. (Wetland site report & conservation management plan, Anaiwilundawa tanks, 1994) But the water is covered with varied aquatic weeds.

Several researches were carried out by various researchers. There are records on previous applications of biological control of Water hyacinth and *Salvinia* by the Department of Agriculture. But there are no previous studies on aquatic weeds and water dependencies in AWS.

### **Significance of the study**

The AWS harbours a rich native terrestrial and aquatic faunal and floral biodiversity that is further enriched by the seasonal migration of waterfowls. These factors led to the declaration of Anaiwilundawa as a birds sanctuary and recognition of it as a Wetland of International Importance by the Ramsar Convention. The group of seven reservoirs, which cover the area of about 14ha, is the heart of the wetland ecosystem.

### **Research problem**

The water capacity of reservoirs is the most important factor for the sustainability of the sanctuary. The people living around the sanctuary use the water for different purposes. But the reservoirs are covered with aquatic weeds. It is a significant threat to the natural balance of the wetland ecosystem as well as

the community which depends on the water of reservoirs. The management practices need to be applied to control the weeds.

### **Purpose of the study**

AWS, the wetland ecosystem contains seven reservoirs. The water is the main factor for the balance of the ecosystem. The people on diverse needs, depends on water of these reservoirs. The existing quality of water is deteriorating. In this study the researcher is going to find the impacts of aquatic weeds of the reservoirs in AWS.

The findings are important to the managers of the sanctuary who are responsible for the conservation and sustainable utilization of natural resources of this wetland ecosystem. They can be incorporated into the management plan. The proposed management practices can be applied in other wetlands as well under similar conditions. The weed control methods would be important to the DWC who are the management authority of the sanctuary.

### **Scope of the study**

In this study the writer wishes to focus the attention on the aquatic weeds but not on terrestrial weeds. The list of the aquatic weeds in tank system is being prepared. The direct and indirect dependencies on tanks are being studied. The writer wishes to discuss the weed management methods. These methods can be applied by the DWC who are the management authority of the sanctuary. The writer does not plan to calculate the total area density of each aquatic weed in tanks.

Anawilundawa Wildlife Sanctuary, the wetland ecosystem contains seven reservoirs. The water is the main factor for the balance of the ecosystem. The people have various dependencies on the water of these tanks. The existing condition of the water is becoming unsuitable for fauna and flora existence.

The main objective of the study is to propose management practices to control aquatic weeds.

In this study the researcher hopes, to discuss the impacts of aquatic weeds on wetland ecosystem of AWS, and to find out the dependencies of surrounding community on water of the reservoirs.

## **METHODOLOGY**

### **Study Area**

#### **Location**

The Anawilundawa Wildlife Sanctuary, covering an area of 1400ha, is situated between the coast and the Negombo – Puttalam railway/road (7<sup>o</sup> 42' N, 79<sup>o</sup> 49' E) in Puttalam District of North-Western Province in Sri Lanka (CEA,

1994). The closest towns are Chillaw (10km) to the South and Puttalam (35km) to the North (Figure 1)

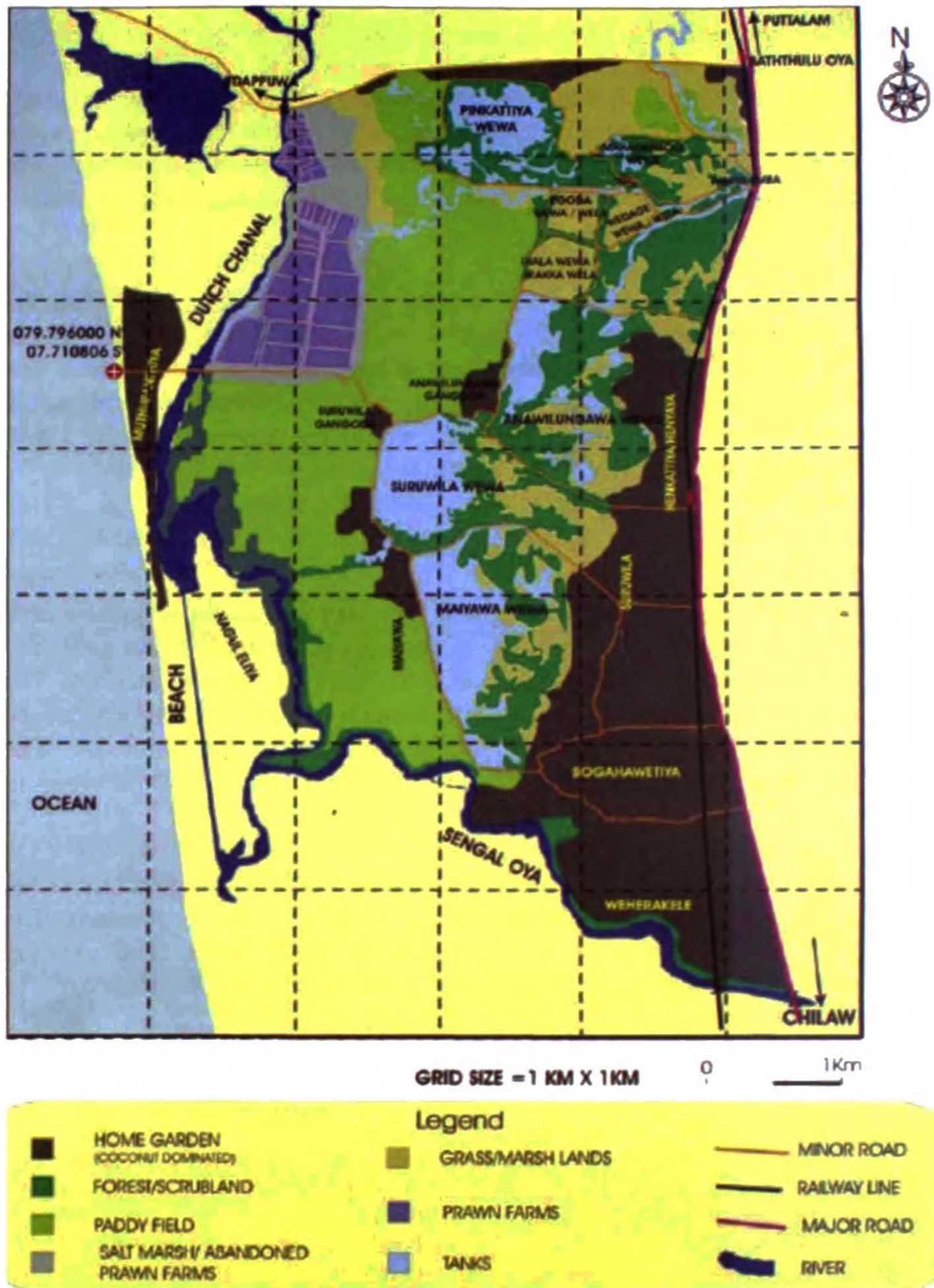


Figure 1. The study area

### Declaration

The AWS was established in June 1997 by the Department of Wildlife conservation under the provisions of Fauna and Flora Protection Ordinance.

In August 2001, the sanctuary was recognized as a Wetland of International Importance by the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), following a request made by the DWC. Figure 1 shows the study area

### Methodology

The survey had been carried out in August and October 2005. In this survey direct observations of dependencies on reservoirs had been recorded. During the day time from 6.00am to 7.30 pm the activities of the people in the sanctuary were observed. A selected set of people were interviewed to find out the dependencies on water, to find their means of income generation activities, names of weeds in water, to identify medicinal herbs.

The weeds, some shrubs, trees were identified with the guidance of herbarium and books on taxonomy. The faunal species were identified with the guidance of taxonomy books.

The traditional weed control methods were identified by interviewing the village community.

## RESULTS

### Aquatic plants in AWS

The list of aquatic plants found in AWS is shown in table 3.

Table 1. Aquatic plants in AWS

Family	Species	Local Name
Acanthaceae	<i>Hygrophila schulli</i>	Niramulliya
Alismataceae	<i>Limnophyton obtusifolium</i>	
Amaranthaceae	<i>Alternanthera sessilis</i>	Mukunu wenna
Aponogetonaceae	<i>Aponogeton natans</i>	Kekatiya
Araceae	<i>Lasia spinosa</i>	Kohila
Araceae	<i>Pistia stratiotes</i>	Diya paradel
Asteraceae	<i>Eclipta prostrata</i>	Kikirindi
Ceratophyllaceae	<i>Ceratophyllum demersum</i>	
Convolvulaceae	<i>Ipomoea aquatica</i>	Kankung
Cyperaceae	<i>Schoenoplectus</i>	
Fabaceae	<i>Nepytunia oleracea</i>	
Hydrocharitaceae	<i>Ottelia alismoides</i>	
Lemnaceae	<i>Lemna sp</i>	
Lentibulariaceae	<i>Utricularia aurea</i>	
Limnocharitaceae	<i>Limnocharis flava</i>	
Marsiliaceae	<i>Marsilia quadrifolia</i>	
Menyanthaceae	<i>Nymphoides hydrophylla</i>	Kumudu
Nelumbonaceae	<i>Nelumbo nucifera</i>	Nelum

Nymphaeaceae	<i>Nymphaea pubescens</i>	Manel
Onagraceae	<i>Ludwigia adscendens</i>	Diyanilla
Polygonaceae	<i>Polygonum tomentosum</i> <i>Polygonum glabrum</i>	Sudu kimbul wenna
Pontederiaceae	<i>Eichhornia crassipes</i> <i>Monochoria vaginalis</i>	Japan jabara
Pteridaceae	<i>Acrostichum aureum</i>	Karam koku
Salviniaceae	<i>Salvinia molesta</i>	Salvinia
Scrophulariaceae	<i>Limnophila aquatica</i>	
Typhaceae	<i>Typha angustifolia</i>	Hambu pan

### The various dependencies of water resources in the sanctuary

People surrounding the sanctuary have various types of dependencies on the sanctuary especially. Most of them are on reservoirs, or associated with the reservoirs. There are two types of dependencies on water resources i.e. direct dependencies and indirect dependencies.

#### Direct dependencies

1. water for bathing and washing
2. drinking water for cattle and other domestic animals
3. wallowing grounds for buffaloes in tank water
4. rowing boats and swimming- entertainment
5. water for paddy cultivation
6. water for vegetable cultivation
7. fishing

#### Indirect dependencies

1. fish and terrapins
2. edible green leaves - Kan kun, Gotukola, Mukunuwenna, Thampala, Neeramulliya, Anguna, Thora, Girapala, Pitasudu,
3. fruits – Tal, Mango, Wood apple, Tamarind, Cashew, Kon,
4. vegetables- Lotus stems, water lily seeds, Drum sticks,
5. reeds for handicrafts
6. fire wood
7. grassing lands
8. edible mushrooms
9. Erriconuts

### The seasonal pattern of major dependencies of AWS

Figure 2 shows various types of major dependencies that vary with the seasons and availability in the sanctuary.

Fire wood extraction and extraction of fruits and vegetables are found throughout the year. Water for Paddy cultivation recorded in two periods April to July in Yala season and November to March in Maha season. During the dry season from March to October and September to November while water level becomes low villagers release buffaloes for grazing and wallowing. According to

these facts the highest water resource dependency is recorded from February to May.

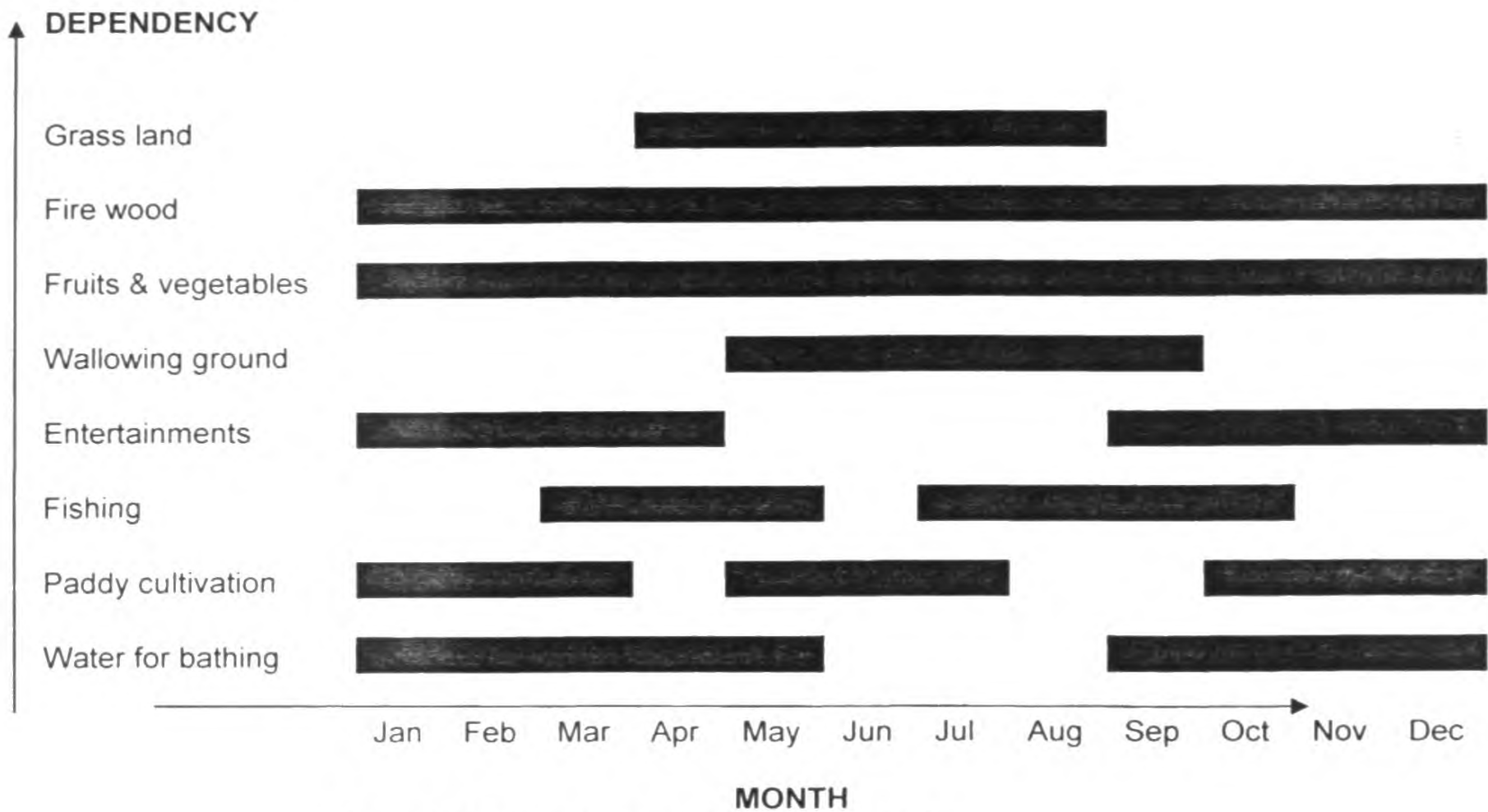


Figure 2. Various types of major dependencies

**Over exploitation of resources**

**Poaching**

During the weekends and holidays large numbers of bird hunters and teams of poachers visit the sanctuary. The poaching of soft-shell and hard-shell terrapins supplies the demand created by hotels in the area.

**Extraction of clay from reservoir beds in dry period**

During the dry season clay mining takes place on the reservoir beds for brick making industry.

**Pollution**

Biocides are not reported to be used in huge quantities within the sanctuary, but there can be the risk of pollution through the runoff from long stretches of paddy fields and coconut plantations within the catchments area. Small quantities of plastic and polythene wastes can be seen on the road sides leading to the sanctuary. These indigestible materials accumulate in the reservoir and water canals. At present this is not a severe problem if the dumping of polyethylene is not controlled it is going to be a severe environmental problem in future.

### **Natural threats**

The rainfall records in Puttalam show a paternal reduction during the recent past. The tank system remained without water for long periods during the last few years.

## **DISCUSSION**

The present study shows that about 10 weed species have extensively spread in the reservoir system of the AWS. Invasive alien weed species have caused comparatively higher impact on water than the native weed species.

Almost all the villagers in and around the sanctuary depend on water resources of the sanctuary; furthermore the water is the main factor that contributes to the balance of the natural ecosystem. But large scale commercial activities making use of water resources do not take place in the study area. Most dependencies are for private consumptions such as income generation activities of the local community such as paddy cultivation, fishing, fire wood collection, vegetable cultivation etc.

Irrigation Department and the Department of Wildlife Conservation are the responsible Government Institutions for maintaining the water capacity of the sanctuary. DWC display some sign boards and information boards in the Sanctuary, but without clearly demarcated boundaries.

As far back as 2004 DWC recruited and stationed number of employees for protection of the Sanctuary.

The Department of Wildlife Conservation initiated a weed control programme in 2005 and removed aquatic weeds manually in Anawilundawa and Suruwila tanks. However chemical weed control methods are not recommended to be carried out in the Sanctuary. Community Based Organizations have been formed with the guidance of DWC and Divisional Secretary of the area. The DWC which is the management authority of the sanctuary organized a campaign for removal of aquatic weeds in May 2005, during the peak dry period. Adjacent communities were involved in this activity through their CBO.

## **CONCLUSION AND RECOMMENDATION**

### **Conclusion**

The natural balances of the ecosystem, the various dependencies of the community and wetland values are related to the water availability of this sanctuary.

### **Issue of insufficient water supply**

During the draught season the water level of the reservoirs decreases dramatically. It is the core problem related to the water level. Besides water flows out to the reservoirs since the sluice gates are not maintained properly and some of them do not operate at all.

### **Aquatic weeds**

The water capacity of the reservoirs is very low because of the above situation. The nutrition level and the eutrophication are high as a result the aquatic weeds grow rapidly.

There are about ten aquatic weeds in the study area. The most of the impacts are caused by Water hyacinth (*Eichhornia crassipes*), Salvinia (*Salvinia molesta*), and Water lettuce (*Pistia stratoates*). Water hyacinth also downgrades recreational facility by reducing the water surface, creating offensive odors and tainting water.

Large leaf surface of weeds increases water loss through transpiration. It also interferes with fish life by reducing water oxygen levels, producing toxic substances such as hydrogen sulfide and reducing phytoplankton population, which is prime food source for fish. They change the ecological balance and habitat of the area. Besides they reduce the water flow and thereby increase siltation.

When compared with the previous records, the water capacity of the reservoirs appear to be decreasing and it was eight inches lower than that of 1995 in the full capacity condition.

The major dependency levels vary with the season, due to availability of water. The highest dependency is recorded from March to July.

### **Recommendation**

Mechanical control of weeds is one method, and removal of Salvinia manually or by machine is a practical control method. Biological control of Salvinia and Water hyacinth is the better method in this sanctuary as this is a protected area. In 1990, Department of Agriculture, Sri Lanka introduced Salvinia Weevil to these water bodies.

Community participation for weed control of this study area has proved to be effective. CBO's have formed in each village. Through these CBO's the community can be involved to removing the weeds, as well as to control illegal activities of the people especially from the outsiders.

Repairing of sluice gates and desiltation the reservoirs should be implemented immediately by the responsible agencies to maintain the water level of the sanctuary.

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Sand mining, felling of timber and poaching should be controlled through Law Enforcement and by regular patrolling by the Department of Wildlife Conservation.

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**APPENDIX 1.** Habitat, site, relative abundance and status of amphibians in the study are.

**Habitat:** Ca= Casuarina Plantation; Ch= Chena; Co= Coconut Plantation; Cs= Coastal Sand Dune; Ho= Home Garden; Ma= Marshland; Mn= Mangrove; Pa= Paddy Field; Sc= Scrubland; Sm= Salt Marsh.  
**Area:** R=Rekawa; LK=Lunama-Kalametiya; W=Walawa Estuary.

**Relative Abundance:** VC=Very Common; C=Common; UC=Uncommon; R=Rare; VR=Very Rare.

**Status in National Red List 1999:** TR=Threatened

\* Endemic species

Family	Scientific Name	Common Name	Habitat	Area	Relative Abundance	Status in National Red List
Bufonidae	<i>Bufo fergusonii</i>	Ferguson's Dwarf Toad	Sm, Ho, Ma, Co, Ch & Mn	W, LK & R	VC	-
	<i>Bufo melanostictus</i>	Common Toad	Ca & Ho	W	C	-
Microhylidae	<i>Liperodon systoma</i>	Baloon Frog	Sm	W & R	UC	-
	<i>Microhyla ornata</i>	Ornate Narrow-mouthed Frog	Ma, Co & Pa	W & R	C	-
	<i>Microhyla rubra</i>	Red Narrow-mouthed Frog	Co	R	UC	-
	<i>Kaloula taprobanica</i>	Common Bull Frog	Ho & Co	W, R & K	UC	-
Ranidae	<i>Sphaerotheca breviceps</i>	Banded Sand Frog	Co, Ho & Sc	W & Ka	C	-
	<i>Sphaerotheca rolandae</i>	Marbled Sand Frog	Gs	W & R	UC	-
	<i>Limnonectes limnocharis</i>	Common Paddy Field Frog	Ma, Ho, Sc, Pa & Mn	W, LK & R	VC	-
	<i>Hoplobatrachus crassus</i>	Indian Bull Frog	Sc, Ho, Gs & Pa	W, K & R	C	-
	<i>Rana gracilis</i> *	Sri Lankan Wood Frog	Ho & Ca	W	VR	TR
	<i>Euphlyctis cyanophlyctic</i>	Skipper Frog	Ho, Pa, Ma, Sc, Mn, Gs & Ch	W, LK & R	VC	-
	<i>Euphlyctis hexadactylus</i>	Six-toed Green Frog	P, Sc & Ho	W, LK & R	C	-
	<i>Polypedates maculatus</i>	Chunam Tree-Frog	Gs	K	C	-
	<i>Philautus leucorhinus</i>	-	Sm	W	VR	-

**APPENDIX 2.** Habitat, site, relative abundance and status of reptiles in the study are.

**Habitat:** Ca=Casuarina Plantation; Ch= Chena; Co= Coconut Plantation; Cs= Coastal Sand Dune; Ho= Home Garden; Ma= Marshland; Mn= Mangrove; Pa= Paddy Field; Ri= Riverine Vegetation; S=Sea; Sc= Scrubland; Sm= Salt Marsh

**Area:** R=Rekawa; LK=Lunama-Kalameiya; W=Walawa Estuary.

**Relative Abundance:** VC=Very Common; C=Common; UC=Uncommon; R=Rare; VR=Very Rare.

**Status in National Red List 1999:** TR=Threatened

\* Endemic species

Family	Scientific Name	Common Name	Habitat	Area	Relative Abundance	Status in National Red List
Crocodylidae	<i>Crocodylus palustris</i>	Mugger	Ri	W	R	TR
Trionychidae	<i>Lissemys punctata</i>	Flap Shell Turtle	Mn, Ma, Gs & Pa	W, LK & R	C	TR
Bataguridae	<i>Melanochelys trijuga</i>	Parker's Black Turtle	Pa & Mn	LK	UC	TR
Testudinidae	<i>Geochelone elegans</i>	Star Tortoise	Sc & Ma	W	R	TR
Cheloniidae	<i>Chelonia mydas</i>	Green Turtle	Cs	R	C	-
	<i>Lepidochelys olivacea</i>	Olive Ridley Sea Turtle	S	W	C	-
Derμοchelyidae	<i>Derμοchelys coriacea</i>	Leatherback Turtle	Cs	W	VR	-
Varanidae	<i>Varanus salvator</i>	Water Monitor	Ca, Cs, Ma, Mn, Sc, Ho, P & Pa	W, LK, & R	VC	-
	<i>Varanus bengalensis</i>	Land Monitor	Sc, Gs, Mn, Ho & Ch	W, LK, & R	VC	-
Agamidae	<i>Calotes versicolor</i>	Common Garden Lizard	Ch	W, LK, & R	VC	-
	<i>Sitana ponticeriana</i>	Fan Throated Lizard	Co, Ca & Cs	W	C	-
Gekkonidae	<i>Heidactylus frenatus</i>	Common House Gecko	Ho, Co, Sc & Ch	W, LK, & R	VC	-
	<i>Hemidactylus brookii</i>	Spotted House Gecko	Ho	W	VC	-
	<i>Hemidactylus triedrus</i>	Termite Hill Gecko	Gs & Sc	LK & R	C	-
	<i>Hemidactylus lesheaulii</i>	Bark Gecko	Mn	LK & R	UC	-
	<i>Gehyra mutilata</i>	Four Claw Gecko	Ho	K	UC	-
Scincidae	<i>Lepidodactylus lugtbris</i>	Scaly Finger Gecko	Ho	R	VR	-
	<i>Mabuya carinata</i>	Common Skink	Ca, Co & Ho	W, LK & R	C	-
	<i>Mabuya macularia</i>	Bronze Green Little Skink	Sc	W	UC	-
	<i>Mabuya madarasi</i> *	Spotted Skink	Ho	LK	VR	TR
	<i>Lankascincus fallax</i> *	Common Lanka Skink	Ho	W	UC	-
	<i>Riopa punctata</i>	Dotted Garden Skink	Ch	LK	UC	-
	<i>Sphenomorphus rufogulus</i> *	Red Throat Little Skink	Ho	W	VR	-
Boidae	<i>Python molurus</i>	Indian Python	Ho & Sc	R	VR	TR
Colubridae	<i>Ahaetulla nasutus</i>	Green Vine Snake	Ho	W, LK & R	UC	-
	<i>Amphiasma stolata</i>	Buff-Striped Keelback	Pa & Ho	W	UC	-

<i>Atractium schistosum</i>	The Olive Keelback	Pa	LK	R	-
<i>Baiga trigonata</i>	Gamma Cat Snake	Ho	W	C	-
<i>Cerberus rhynchops</i>	Dog faced Water Snake	Mn	W	UC	-
<i>Dendrelaphis trisus</i>	Common Bronzeback	Mn & Sc	LK	UC	-
<i>Lycodon aulicus</i>	The Common Wolf Snake	Sc	LK	R	-
<i>Lycodon osmanhilli*</i>	Osmanhill's Wolf Snake	Gi	W	VR	TR
<i>Lycodon striata</i>	Shaw's Wolf Snake	Ho & Sc	W & LK	R	-
<i>Oligodon amensis</i>	Kukri Snake	Sc	W & LK	UC	-
<i>Pyas mucosa</i>	The Common Rat Snake	Pa & Sc	W & LK	UC	-
<i>Xenochorophis asperimus*</i>	Common Pond Snake	Mn & Ma	W & LK & R	VR	TR
<i>Xenochorophis piscator</i>	Checkered Keelback	Pa & Ma	W & LK	C	-
<i>Bungarus caeruleus</i>	The Common Indian Kraut	Pa	LK	UC	-
<i>Hydrophis cynocinctus</i>	The Chittul	S	W	C	-
<i>Hydrophis gracilis</i>	John's Sea Snake	S	W	VR	-
<i>Hydrophis spiralis</i>	The Narrow Banded Sea Snake	S	W	C	-
<i>Naja Naja</i>	Cobra	Ho & Pa	W & LK	UC	-
<i>Daboia russelii</i>	Russell's Viper	Pa & Ho	LK	UC	-

Elapidae

Viperidae