THE WINSTON CHURCHILL MEMORIAL TRUST OF AUSTRALIA

Report by - MICHAEL HARPER - 1988 Fellow

Project: To study methods and developments in the management of Wetlands and Waterfowl in the U.S.A.

Cover : Gray Lodge Wildlife Area - Wigeon

METHODS AND DEVELOPMENTS IN THE MANAGEMENT OF WETLANDS AND WATERFOWL IN THE U.S.A.

Michael J. Harper
1988 Churchill Fellow
Box 340, Monash
South Australia 5342

SOUTH AUSTRALIA NATIONAL PARKS
AND WILDLIFE SERVICE

CONTENTS

1 Summary

This report outlines the findings of a Winston Churchill Memorial Fellowship Study Tour, undertaken by the author to study methods and developments in the management of wetlands and waterfowl populations.

The tour covered the following states of the United States of America; Oregon, California, Illinois, Louisiana, Texas and New Mexico. In the course of the tour the Fellow met people experienced in the fields of habitat and wildlife preservation, management and restoration, waterfowl disease research and control, wildlife utilization and control, law-enforcement, public interpretation and education and fund raising. Considerable practical experience of many of the relevant techniques was gained.

Details are reported here and their relevance to the South Australian and Australian situation discussed, with recommendations solicited.

2 Introduction

2.1 BACKGROUND

Throughout the 1980's the management of wetlands and waterfowl populations in Australia have become increasingly complex. A shrinking natural resource, habitat rehabilitation, increase in waterfowl hunter management and lead poisoning of waterfowl to name a few items have compounded the situation. During my 16 year career in the South Australian National Parks and Wildlife Service I have been involved to varying degrees in the management of wetland areas in the south eastern region of the state. The frustration at the lack of knowledge available in Australia to a wetland manager on management techniques, prompted me to apply for a Winston Churchill Memorial Trust Fellowship, to research the methods used in the United States of America (USA) to conserve wetlands and waterfowl population.

With the combined support of the Churchill Trust, the Wildlife Conservation Fund and the South Australian National Park and Wildlife Service, I spent 12 weeks between the 28/9/88 and 21/12/88 studying in U.S.A. of which 3 weeks were recreation leave to enable flexability of itinerary and rest periods.

2.2 ITINERARY

A detailed itinerary is given in Appendix I. However, a broad outline of my travels is as follows:-

Stillwater National Wildlife Refuge, (N.W.R.) Nevada, Malheur N.W.R. Oregon; Klamath Basin N.W.R. Complex,Humboldt Bay N.W.R., Humboldt State University,Lake Earl State Refuge, Sacromento N.W.R., Gray Lodge Wildlife Area, Ducks Unlimited Regional Office and California Waterfowl Association Head Office, Sacromento and San Luis N.W.R., California; Palos Hills Forest Preserve and Ducks Unlimited Headquarters, Chicago; Williams Inc, Patterson, Lacassine N.W.R. Rockefeller Wildlife Refuge and Catahoula N.W.R. Louisiana; J.D. Murphree Wildlife Management Area, Sea Rim State Park, Anahuac N.W.R. and Aransas N.W.R. Texas; Bosque Del Apache N.W.R. and La Joya State Game Reserve, New Mexico.

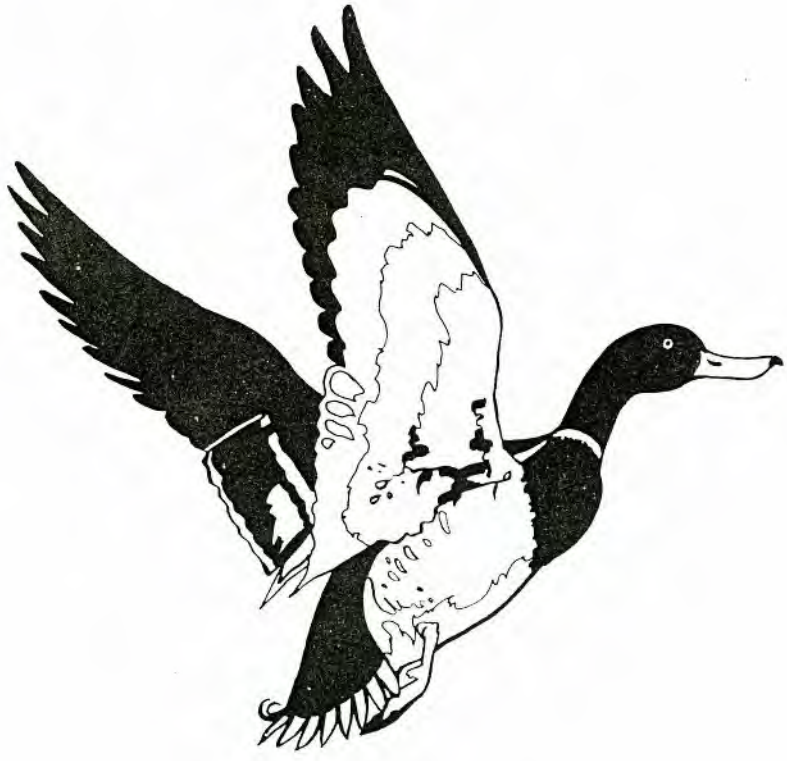
2.3 ORGANISATIONS CONSULTED

Much was learnt by consultation with a wide scope of organisation which contributed to the management and protection of America's wetlands, weather National, State or Local Government, private or charitable. Organisations I researched were; U.S. Fish and Wildlife Service (U.S.F.W.S.), California Department of Fish and Game, Humbolt State University, California, California Waterfowl Association, Ducks Unlimited Inc., Cook County Parks Department Chicago, Williams Inc., Patterson, Louisiana, Louisiana Department of Wildlife and Fisheries, U.S. Army Corps of Engineers, Vicksburg, Mississippi, Taxes Parks and Wildlife Department, New Mexico Department of Game and Fish.

I interviewed Refuge Managers and their assistants, a Professor in Wildlife Management, Habitat Management Specialists, Research Scientists, Refuge Biologists, Regional Biologists, Field managers, Senior personnel in private organisations, Information and Law enforcement Officers (See appendix II for contacts).

The flow of information was not only one way and most people interviewed were keen to learn about Australia and its wetlands. During the study tour nine lectures/slide shows were presented (see appendix III for details).

Field research was enhanced by observing or taking part in law enforcement patrols of waterfowl hunting regulations, manning hunters check stations, waterfowl census by aeroplane, boat and vehicle and duck banding.



3 Habitat Preservation

Wetlands losses in the U.S.A. since the late 1700's have been enormous. Of the original 87 million hectares of wetlands believed to exist, it is now estimated that only 38 million ha. remain. Some authorities believe that 12 million ha. of these, are so badly contaminated and degraded by toxic substances, as to be useless. The present rates of wetland loss is still dramatic, and is estimated to be between 120,000 and 180,000 hectares per year. The major cause of wetland destruction is still drainage and clearing for agriculture use, despite several wetland protection programmes established by the federal Government.

A number of states and regions of the U.S.A. have suffered major losses of habitat, eg California has lost over 90% of its natural wetlands with the prairie pothole regions of northern U.S.A. being the most affected (Iowa 99% loss).

The participants in conservation and management of wetland habitat within the U.S.A. are all levels of government, private industry, volunteer organisations and individuals. The U.S. Fish and wildlife Service of the Dept. of the Interior manages over 400 refuges encompassing approximately 36½ million hectares throughout the country. The refuge system protects a range of habitat types, however many are located along the waterfowl migratory flyways, to feed and shelter birds during the migrations. Of the six states visited during the study tour, all were involved in a program of management of state owned wetlands.

A number of volunteer conservation organizations are involved in wetland habitat retention, of which Ducks Unlimited (see section 11) and the National Audubom Society are some of the best known. By far the largest percentage of wetlands are in private ownership, of which management by a duck hunting club or for duck hunting is significant. It is believed that about two thirds of the wetland area in California is directly conserved or created for waterfowl hunting. If hunting was stopped, it is believed that most of these wetlands would disappear. It is my understanding that the link between the conservation of wetlands by the private sector and hunting of waterfowl is preverlent throughout the U.S.A. Thus the management and utilization of waterfowl populations has a major bearing on the retention of wetlands within the country.

3.1 PROGRAMS TO PROTECT WETLANDS

Many states in the U.S.A. have established programs for the regulation and protection of wetlands. Generally coastal wetland protection programs are more advanced than inland programs. There are a number of Federal regulatory programs but due to a conflict of interest by the regulatory authority and differences in Government agency interpretation, these laws have not had a major impact on stopping wetland distruction.

There are also many non-regulatory federal programs to protect wetlands, but they involve land acquisition through purchase or lease. These programs have been successful but due to a limit in finance availability, acquisition alone has not stopped wetland destruction. The following describes some of the successful programs. (Statistical information on these programs was obtained from the National Wildlife Federation report "Status Report on Our National Wetlands")

(a) The Duck Stamp Act

Passed in 1929, the Migratory Bird conservation Act authorized federal acquisition of land for migratory waterfowl refuges. The 1934 Duck Stamp Act established a source of funding for the Migratory Bird Conservation Act through the sale of federal migratory bird hunting stamps, or duck stamps. Revenues from the sale of these stamps, which are required of all waterfowl hunters, aged 16 and over, are deposited into the Migratory Bird Conservation Account. These monies are then used to acquire habitat for migratory waterfowl, primarily wetlands, although adjacent uplands for nesting and cover are also acquired using these funds. Since it was enacted, the duck stamp program has generated nearly $313 million used to acquire more than 930,000 hectares of waterfowl habitat.

The migratory bird hunting and conservation stamp also is discussed in section 8 on hunting.

(b) The Water Bank Program

The Water Bank Program is administered by the U.S. Department of Agriculture's, Agricultural Stabilization and Conservation Service. The program authorised $10 million per year, to leases waterfowl habitat for 10 years from private landowners. This program has not received much money in recent years. As of April 1987, the Water Bank Program had funded 4,615 lease agreements, protecting 62,000 hectares of wetlands and 123,000 hectares of adjacent uplands.

(c) The Emergency Wetlands Resources Act of 1986

The most recent federal legislation enacted to protect wetlands through acquisition is the Emergency Wetlands Resources Act of 1986 (EWRA). The EWRA expanded and enhanced sources of revenues for acquiring wetlands by raising the price of duck stamps, requiring entrance fees for selected units of the national wildlife refuge system, and paying into the Migratory Bird Conservation Account an amount equal to the annual duties paid on imported firearms and ammunition. The EWRA also requires the National Wetlands Inventory to finish mapping the Nation's wetlands by the year 2000 and to update the Status and Trends Report at ten year intervals, beginning in 1900.

3.2 CONSERVATION EASEMENT PROGRAM

The conservation easement program is administered by the U.S. Fish and Wildlife Service and funded from the Duck Stamp Act. The program assure the preservation of waterfowl habitat, but allows the land to remain in private ownership. The goal of the program is to acquire perpetual easement on a willing seller basis, covering natural wetland habitat or cropland permanently restored to wetland. This program has been used extensively in the prairie pothole region of the country where most wetlands are small in size but of great value to waterfowl production. Another use of the program has been in areas where it may be politically unacceptable or not warranted to create a public owned area to protect the wetland.

An easement agreement involves the following points:

- The existing land use is preserved and the landowner continues to manage the area.

- The landowner cannot alter the land in anyway that is detrimental to waterfowl use.

- The easement is in perpetuity and applies to future ownership.

- Waterfowl hunting and mineral rights are not affected.

- Land tax and rates are still the responsibility of the landowner.

- U.S. Fish and Wildlife personnel have the right to entry onto the land to monitor the program.

The amount payable to the landowner for the easement is between half and three quarters of the value of the wetland if it was developed to a stage for crop production.

3.3 RECOMMENDATIONS

Consumptive user groups in the U.S.A. such as waterfowl hunters and fisherman, tend to be very energetic in their endeavours to protect wetlands. This is demonstrated by the founding of the Ducks Unlimited organization 50 years ago, by a group of waterfowl hunters concerned about the destruction of wetland due to reduced waterfowl numbers. By putting their money or time where their mouth is, to term a phrase, these groups have ensured the continuation of their utilization of particular wetland species. It is recommended that consumptive user group in Australia take a more active and financial roll in the protection and management of wetlands. If these groups do not involve themselves in the protection of the resource they utilize, they may, in the future find major restrictions, or total banning by governments of their particular utilization, due to the species inability to sustain a regular harvest.

All the U.S.A. non regulatory programs to protect wetlands have merit. However the Duck Stamp Act has the most application due to its funding base. It is therefore recommended that both federal and state programs be created to raise funds to protect wetlands on a similar basis as the U.S.A. Duck Stamp Act.

Due to financial and staffing constraints on most Australian conservation agencies, it is recommended that the conservation easement program be implemented to help protect wetlands. This program has great merit for use in the south east region of South Australia, or similar areas, where most wetlands are small but of high value.

4 Habitat Management

In the U.S.A. wetland management is divided into three fields, preservation of undisturbed natural habitat, restoration of degraded or destroyed natural wetlands and the creation of new areas. This section will be devoted to the latter two subjects as preservation of wetlands has be discussed in section 3.

4.1 BACKGROUND

Many biologists consulted believed the loss of habitat in the USA is so critical to some aquatic species, that management of most wetlands is now necessary, even if degradation has not occurred , in order to enhance habitat values (thus increasing the carrying capacity of wildlife species and or numbers). This is especially true for waterfowl species as they are managed as a renewable resource and harvesting by hunting is permitted.

Many units of the National Wildlife Refuge System of the U.S. Fish and Wildlife Service are created or restored wetlands which were constructed in the 1930's. Most management programmes have evolved over the life of these refuges with successful management practises being maintained and the less successful ones being modified where necessary. Many projects appear to be functioning, however, a number of created wetlands have failed outright or have deteriorated to a point of being non-functional. It is frequently much easier and less expensive to restore a wetland than it is to create one because restoration relies less on sophisticated technological solutions, however sometimes this can be reversed.

4.2 PLANNING

Once the need for the creation or restoration of habitat is established the managers then establish objectives. The most common ecological objectives identified during the study were as follows:-

1. Select a site that maximizes the interspersion of habitat types after flooding for the greatest diversity of wildlife species. If possible these types should include open water,emergent vegetation, wetland shrubs and trees, flooded dead timber and adjacent edges of highland openings, shrubs and trees.

2. Manage specifically for a group of similar species or a single species eg ducks and geese for their autumn and spring migration stop-overs.

3. Manage for 6 to 8 key wildlife species across the habitat and time spectrum which act as indicators. However the life history and requirements of these species need to be known.

The principal management practise for the above objectives is the impoundment of shallow water incorporating moist soil and greentree reservoir management or the periodic drawndown of water to maintain plant diversity. A typical intensely managed wetland refuge in California included the following management units: highland-tree and grassland, permanent water, seasonally flooded (autumn/winter, spring and summer) and watergrass production.

4.3 MANAGEMENT OF FLOODED IMPOUNDMENTS

The success or failure of a shallow water impoundment depends mainly on the design and construction characteristics, as precise water level control will be required. It is essential to have topographical, soil Ph, ground water level and salinity, and soil salinity data of the site.

The initial development of impoundments is expensive as permanent embankments and internal banks need to be constructed (preferably on contours) and water control structures installed to enable water manipulation.

4.3.1 EMBANKMENT CONSTRUCTION

Suitable material for embankment construction is essential thus knowledge of the soil texture of the site is required. If soil from an existing wetland is to be used the top high organic soil should be avoided due to shrinkage and subsidence characteristics. It is advisable to build the peripheral embankments large enough to support equipment capable to mowing vegetation to control pest plants and identify rabbit infestations. The embankment should be built to an elevation compatible with planned land use and the degree of protection required. Settled side slopes should be of a 3:1 to 4:1 slope with the latter being easier to maintain and mow.

A superior quality embankment is made by carting in material, than just pushing it up with a bulldozer. An advantage from carting the material from the impoundment area is the ability to construct channels which should be 50cm to 80cm deep to create diversity. However, the channels need to be jointed up to an outlet to aid in drainage of the impoundment, especially if carp are present.

If a drag line is to be used to construct the embankment the borrow ditch should be dug at least 5 metres from the base of the embankment to help stop erosion from wave action.

If required, internal banks on contours of about 15 cm. intervals can help achieve even water depth throughout the impoundment, but will limit diversity.

4.3.2 WATER CONTROL STRUCTURES

Each impoundment should have a separate inlet and outlet control structure. The outlet should be situated low enough to enable the complete drainage of the impoundment, via channels and or borrow ditches. Structures should be large enough to drain the area quickly to handle any surplus water, resulting from flooding.

The most commonly used structure on refuges was a stop log type (see fig 1). The structure was made from a range of materials consisting of concrete, wood or corrugated galvanized iron, of which the latter was the most wide spread. The reason for the stop log structure popularity was the ability to control water levels precisely with limited supervision.

4.3.3 IMPOUNDMENT SIZE

The opinion between refuge staff differed greatly when it come to recommending an ideal size for a shallow water empoundment. However, I was able to view the management of large 500 Ha. to 1000 Ha. and small 25 Ha. to 200 Ha. size impoundments, when I visited Klamath Basin N.W.R. Complex and Sacromento N.W.R. respectively. It is my opinion that a site manager needs to select the appropriate impoundment size to suit the individual project. Listed below are comments on both large and small size impoundments.

Large Impoundments

- Depending on the topography, may lack the ability to precisely control water levels. However this can create diversity.

- Can create a range of cells within a large unit at different water depth to help with water control and still maintain diversity.

- Can have little wildlife disturbance.

Small Impoundments

- Have the ability to control water levels precisely.

- A large number of small impoundments are complicated to manage and labour intensive.

- Disturbance to wildlife can be great.

4.3.4 MOIST SOIL MANAGEMENT

The term moist soil management refers to the management of native plant communities associated with mudflats or similar habitat.

In North America this technique incorporates the draw down of water in spring to promote natural plant growth, followed by the flooding of the mature plants in autumn, to give imigratory waterfowl access to the plant foods.

Prior to the relatively recent popularity of this management technique, waterfowl management in the U.S.A. centred around the flooding of row crops, such as corn, Japanese millet, domestic rice and soybean to feed migrating waterfowl. However the propagation of varieties of millet and barnyard grass are still used on some refuges under the ambit of watergrass production.

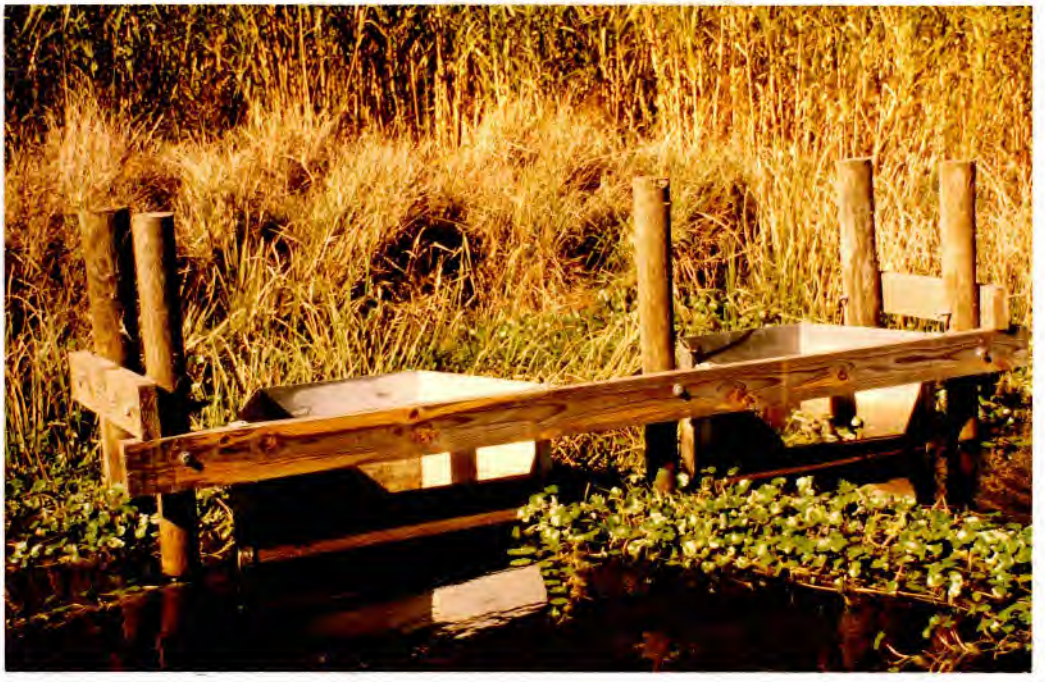


FIGURE 1 Stoplog water control structure, J.D. Murphree Wildlife Management Area, Texas.

Cypress trees, Catahoula N.W.R., Louisiana.

The art of moist soil management is usually applied to man made seasonally flood impoundments but can be used in the management of regulated natural wetlands to attract and hold a wide variety of wildlife from invertebrates to mammals.

In the U.S.A. plant and animal species differ with latitude and some management techniques only suit particular situations. However there are many ecological and management principles that are important in moist soil management, regardless of location. The following points have direct application to a moist soil management project in Australia.

(a) Development/Operation

- For optimum success, good embankments and control structures are required for precise water manipulation and a pumping system to remove or add water.

- A group of small impoundments provides more management flexibility than a single large one. Control of vegetation or flooding to attract one group does not preclude options to attract other wildlife on adjacent impoundments.

- When saline water must be used, a cardinal rule is that you must flush out of the impoundment just as much salt as you bring into it, or you will end up with a salt flat, that will grow little or no plants. If the soil becomes saline, open drains may be required along the outside edge of the impoundment to lower saline ground water levels. Chisel ploughing or ripping can be undertaken to break up the soil to aid in the leaching of the soil. Discing should not occur as it will bring salt effected soil to the surface again.

- When the impoundments are flooded they should be inspected regularly depending on evaporation and seepage rates to ensure that correct water levels are maintained. However during and after draw down, the impoundment should be checked every 2 to 3 days to monitor germination and plant growth, to identify moisture requirements and problem species which require control.

- By rotating management option amongst a group of impoundments during the year, the maximum diversity for wildlife can be maintained.

- Due to the individual characteristics of each impoundment, good results from moist soil management usually only comes from management experience of the area. Thus it is essential to record all events from water manipulation, plant species germination and wildlife use.

(b) Vegetation Management

- In most cases desirable local plant species should be encouraged, than to attempt to introduce new species to an area. Moist soil plants are categorized by their desirability as food and or habitat. Two moist soil plant species which supply both food and habitat to waterfowl and are used extensively in North America and occur in Australia are Barnyard grass Echinochloa crusgalli and Willow Smart Weed Polygonum lapothiforium.

In the past a number of Scirpus species have been promoted as excellent moist soil plants. However recent studies have determined that due to the hard outer coating of the plants seed, waterfowl usage as food is limited, but it may be used mainly as a form of grit. Small stands of Scirpus are encouraged within an impoundment, due to the high numbers of invertibrates associated with the plant.

- In general the annual plants invade a new impoundment first and are gradually replaced by perennials.

- The time and length of draw down of an impoundment and the stage of succession (number of years since the area was disturbed by discing or ploughing, or the number of years since the impoundment was flooded continuously), are important factors which determine species response to moist soil manipulation. During slow draw-down impoundments are gradually drained during a period of 2 to 3 weeks or more via evaporation which produces a diverse vegetation cover. Fast draw-down occurs within a few days and normally produce extensive stands of similar vegetation.

Species density and diversity change between an early and late spring draw-down, due to the time the saturated soil takes to dry out, (little germination occurs if the soil dries within a few days).

- Water depth and flooding duration also has a strong affect on wetland plants and is used as a tool during the growing season to encourage one species over another. However, the identification of seedlings is essential as most species have critical water depth and flooding duration requirements, during the seedling stage.

- Complete submergence of seedlings for longer than 2 - 3 days (grasses and broad leaf plants) can retard or kill the plants.

- One of the severe problem plants, to moist soil management throughout most of U.S.A., is Cocklebur Xanthium stramarium. This species is very similar in habit and life form to the introduced California Burr Xanthium orientale of Australia. It is most likely that California Burr will be a problem to moist soil management in Australia, especially in the Murray/Darling Basin where the plant is prevalent.

A number of control methods are used to limit infestation of Cocklebur on refuges in the U.S.A. There are as follows:-

1. Shallow flooding (10 cm) of the impoundment for 10 to 14 days prior to the Cocklebur flowering will kill the plant. However if the infestation is severe, competition from the Cocklebur prior to killing the plant may effect desirable plant production.

2. The seedling plants are killed if completely flooded for 24 to 36 hours at the second leaf stage, but if plants are further advanced the kill rate will drop rapidly. Cocklebur usually germinates later than most desirable species, thus creating ideal conditions for this control method.

3. Where there is predominately Cocklebur within an area of an impoundment, the plants are mowed prior to seed set to stop seeding.

4. The chemical 'roundup', via the use of a wick or carpet applicator can be applied if the Cocklebur is taller than most desirable species.

(c) Reflooding Impoundments

- If the impoundment has dense vegetation throughout, it may be necessary to open up areas to allow waterbird access to feed. This can be achieved by discing or mowing paths or areas throughout the impoundment.

- If possible, water should percolate between impoundments by the use of gravity, via stop log structures to keep water fresh.

- Long narrow mounds, about 30 cm high called borders, can be constructed in the impoundment by discing a strip of ground, then grade it up into a mound. The border will supply a roasting site and a feeding edge for wildlife, however they will only usually last one season and need reconstruction prior to the next reflooding.

- By reflooding the impoundment slowly (just above the evaporation and seapage level) wildlife have access to the changing water edge for the maximum period possible. The edge of a wetland is a major feeding site for a large variety of wildlife.

- To promote diversity of waterbird species which will utilize the impoundment, water depth should range between 10 cm and 25 cm, or be compatable with preferred species feeding modes.

- Invertibates are an important waterbird food source within impoundments, of which production can be promoted by fluctuating water levels.

(d) Habitat Manipulation

As stated previously annual plants generally invade new impoundment first followed by perannials, thus creating a succession of plant species. With most moist soil management projects, production of desirable plant species usually decrease as perannial plants dominate such as Tyhpa and Baumea sps. Thus after about 4 years or when required, succession needs to be set back, which is usually done by discing up the floor of the impoundment to expose the roots of perannial plants to the heat of the sun, thus killing them. Another method sometimes used is the drying out of an impoundment for 2 or more years, to create a drought situation which will kill a high percentage of perannial plants.

Where diversity of impoundments are required a moist soil management area consisting of dominately perannial plants (60% to 70% cover) may be converted to a permanently shallow water wetland (30 cm to 50 cm deep). In the Central Valley Refuges of California hard stem rush species such as Baumea, Eleocharis, Scirpus and Phragmites were encouraged and Typha discouraged, because of its rapid colonising ability and difficulty in controlling.

4.3.5 GREEN TREE RESERVOIR MANAGEMENT

Within the Mississippi River Basin green tree reservoir management is common in areas of bottomland (floodplain) hardwood forests. The forest is flooded during the dormant season to attract Mallard and Wood ducks which feed on fallen nuts especially acorns. Such managed forests are usually flooded earlier and deeper than would occur naturally. The main requirement for managing water levels, is a low dam suitable for making a temporary wetland, 30 cm to 50 cm deep. A reservoir is often made by damming a small creek where it joins a river. There is usually a natural bank along the edge of the river to help hold back the water. Undesirable trees (those which produce no nuts) are harvested and or thinned out, to encourage growth of desirable trees. However some dense thickets are left to provide loafing cover for ducks.

The principal of green tree reservoir management could apply in Australia in a reverse situation. The flooding of a Red Gum forest or woodland in late winter through to early summer occur naturally throughout areas of South Eastern Australia. This habitat is vital to a large percentage of the regions breeding waterbirds, however flood mitigation and vegetation clearance has had a major impact on this habitat. A way to reverse this loss of habitat is to apply the green tree reservoir management technique, to areas of red gum forest and woodland to create breeding habitat for waterbirds.

4.3.6 FLOODPLAIN CHANNEL IMPOUNDMENT

Throughout a number of refuges, former river channels or elevated floodplain channels which fill during flood periods, are dammed to supply brood habitat for waterfowl after floods have receded. Water is either released or allowed to naturally dry, depending upon the time frame required.

Due to the recent lack of, or short duration of floods within the Murray Darling Basin, the damming for limited periods of floodplain channels may have application to improve waterbird and fish breeding.

4.4 UTILIZATION OF AGRICULTURE CROP LAND

On refuges and private land where flood irrigation is used to grow grain crops, such as rice or wheat, the crop stubble is flooded during autumn and winter to supply waterfowl food, such as waste grain and invertibrates.

The seasonal flooding of a ploughed fallow paddock is also undertaken to supply such foods as tubers, roots and invertibrates. Wading birds make particular use of this management technique, if water levels are shallow (5 cm to 15 cm deep).

A couple of refuges visited have had success in producing a good crop of sago pond weed Potamogeton sp., an excellent duck food by flooding wheat stubble for 18 months at about 30 cm to 45 cm deep. This technique also eliminates pest plants on the site, which have been invading the wheat crop.

4.5 HABITAT MAINTENANCE

A number of management techniques are used throughout the U.S.A. on natural and man made wetlands, to maintain diversity and or increase carrying capacity.

Some of the techniques used are control burning, crushing and mowing of vegetation, stock grazing, pothole and island construction and water drawdown. The former methods remove or open up areas of dense vegetation to allow wildlife access.

Potholes are usually constructed in areas of semi dry sedge-grass meadows, around the edge of wetlands. By constructing a series of small potholes throughout the meadow ,waterfowl production is increased because open water areas are created which are critical to breeding ducks. Potholes are either constructed by a bulldozer, dragline or blasting.

Islands are usually constructed to increase nesting, roosting or edge feeding sites for waterfowl. It is important to have an area of open water adjacent to the island to encourage use. Unless the island is designed as a breeding site, the height of the island should be just below the high water mark to discourage rank highland vegetation from colonising the area, which will limit waterfowl use.

The water drawdown of a wetland is usually undertaken to increase plant and wildlife diversity. Most management authorities in the U.S.A. don't regularaly artifically dry out wetlands, unless the following indicators are assessed and compared with historial data.

1. Number of plant species and percentage covers.

2. Wildlife use of the area.

3. Density of carp if present.

4.6 RECOMMENDATIONS

It is recommended that Wildlife Authorities throughout Australia investigate the techniques of managing flooded impoundments to compensate for the loss and deterioration of natural wetlands. The application of both greentree reservoir and floodplain channel impoundment have great merit and would probably be cost effective. If these techniques were successful, private organizations and individuals should be encouraged to participate in a programme, to increase the area of wetlands within the Australian continent.

Tolderol Game Reserve in South Australia was set up as a research area to investigate flooded impoundment management, but now work has been suspended. Due to the level of development at Tolderol, (7 impoundments), it is recommended that Tolderol Game Reserve become a research facility, to investigate the feasibility of moist soil management in southern Australian conditions.

In areas of Australia where flood irrigation is used to grow cereal crops, Wildlife authorities should investigate the possibility of encouraging the utilization of fallow and harvested paddocks, to create temporary wetlands.

Throughout Australia most Conservation Agencies tend to be only preservationists when managing so called "natural" wetlands, however, a lot of these areas are far from being in a original state.

Throughout the U.S.A. wetlands habitat maintenance programmes play an important role in conserving wetlands and increasing aquatic wildlife which can substain utilization eg fish and waterfowl species. It is recommended that wetland managers investigate the possibility of introducting habitat maintenance programmes on protected wetlands to increase diversity and wildlife carrying capacity in the light of future utilization of some species.

5 Waterbird Management Programmes

The hunting of Waterfowl is the major waterbird management program in the U.S.A. and due to its applicability to the Australian situation, it is discussed separately in section 7.

5.1 NORTH AMERICAN WATERFOWL MANAGEMENT PLAN

The North American Waterfowl Management Plan is an agreement signed in May 1986 between the Canadian and U.S.A. Governments. The plan sets out approximate waterfowl population goals, to meet public demands and actions needed to achieve those goals, by the year 2000. The achievement of these goals is beyond the capacity of the two federal governments and requires commitment from state and local governments, private organizations, businesses and individuals - hunter and non-hunter alike.

The plan outlines the scope of the work to be done on a continental basis and provides broad guidelines for habitat protection and management actions. Each regional government and waterfowl flyway administrative unit, is establishing specific plans for habitat preservation and mangement in their respective jurisdications. To administer these regional plans an implementation board is set up, with representatives of all interested parties within the government and private sector. From this board, a working committee is established which comprises of mostly professional waterfowl management personnel which administers individual projects.

5.2 SPECIES RECOVERY PROGRAMS

During the study tour a number of species recovery programs were investigated, of which the most renowned one was the Whooping Crane, of which only 152 individual birds remain. The other programs were the Aleutian Canada Goose which migrates between Alaska and California and the Mottled duck which inhabits the coastal wetlands of the Gulf of Mexico.

Various management methods and combination, from captive breeding reintroduction, predator control and habitat creation, have been used to increase the population size of these endangered or threatened waterbirds. However two items should be obtained if the program is to be a success, reliable biological data and public support. To ensure continuing public support biological information released to the public needs to be extremely reliable, especially population numbers, otherwise the programs creditability will be damaged and public support lost.

In some programs like the Whooping Crane, specific legislation has been created to protect the birds and their habitat.

5.3 REFUGE INVENTORY PLANS

The U.S. Fish and Wildlife Service has developed refuge wildlife inventory plans, to standize the collection and documentation of wildlife population data. Due to the intensive management of a high percentage of national refuges, population surveys are regularly carried out to determine management success.

The inventroy plans are designed to ensure that census data is of high quality, well documented, repeatable and designed with sufficient detail to allow collection of comparable information over time. The plan also includes manhours and finance required to conduct the surveys. Wildlife authorities place major importance on wildlife census data, in deciding future management stratagies for an area.

5.4 HABITAT SUITABILITY INDEX MODELS

The habitat suitability Index (H.S.I.) model series is published by the U.S. Fish and Wildlife Service on a range of waterbird species. The model provides habitat information useful for impact assessment and habitat management. Existing information on quantitative relationships between key environmental variables and habitat suitability of the species, provides the foundation for the H.S.I. model. The model combines the habitat use information into a framework, suitable for field use and produces an index value between 0.0. (unsuitable) to 1.0 (optimum habitat). The H.S.I. models are regarded as a hypothesis for species - habitat relationships. However field managers find these models useful in giving a general comparison between sites.

5.5 FUND RAISING

There are a number of federal and state initiatives to raise money for general wildlife management, which includes endangered species, game reintroduction and habitat management. Wetlands and waterbirds species receive a major share. Listed below is a brief outline on some of the programs which were encountered during the study.

Federal

- A 11% excise tax on sporting firearms and ammunition.

- A 10% excise tax on fishing equipment.

- Excise tax on fuel used by recreational boats.

State

- A levy is placed on horse betting to be spent on recreational wildlife conservation projects.

- State hunting permits.

- State title fees for registering a interstate motor vehicle.

- Voluntary contributions of tax rebates can be indicated on a tax form to be given to a conservation fund.

- Special non game stamps and art prints sales.

5.6 RECOMMENDATIONS

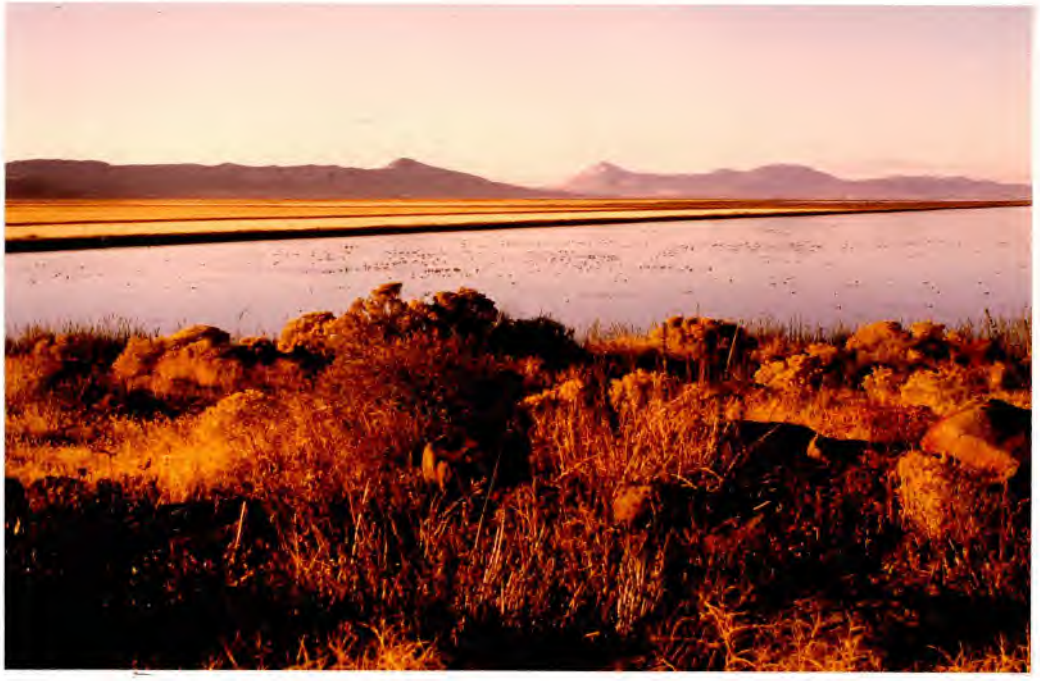
In reference to the management of waterfowl in Australia the following is recommended.

(a) The federal government play a major part in the management of waterfowl populations in Australia, to enable a continental perspective to prevail and a plan of management be drawn up as soon as possible.

(b) The application of habitat suitability index models be investigated for use in Australia.

(c) Conservation agencies which are involved in regional or site population surveys, consider implementing inventory plans or a similar program.

(d) Both the federal and state governments take the lead in raising funds to implement wildlife management programs. (e.g. sales tax on hunting sporting goods be diverted to wildlife management programs.)



Tule Lake N.W.R., California .

Snow Geese and Sandhill Crane feeding in cereal stubble. Bosque del Apache N.W.R., New Mexico.

6 Waterfowl Disease

Within the USA there are two important disease problems affecting waterbirds which also occur in Australia; Avian botulism and lead shot poisoning. Most waterfowl areas visited during the study tour have regular waterbird losses to some degree, from one or both of these diseases.

6.1 AVIAN BOTULISM

Outbreaks of avian botulism have occurred in North America since the turn of the century with most occurances having been reported within the past 20 years. Losses vary from year to year and from species to species, but outbreaks causing losses of 50,000 or more birds are fairly common. The most common groups of waterbirds affected are waterfowl, waders, gulls and herons.

The bird is paralysed or dies after exposure to a toxin produced by the botulinum bacterium. The bird takes the toxin in by feeding directly on invertebrate carcasses which have the toxin in them or live maggots of blow flies. Flies lay their eggs on the carcass of an animal which has died of avian botulism and the resulting maggots store botulinal toxin in their bodies, as they consume the carcass.

6.1.1 DISEASE CAUSE

Avian botulism is most likely to occur in the presence of high air temperatures, fluctuating water levels and a suitable medium for the botulism bacteria to grow, such as vertebrate or invertebrate carcasses. The bacteria are widely distributed in a spore form in organic soils.

The relationship between the botulism bacteria and the complete environmental parameters needed to promote the disease, are still not completely understood. At Sacromento N.W.R. a research team from the National Wildlife Health Centre at Madison, Wis. are presently conducting a major research project, on the environmental parameters required for an disease outbreak.

6.1.2. DISEASE RECOGNITION

Avion botulism affects the nervous system, causing muscle paralysis. Depending on how far the disease has progressed, various levels of paralysis will be observed.

Usually the bird looses the ability to fly first, followed by paralysis of the leg muscles. Paralyses of the inner eyelid and neck muscles follow, which are the two most easily recognizable signs associated with avian botulism.

6.1.3 DISEASE PREVENTION

Disease prevention should focus on the following factors which contribute to the development of an outbreak; fluctuating water levels during summer and animal carcasses for toxin production.

(a) Control of Water Levels

Areas managed for waterbirds should not be reflooded in summer if the area has been dry for a prolonged period of time. Rather reflooding should occur in spring if summer water is required. Similarly summer drawdowns should be avoided if fish are present, as fish carcasses also provide suitable medium for bacterial growth. If an area is prone to disease outbreak, water levels should be kept as stable as possible.

(b) Carcass Removal

Prompt removal of any carcasses is essential to prevent development of die offs during periods with hot daytime and warm nightime temperatures. All animal carcasses should be burned or buried deeply.

6.2 LEAD SHOT POISONING

The first recorded incidence of lead poisoning of waterfowl in the U.S.A. occurred in Texas in 1894 from spent lead shot ingestion. The lead was deposited in the sediment of the wetland by commercial duck hunting activities. Research between 1938 and 1954 examined 36,000 waterfowl gizzards and found that an average of 6.6 percent contained lead shot. A number of recent U.S.A. studies have yielded similar results and have also found elevated lead in liver tissue to be 2.8 times greater than lead in gizzards.

The number of birds with lead in the gizzard varies amongst species, with diving ducks more likely to swallow lead shot than dabbling ducks. Ducks that feed on plants and invertebrates in the water or on the surface like shovelers, are less likely to pick up lead shot that has settled into the sediment, than ducks like Black Ducks that may dig for food. Waterfowl either mistake pellets for food, or seek it out as a source of grit. Once the lead pellet is in the gizzard the digestive juices and the action of the gizzard muscle wears the pellet down and releases lead salts into the body. Not every bird that swallows a lead pellet dies from lead poisoning. Factors which affect the susceptibility of an individual bird are:-

- number of pellets the bird swallows

- time the pellet is retained in the gizzard

- previous lead exposure

- diet: invertebrates and natural leafy green foods can help offset the toxic effects of lead. A complete grain diet can increase the toxicity of lead.

- environmental conditions - weather, food availability, shelter etc.

Raptors which scavenge or prey on waterfowl receive lead shot poisoning from lead imbeded in the tissue of wounded or dead

birds. The main raptor species in the U.S.A. to suffer lead shot poisoning is the Bald Eagle. A bird of prey must ingest a lead pellet not eat infected tissue like liver which has a high lead content. The bird is able to digest the lead pellet due to the very acid condition in the ingestive tract, reducing lead to lead salts which are toxic.

6.2.1 DISEASE CAUSE

There is no scientific evidence that waterfowl in U.S.A. get lead poisoning from breathing air that contains lead or from eating plants that have absorbed lead from the environment. Birds do sometimes get lead poisoning from swallowing lead batteries, lead based paints, fishing sinkers and other lead objects, however there is no evidence that such sources are a major cause of lead poisoning.

The most common source of lead in U.S.A. wetlands, comes from spent lead shot disposed by hunters eg. there is about 280 number six lead pellets in a 1¼ once, 2 3/4 inch 12 gauge shotgun shell. On the average, six shells are fired for each waterfowl bagged. This results in about 1400 lead pellets being deposited in the environment for each bird bagged.

Lead pellets from shot shells when ingested are the most common source of lead poisoning in the U.S.A., of birds which feed on or around wetlands, including waterfowl, coots, rails, raptors and occasionally wading birds. Losses of waterfowl can occur at any time of the year, although in North America most cases of lead poisoning occur after the waterfowl hunting season has finished. During the hunting season the disturbance of hunting keeps waterfowl from spending much time feeding in hunting areas. When the season is over and hunters leave, waterfowl can spend more time feeding in these areas and have more opportunity to swallow lead shot, that was disposited during the previous hunting season.

6.2.2 DISEASE RECOGNITION

Lead poisoning doesn't usually cause large visible die offs like those caused by other waterfowl diseases. Lead poisoning is not contagious and birds get poisoned one by one, depending on whether they swallow and retain lead pellets long enough.

The general trend in clinical signs of a lead poisoned waterfowl over time are as follows, (Lead Poisoning in Waterfowl by USF&W)

- 3 to 10 days after ingestion the digestive juices and grinding action of the gizzard reduces much of the pellet into lead salts. These lead salts reach the blood stream and are carried to major body organs. The bird may carry its wings in a "roof shaped" position and may be mistaken for a hunting cripple. The vent may be stained green and the presence of bright green faeces on the ground, indicates the presence of lead poisoned waterfowl.

- 5 to 12 days the digestive tract often becomes paralyzed and may result in the escophagus becoming packed with undigested food.

- 7 to 10 days the bird seeks isolation and seclusion.

- 14 to 18 days the bird loses its ability to fly and the wing tips droop. At this stage the bird becomes vulnerable to predation. The fox is a major predator or scavenger of lead poisoned birds.

- 17 to 21 days the bird falls into a coma and dies from lead poisoning. Heavy predation of effected birds helps prevent a build up of dead birds.

An autopsy will often show liver atrophy, an enlarged gall bladder distended with thick dark green bile. The gizzard lining is often stained light to dark green.

6.2.3 DISEASE PREVENTION

To reduce the disease there must be a reduction in the availabity of toxic shot, through physical methods such as soil tillage, water manipulation or the use of non toxic shot. An added grit supply may help reduce shot intake.

(a) Soil Tillage

Soil tillage reduces the availability of shot to waterfowl, but is only a termporary solution, since annual hunting activities renews the lead poisoning potential. (The La Joya State Game Reserve impoundments, were dried out and ploughed each year to promote shot movement down through the soil profile). Tillage is impractical over many of the U.S.A. wetland habitats.

(b) Water Manipulation

The drying out of wetlands and deep water flooding can reduce lead ingestion, but also eliminates or reduces waterfowl habitat. It is against wildlife management principals to harvest waterfowl from an area, then destroy or make it unavailable to waterbirds after the hunting season.

(c) Grit Stations

In areas where natural grit is scarce the placement of course sand at selected locations within the wetland, may help elleviate shot intake by waterfowl. It has been demonstrated at a number of refuges that for ducks to utilize grit stations, the station needs to be surrounded by water eg mowed levee banks, or small islands and peninsulars void of vegetation.

(d) Non Toxic Shot

The use of non toxic shot for hunting waterfowl is the only long term solution, to significantly reduce bird losses from lead shot poisoning. The lead poisoning/non toxic shot debate has raged for decades in the U.S.A. A great deal of research has been undertaken to discover an alternative shot, which was non toxic, bassistically acceptable and economical to produce. At present there is only one viable substitute for lead shot and that is steel shot.

Numerous studies were conducted in the seventies to compare the ballistics of steel verses lead. Some were bias towards lead or steel but most showed there was little difference. However most studies are now antiquated due to modern steel cartridge loads, which are superior.

The following is a short history of the introduction of steel shot for the hunting of waterfowl in the U.S.A. Since the signing of the Migratory Bird Treaty Act of 1918 the U.S.A. federal government has had the responsibility of managing the national waterfowl population. One of the USFWS responsibilities is to set guidelines for states to regulate and administer the waterfowl hunting season. In the early seventies the USFWS started to introduce the use of steel shot on selected areas within the country. One such area was Catahoula Lake, which has a history of major waterfowl losses, due to lead poisoning. To convince hunters of the ballistic capabilities of steel shot, the USFWS gave cartridges to them the first year and then subsidised the cost of cartridges for the next couple of years.

During this period, there was major opposition to the USFWS forced introduction of steel shot by many states, hunting organisations and some cartridge manufactors. In the light of this opposition, the U.S. Congress past a law requiring each state to agree to the introduction of steel shot before the USFWS could proceed. Very few states agreed, thus the introduction of steel shot was halted in 1979. However over the next 6 years a large number of states introduced non toxic shot zones, on individual wetlands which had demonstrated a lead poisoning problem. A few states even introduced regulations banning the use of toxic shot throughout the state, for waterfowl hunting.

In the mid eighties Bald Eagles (an endangered species) were found to be dying from secondary lead shot poisoning. One such location was the Klamath Basin N.W.R. Complex. With this knowledge and the status of the Bald Eagle, conservation organizations took the USFWS to court. The court ruled that the USFWS was to consider alternatives for protecting Bald Eagles from lead poisoning. After the federal government threatened to close waterfowl hunting areas, the states agreed to a five year program to phase in the use of steel shot for the hunting of waterfowl. The program has enabled the highest hunted zones of a state to be closed in 1987 with the lowest being closed in 1991. The zones were defined by local government boundaries.

Steel vs. Lead

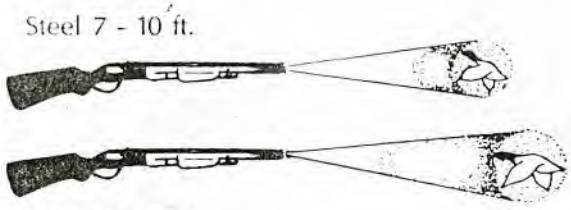
- Figure 2 outlines the major differences in the ballisical capabilities between steel and lead shot.

- Steel shot is made by forming soft steel wire into pellets which are then annealed and coated. The process is similar to that used to make ball bearings. A steel pellet weighs about 30% less than a lead pellet of similar size. Therefore there are more pellets in an once of steel shot than in an once of lead shot.

STEEL vs LEAD

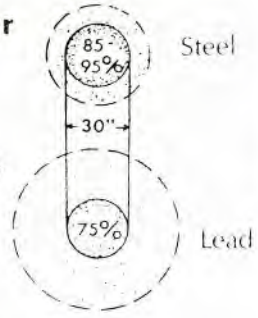
Steel shot strings are shorter than lead.

50 yard example



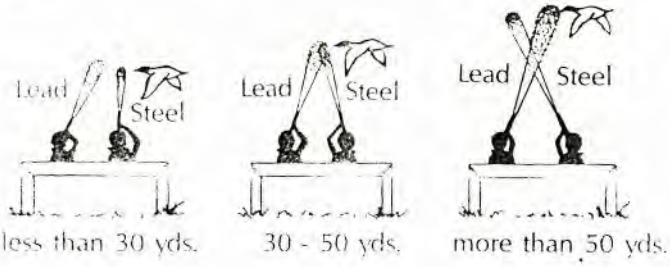
Steel shot patterns are denser and smaller than lead at 35-45 yards.

Steel requires more accurate shooting, but more pellets hit your target.

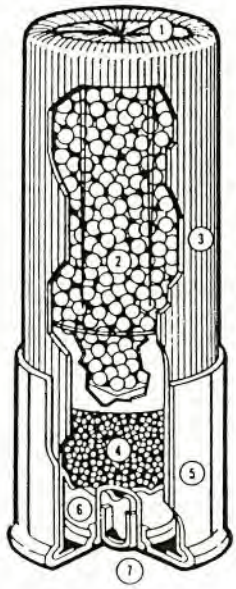


Aiming point varies with distance.

Steel is faster than lead at close range but slower at far ranges.



Use two sizes larger steel for similar performance to lead.



STEEL SHOTSHELL

1. FOLDED CRIMP.
2. SHOT ENCLOSED IN PLASTIC CUP.
Special, tough plastic shot container surrounds the steel pellets to provide protection to the barrel. Flanged base seals the powder gases on firing.
3. PLASTIC TUBE.
4. SMOKELESS POWDER.
5. METAL HEAD.
6. BASE WAD.
7. PRIMER.

FIGURE 2 Major differences in the ballisical capabilities between steel and lead shot.

- Most American cartridge manufacturers make the following range of steel shot 6 (.11 ins. diameter), 4 (.13 ins.), 3 (.14 ins.), 2 (.15 ins.), 1 (.16 ins), BB (.18 ins.), T (.20 ins.) and F (.22 ins.) American standard.

- Steel shot is available in the USA to suit 10, 12, 16 and 20 gauge smooth bore shotguns. The main suppliers are Federal Remington and Winchester.

- Steel shot reloading kits are available in the USA. One company supplying steel cartridge components is; Non-Toxic Components Inc., P.O. Box 4202, Portland, Oregon, 97208.

- The cost of a box of 25 steel cartridges was between $1 and $3 US more than lead in late 1988. It is expected that by 1991 when all duck hunters will have changed over to steel, the price difference will be even smaller.

- Fears of gun damage by steel shot for most part are baseless. The majority of modernday shotgun are capable of firing steel loads without problems. Exceptions are older thin walled double barrel shotguns and some imported single barrelled shotguns. Also with some full choke guns, cosmetic damage in the form of a ring bulge near the muzzle may develop. If a person has doubts about their gun they should contact the manufacturer.

- The question of increased crippling of ducks with steel, has been clouded by the use of different measures to compare effectiveness. But shooting tests show little difference in the performance of steel and lead shot.

6.3 RECOMMENDATIONS

A number of small avian botulism outbreaks have occurred in Australia. However unless the outbreak kills a large number of birds and occurs in the settled parts of the country, it is unlikely to be discovered. It is recommended that hunters, bird watchers and wildlife management personnel be encouraged to lookout and report any multiple unexplained waterbird deaths, to enable our knowledge of waterfowl diseases to be enhanced.

At present there is a number of locations within Australia which documented cases of lead shot poisoning of waterfowl have and still are occurring. The extent of the problem is not fully understood within the Australian context at this stage. However we do know lead is a toxic substance and we are placing lead into our wetlands by hunting waterfowl using lead shot. A number of Australian waterbird species feed within the sediment of wetlands and thus are at risk of lead shot poisoning. There is also a substitute for lead shot which is ballisically acceptable.

Therefore it is recommended that the use of lead shot to hunt waterfowl be immediately banned throughout Australia, regardless of knowledge, as to the extent of the problem within the country.

In areas where lead poisoning is a problem and natural grit levels are low the use of grit stations should be considered eg Bool Lagoon Game Reserve - the peninsulars of Little Bool.

7 Habitat Contamination

In addition to drainage and clearing for agriculture use, the next major threat to wetlands in the U.S.A. is contamination from toxic substances. It is estimated that 12 million hectares of wetlands throughout U.S.A., have been contaiminated to such an extent as to render them useless.

7.1 KESTERSON RESERVOIR (SELENIUM)

During the study tour, a wetland contamination case was studied, this was the Kesterson Reservoir within the Kesterson NWR, California. In the early 1970's twelve evaporation ponds totalling 518 ha. within the refuge, were constructed to dispose of subsurface drainage water, laden with salt. The water came from farms in the central San Joaquin Valley, California. This joint authority project, was deemed an environmental success with numerous waterbirds breeding and wintering on the evaporation reservoir.

In 1981 due to new legislation the water entering the reservoir was tested for toxic substances and showed high levels of selenuim. Investigation during the following years revealed high levels of selenium in the food chain organisms. The elevated levels of selenium was causing a high incidence of mortality and deformity among newborn coots, grebes, stilts and ducks and the death of adult american coots in the reservoir. Investigations also found that the selenium had concentrated in the ponds closest to the inlet, while the salts had concentrated in the furtherest ponds.

It is anticipated that the reservoir will be filled in with unpoluted soil by the end of 1989 due to the threat to wildlife, stock and man.

7.2 RECOMMENDATIONS

A number of evaporation basins exist throughout the irrigation areas of the Murray Darling Basin and many support major populations of waterbirds, especially during dry periods. With the present government move to reduce salt entering the river system by interception schemes, the number of evaporation basin will increase in the near future. If managed correctly, these new wetlands can be very productive and support many species of waterbirds.

It is recommended that water entering existing evaporation basins be tested for toxic substances at determined intervals. Also that water which is to be placed in a new evaporation basin be tested for toxic substances prior to construction, to enable it to be designed to limit waterbird use, if there may be a problem (eg. deep water, steep sides etc.).

8 Waterfowl Hunting

The primary responsibility for setting the waterfowl hunting regulations, rests with the federal government. It received this authority from the Migratory Bird Treaties which were negotiated among the United States, Canada and Mexico Governments to protect migratory game and nongame birds, as they migrated back and forth between these countries. (Most species of waterfowl of North America are migratory). The treaties have provisions for hunting, which stipulate that the season cannot be more than 107 days in length and it must fall within the period of September to March 10th.

The four great waterfowl flyways (migration routes) Pacific, Central, Mississippi and Atlantic, provide a basis for management of waterfowl populations which results in regulations based on regional conditions.

There is approximately 1½ million waterfowl hunters in the USA and about one third of them are located in just 5 states, Louisiana, Minnesota, Wisconsin, Texas and California. In contrast West Virginia has only 1400 waterfowl hunters.

8.1 SETTING THE HUNTING SEASON

Within the federal government the US Fish and Wildlife Service, assumes responsibility for setting hunting regulations. The hunting season is managed to harvest the maximum waterfowl numbers without causing a decline in the number of breeding birds. Surveys are carried on by federal, state and Canadian technicians throughout the year to monitor the population. The first survey to assess the coming years crop takes place as the hunting season closes. This is the winter inventory and it is taken to determine the number of birds, that have survived the hunting season and are potential breeders.

The next survey is taken on the breeding grounds at the beginning of spring. This survey reveals the number of breeding pairs of ducks and the existing water conditions. Another survey at the end of spring shows how many young, these breeding birds have produced. Once the production is determined a forecast is made of the fall flight, of the four flyways.

The information concerning the forecast for the fall flight, is sent to the four flyway councils so they can make their recommendations, for season and bag limits. The flyway council is made up of the wildlife management agency directors and commissioners, from each of the states in the flyway.

After considering the council recommendations, reviewing the breeding ground reports and the forecast for the fall flight, the USFWS sets the framework for the seasons and bag limits. States must select the dates of the season to fall within the hunting period(Sept. to March) and have a choice of a straight or split season.

There are other aspects of the regulations in which the states have no choice. These include the bag limits, shooting hours, restrictions on certain species and methods of hunting. A state can be more restrictive than the federal regulations, but they cannot be more liberal.

8.2 HUNTING REGULATION

The federal objectives of the migratory bird hunting regulations are:-

1. "To provide an opportunity to harvest a portion of certain migratory game bird populations, by establishing legal hunting seasons.

2. To limit harvest of migratory game birds to levels compatible with their ability to maintain their populations.

3. To avoid the taking of endangered or threatened species so that their continued existence is not jeopardized and their conservation is enhanced.

4. To limit taking of other protected species where there is a reasonable possibility that hunting is likely to adversely affect their populations.

5. To provide equitable hunting opportunity in various parts of the country within limits imposed by abundance, migration and distribution patterns of migratory game birds.

6. To assist, at times and in specific locations, in preventing depredations on agricultural crops by migratory game birds".

The migratory bird hunting regulations are divided into three categories.

(a) Basic Regulations

They are regulations which do not change from year to year and apply to the hunting methods, possession, dressing, transporting and storing of migratory game birds.

Some regulations which apply to the hunting of waterfowl in the USA but do not apply in South Australia are:

No person shall take migratory game birds:

- With a shotgun capable of holding more than three cartridges.

- From a sink box (a floating device affording the hunter concealment beneath the surface of the water).

- From or with the aid or use of a motor driven land conveyance or aircraft.

- Using records or tapes of bird calls, or sounds or electronically amplified imitations of bird calls.

- Possession limit is the maximum number of birds that can be taken legally in two days.

- No person shall possess more than one daily bag limit of freshly killed birds while in the field or returning from the field.

- No person shall given, put or leave any game birds at any place or in the custody of another person unless the birds are tagged by the hunter with the following information: the hunters signature, the hunters address, the number and species of birds and the date such birds were killed.

- One fully feathered wing or the head must remain attached to the dressed bird while being transported between the place taken and the permanent residence.

- All game birds shall be retrieved, if possible and retained in the custody of the hunter in the field.

- Crippled birds must be immediately killed.

- Each waterfowl hunter 16 years of age and over must carry on his person a valid Migratory Bird and Conservation Stamp.

(b) Framework Annual Regulations

They are regulations most often changed in response to management needs and apply to hunting dates, times and season length and daily bag limits.

- The sport hunting is permitted in the USA of the following waterbird taxonomic families, in regards to annual regulations.

Anatidae (ducks, geese, brant and swans)
Gruidae (cranes)
Rallidea (rails, coots and gallinules)
Scolopacidae (woodcock and snipe)

- Season length varies from year to year and from flyway to flyway but cannot exceed 107 days. The season can vary between species or groups of species e.g in California the 1988 hunting season was split into the following:

(a) Ducks, coot, moorhen and common snipe, 59 consecutive days.

(b) Geese, 93 consecutive days.

(c) White-fronted Geese, 23 consecutive days.

- During the past year shooting hours have been sunrise to sunset.

- Bag limits vary between species group eg. California bag limit for 1988 were:

(a) Ducks, 4 per day including no more than 3 mallards of which only 1 can be a female, 1 pintail, 2 red heads and no canvasbacks.

(b) Geese, 3 per day with only 2 of each species.

(c) Coot and Moorhen, 25 per day.

(d) Snipe, 8 per day.

- Generally season lengths, bag composition and number are uniform within flyways with the most liberal being the Pacific flyway and the most conservative the Alantic flyway. This reflects differences in the abundance of birds and numbers of hunters etc.

(c) Special Regulations

Most special regulations are modifications of frame-work regulations and usually do not change from year to year. Often these regulations have been aimed at more effectively harvesting those species considered lightly utilized. They include items like split season, zoning, special season, bonus birds and the point system.

- States may split their hunting season lengths for most species into two non-consecutive segments. Most states split seasons to take advantage of species specific peaks of abundance or to redeploy enforcement efforts.

- Zoning is undertaken to provide more equitable distribution of harvest apportunity for hunters throughout the state.

- The object of a special season is to increase the exploitation of species of ducks traditionally viewed as being lightly utilized.

- Bonus birds are birds allowed in addition to the regular daily bag limit. In most cases the bonus birds are of those species viewed as being lightly harvested.

- The point system is an alternative to the conventional daily bag limit for ducks. Under the point system, ducks are assigned point values (usually 10-100) according to the degree of protection needed. The daily limit is reached when the point value of the last duck taken added to the points values of ducks already taken equals or exceeds 100. However it has been found that many hunter achieve the same daily bag, regardless of the harvest system they are required to use.

8.3 PUBLIC HUNTING AREA PROGRAMS

During the study tour a number of hunting programs on state and federal waterfowl areas were investigated. Most areas had the following common management.

- Only 50% of the refuge was open to hunting.

- The hunting was divided into two sections, one with marked space blinds, the other a free roaming area.

- A quota was set on the number of hunters allowed on the area at one time.

- A fee to hunt on the area was charged to cover the management costs of the hunt.

- Between the refuge and hunting area a 100 meter retrieval zone was established where loaded firearms were prohibited.

- Most areas were open for the hunting of waterfowl for 3 to 5 days a week.

One of the following methods were employed to regulate the number of hunters entering a area.

(a) Reservation System

Requires a hunter to fill out an application with a $1 non-refundable application stamp attached and send it to the departmental headquarters, at least ten days prior to the hunting date desired. Hunters whose application is drawn in the lottery are notified by mail one week before their hunting date.

(b) The first come, first served system.

Requires the hunter to go to the refuge and register in the "first come, first served" line. Hunters are registered and park their vehicles in lines in the order in which they arrived at the refuge. Permits are issued to those hunters to fill the quota for the day, or to fill vacancies as other hunters check out this is called the "sweat line".

(c) Lottery System

Blind sites are selected by lottery at the beginning of each days hunt. The daily lottery begins approximately two hours before shoot time at the check station, located on the hunting area.

8.4 HUNTER EDUCATION

Publications on hunting regulations and seasons, waterfowl guides and sunrise and sunset time tables, were readily available in most states.

Some states visited had no formal state run hunter education program, however hunting organisations such as the California Waterfowl Association conducted hunter safety programms.

About thirty states however require hunters to complete hunter education training prior to the issuance of a hunting license.

The basic aims of the education programmes investigated were:

- To reduce the number of hunting accidents by promoting safe gun handling.

- To teach hunter safety, hunter responsibility and field ethics.

- To inform hunters of basic game needs and basic game laws.

- To promote good sportsmanship and a better relationship between hunters, landowners and the state wildlife authority.

A fee was charged to undertake the course and a minimum exam score of 70% was required to pass. All students received a hunter education handbook and patch. On satisfactory completion of the course, students received a hunter education ID card which was honored throughout the country.

8.5 DUCK STAMPS

Over 30 states require waterfowl hunters to carry a state duck stamp in addition to the Federal duck stamp, on their basic hunting licence. The stamp fee varies from $2 to $10 and in some states fishermen are required to purchase a stamp. Receipts from state sales are used for wetland habitat acquisition, research and management and is the major funding source for much of the work achieved.

The design selection for a stamp is either commissioned or a contest is conducted which is judged by a panel of art and waterfowl experts. Competition among artists is intense in the Federal Duck Stamp design contest. Wildlife artists are funded by various sporting magazines and art galleries. Eight hundred designs were entered, at a cost to each artist of $50 per design in the 1986 Federal Duck Stamp contest. Although the contest itself offers no monetary prize, winning artists generally each receive in excess of $1 million as a result of print sales. Over 4 million federal duck stamps are sold each year.

The public recognition of the stamps value for wildlife and as a collectors item, has prompted non hunting conservationists and stamp collectors to buy them. States which commission a artist to design a stamp, also sell prints to raise extra funds.

8.6 PRIVATE WATERFOWL HUNTING AREAS (DUCK CLUBS)

It is estimated that 16 million hectares of the remaining 38 million ha. of wetlands in the USA are leased by private landowners to waterfowl hunters. A number of hunting lease arrangements operate.

- A duck club will lease land from the owner and organise the hunting themselves.

- A private owner constructs blinds and either leases it to a club or may advertise one day hunts for individual hunters.

- A person may lease land, then set up blinds and manage the hunting themselves.

A number of affluent duck clubs and individuals own their own wet-land and may employ managers and seasonal staff. One duck club visited in California, the "Butte Lodge Hunting Club" owned 560 ha of prime waterfowl habitat. The club had 38 members who paid $110,000 to join, with a yearly subscription of between $4,000 to $10,000. The property had a 60 ha. refuge area and 52 hunting blinds on the remaining land. Hunting was only allowed on Saturdays, Sundays and Wednesdays and was managed on a lottery system for blind selection.

8.7 RECOMMENDATIONS

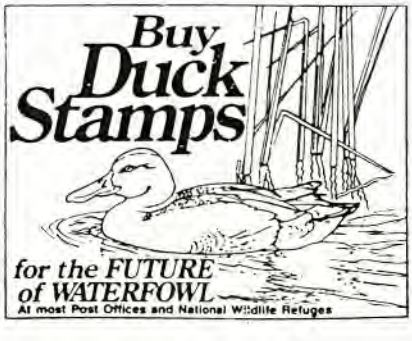
It is estimated that there is approximately 120,000 duck hunters in Australia with the majority residing in Vic, NSW and S.A.. Australian waterfowl hunting seasons are set and administered by individual states with limited consultation with other states.

However even though our waterfowl are not migratory, most species are either nomadic or undertake regional dispersal, having no regard for govermental boundaries. Most states decide on hunting season regulations more on historial lines than on up to date biological data. It is recommended that the Australian National Parks and Wildlife Service administer waterfowl hunting throughout Australia, along similar lines to that of the USFWS, to enable a continental perspective to prevail.

Most Australian wildlife authorities have comprehensive waterfowl hunting regulations, however it is recommended that the USA regulations on possession, dressing birds and zoning or split season be considered to help control numbers and species taken and to increase hunter success.

Waterfowl hunters are consumptive users and the user pay principal is readily accepted in Australia. However Australian Wildlife authorities and private landowners do not exploit this to the fullest, or governments redirect hunting permit receipts away from wetland management. It is recommended that both a federal and state wetland habitat stamp (duck stamp) program be implemented to aid the conservation and management of wetlands. Authorities and hunters should also encourage landowners to sell hunting right to their properties, thus obtaining a monitory return on a preceived useless piece of land. One of the main forces behind the conservation of private wetlands in the USA, is the monitory return landowners receive from consumptive uses, such as duck hunters.

Hunter education is an essential part of any wildlife hunting program. Therefore it is recommended that all states require hunters to undertake a mandatory hunter education course. The course should include knowledge of guns and ammunition, proper gun handling, safe hunting methods hunter responsibilities eg. (game identification, sportsmanship and game management principals).



9 Pest Species Control

9.1 TYPHA sps. (cumbungi)

North America has a number of typha species, however they are different to the two Australian species.

One of the major control tactics in killing the North American typha is to starve the plants tubers of a supply of carbon dioxide. The transfer of gasses is achieved throughout the year via live or dead leaves. Some control methods used to utilize this biological information are:-

- Cut the plant off below water level after the growing season.

- Dry the wetland out after flowering, then slash plants and reflood for about 20 - 30 days.

The following methods are used to control or open up stands of typha:-

- Spray the plant with a translocating non oil base chemical after flowering when the plant is replenishing carbohydrates to the tuber's.

- Burn the tubers when the soil is dry enough for a peat fire, (historically this is probably the natural control method).

- A four year prescribed drought will drastically reduce a typha stand.

- Discing the stand in mid summer exposes the tubers to the sun which will kill them.

The burning of typha and other reed type species only promotes growth due to the release of nutrients.

9.2 COMMON CARP

Two refuges visited had major carp investigation problems, Malheur and Sacromento.

Most fish species compete with waterfowl and waterbirds for submergent invertebrate and plant foods. Carp by their actions are one of the most destructive fish in this regards. Carp are omnivorous, feeding on a aquatic vegetation and invertebrates. Their feeding activities result in physical destruction of aquatic plant beds (even reed species) and increase water turbidity resulting in reduced light for photosynthesis. Carp infestations in fresh water wetlands can quickly reduce the waterfowl food production of the area to 10% of its potential. At Malheur N.W.R.a two year average of the refuges area of sago pondweed, before and after major carp control efforts, went from 1400 hac. to 8000 hac.

Carp infestations are very difficult to control. Only a few carp in a system can saturate the habitat within five years. Rotenone is an effective chemical for providing temporary carp control, however, it is expensive and it rarely results in 100% control.

The best technique to control carp, where feasible is to drawdown the wetland. Carp barriers (fig 3) can be used to stop or slow reinvasion of carp into the wetland system and may increase productivity of an area for several years. If carp are stopped most other fish species are also excluded.

9.3 PREDATORS

The general control of predators affecting waterbird breeding success has been widespread on many U.S.A. refuges in the past. However this practice of general control has stopped and only individual species which are having a major impact on a threatened or vunerable species are controlled. One such case is the predation of eggs from Greater Sandhill Crane nests, by ravens. At a number of refuges where cranes breed, ravens account for the largest single loss of eggs. Thus ravens are controlled by building a dummy crane nest and the placing of chicken eggs with the poison D.R.C.1339 in them. This poison is specific to Corvidae birds and was developed by the Denver Wildlife Research Centre. Poisoning is conducted during the period when the cranes are nest building.

If fox control is required it is undertaken by randomly placing 2.5 cm square tables of talo laced with 1080.

9.4 MINIMIZING CROP DAMAGE BY WATERBIRDS

Only a limited number of species cause major crop damage in North America, they are mallard and pintail ducks, the geese species and sandhill cranes. On a individual basis cranes are more destructive than ducks and geese. The most damage occurs to mown grain and frequently coincides with waterfowl migration and changing weather conditions. Damage occurs by direct consumption, contamination by faeces and trampling of swaths. Rice, wheat, barley, oats and millet are usually the most seriously effected. Dwarf varieties of grain, make heads more accessible to ducks and geese and will add to the problem.

Once a field is discovered by the birds, a feeding pattern is established within days. Flight paths are traditional and ducks may return to the same field year after year. There are two directions to take in preventing crop damage, change the birds habits or change cropping habits. Methods used to scare birds are similar to those used in Australia, visual devices, propane guns, gun fire and a combination of these methods.

It has been found that scare devices should be in place before the birds arrive. Timing is critical if the birds beat the device to the field, its effectiveness diminishes. For best results a feeding pattern should never be allowed to start.

In areas where regular major crop damage occurs, lure crops or bait stations are established, usually on government owned land. Generally a lure crop is a cereal grain crop that has either been mowed or flooded and left for the birds to use.

One of the best changes in farming methods is to leave waste grain in the field after harvest. Then the birds can feed on available stubble and the pressure may be reduced on nearly unharvested fields.

FIGURE 3 Fish screen to keep adult common Carp from entering the wetland, Sacramento N.W.R., California.

Snow Geese, Bosque del Apache N.W.R., New Mexico.

9.4.1 CRANES

There are 3 species of cranes in North America, Whooping and Greater and Lesser Sandhill. Due to the large numbers (½ million+) of cranes on the continent, crop damage can be substantial in certain localities. The main crops affected are corn, sorghum and alfalfa as well as cereal grains to some extent. The main control device used is the propane gun which is moved about the field or mounted on a rotating, lazy susan device, so birds do not become accustomed to the noise. It has been found that one gun will protect about 18 to 20 hectares from crane predation.

Other scaring devices used with success are helium-filled balloons, fireworks, shell-crackers and scarecrows.

9.4.2 SUPPLIERS OF SCARING DEVICES AND MATERIALS:-

Firecrackers, Shellcrackers, etc.

Marshall Hyde, Inc.
P.O. Box 497
Port Huron, MI. 48060
313-982-2140

Stoneco Inc.
P.O. Box 187
Dacono, CO. 80514

Western Fireworks Co.
2542 SE 13th Ave.
Canby, OR. 97013
503-266-7770

Balloons & Kites

Raven Industries, Inc.
P.O. Box 1007
Sioux Falls, SD. 57117
605-336-2750

Weather Measure Corp.
P.O. Box 41257
Sacramento, CA. 9548
916-481-7565

Atmospheric Instrumentation Research (AIR) Inc.
1880 S. Flatiron Ct., Suite A
Boulder, CO. 80301
303-443-7187

9.5 RECOMMENDATIONS

The information on the control of typha and predators, and minimizing crop damage by waterbirds, is only a basis for ideas which could be expanded or modified to suit the Australian situation.

In the 1960's common carp were introduced into the Murray-Darling River system and rapidly colonizes most of the basin's wetlands. Though the visual impact on the basin aquatic vegetation was dramatic, very little quantitive data has been collected on the effects carp have had on the Murray-Darling ecosystem. This lack of knowledge or misunderstanding about the impact carp have had, is demonstrated by the lack of reference to carp damage in governmental reports, on the problems and management of the river basin.

It is recommended that governments recognise the damage that carp have and can course to fresh water ecosystems and manage certain wetlands of the Murray-Darling basin to exclude carp. This management action will also exclude other fish species, however, fish are only one group of organisms which inhabit the Murray wetlands. Thus wetlands which are less favourable to threaten native fish species, should be zoned a carp free area and managed as such.

"Aren't you supposed to **swim** *after them?"*

10 Public Use

Historically US wildlife refuges have concentrated their management efforts towards wildlife populations and consumptive recreational use. Only in relatively recent years, have most refuges included general public use in their management objectives.

10.1 PLANNING

A number of refuge management plans (Master plans) were viewed during the study. The plans are very brief and only obtained 4 or 5 major management objectives. The objective which referred to public use usually read as such "To provide opportunities for environmental eduction, interpretation and wildlife orientated recreation for "xx" visitors annually".

To intergrate wildlife and public use within a refuge, a compatibility chart was drawn to determine the conflict or compatibility of major wildlife species, and public use activities, for each management zone.

Following the adoption of the master plan, operational management plans are written of which one is a public use plan. The public use management is usually divided into the following subjects:-

Education - outdoor classroom, display shelter, interpretation centre.

Interpretation - wildlife trails (foot, vehicle) observation tower.

Recreation Non/consumptive - wildlife observation (foot, vehicle, boat) photography.

Recreation Consumptive - waterfowl hunting, trapping, fishing.

10.2 FACILITIES

Most refuges only allowed general access to a portion of the refuge. However the public use area, usually contained a section of each habitat type and an area where high concentrations of wildlife could be viewed. Auto trails were the most common visitor facility, with observation towers, walking trails and board walks located within certain refuges. Consumptive and non consumptive recreational activities were usually located in separate zones within a refuge.

10.3 ENTRANCE FEES

Most federal refuges had no entrance fees. If entrance fees were charged, entrance booths were only manned during high visitation days, with a volunteer entrance registration system operating during the remainder of the time.

10.3.1 VOLUNTEER REGISTRATION SYSTEM

An envelope with a detachable slip was made available for visitors to place the entrance fee in and deposit it into a collection box. A visitor was required to write their name, vehicle licence number and date on the envelope. The tear off slip was required to be displayed on the drivers side of the vehicle dash board, with the vehicle licence number and date written on it. Most state parks and wildlife areas conducted a similar volunteer system, to collect entrance and camping fees.

10.4 TOUR OPERATIONS

At the major waterfowl hunting refuges in California, hunting guides operated within these areas. Some problem existed between regular hunters and the hunting guides competing for the best hunting location.

Six tour boats conducted guided cruises to view whooper cranes and bird rookeries within Aransas N.W.R. Most cruise operators were very responsible and professional and caused limited disturbance to wildlife.

10.5 INTERPRETATION LITERATURE

The following is a discription of some noteworthy literative encountered on the study tour.

- Newspaper style; usually refuge or subject specific, mostly only 4 pages.

- Refuge brochures; general information with map.
  mammal list
  bird list
  self guided auto route
  hunting and fishing information

- Common wildlife of a refuge; a pictorial check list.

- Regional visitor directory; brief discription of each refuge, regional map, contact addresses.

- Endangered species brochure; species specific.

- Photographic apportunities; where, what, how.

10.6 RECOMMENDATIONS

It is recommended that a wildlife species/public use activities compatibility chart, be undertaken for each reserve management zone. This chart should be included in the management plan.

As well as producing straight bird or animal lists of a reserve, managers should also consider publishing a pictorial wildlife check list, of the common species of the area.

11 Volunteer Conservation Organisations

Of the many USA volunteer conservation organisations involved in wetland conservation, only two were investigated; Ducks Unlimited Inc. and The California Waterfowl Association.

11.1 DUCKS UNLIMITED

Ducks Unlimited (D.U.) is one of the world's most effective volunteer conservation organisations, which now employs over 250 permanent staff.

The USA based organisation was founded in 1937 to help restore and enhance critically needed waterfowl breeding habitat in Canada, where nearly 70 percent of North America's waterfowl are produced. Today, Ducks Unlimited is involved in projects in the breeding, staging and wintering grounds of Canada, the United States and Mexico.

Since inception D.U. has completed more than 3650 wetland restoration projects. During its first 50 years, D.U. raised some 436 million for wetland enhancement and management. Membership presently stands at 544,000 individuals with some 3860 fund raising committees nationwide. A programme for young conservationists under the age of 18, called Greenwings, was initiated in 1973 and now has more than 60,000 members.

The base of D.U.'s fund raising efforts is the proceeds from banquets organised by local fund raising committees. In 1987 $59.8 million was raised with a $120 million turnover. Revenues were divided into the following:-

Net proceeds from banquets	47.3%
Membership	16.6%
Sponsors	16.5%
Major sponsors	6.1%
Interest and other	6.0%
Advertising	4.1%
State Governments	3.4%

Expenditure for 1987 was:-

Habitat programmes	80.2%
Field operations and development	14.3%
Administrative expense	3.1%
Supporting services	2.4%

The main reason D.U. has achieved success in conserving wetlands is that the organization does not own land, but enters into long term agreements with landowners, both government and private. Usually the agreement costs nothing as the wetland restoration or management project undertaken by D.U., benefits the landowner.

The organisations main conservation initiatives of the 1980's includes the following three components;

- MARSH (Matching Aid to Restore States Habitat); which provides funds to state conservation departments for wetland acquisition and enhancement.

- Habitat; DU's "hands on" engineering and biological arm which restores key waterfowl habitat.

- Habitat Inventory and Evaluation; which catelogs and evaluates wetlands, primarily in the prairie pothole region, using data from the landsat 5 satellite.

11.2 CALIFORNIA WATERFOWL ASSOCIATION

The California Waterfowl Association (C.W.A.) was founded in 1945 to look after the interests of the California duck hunter. The main goals of the organization are:-

- to preserve and enhance wetlands

- to improve the production of waterfowl within the state

- to benefit the sport of water-fowling.

The organization has 8000 members, which is about 10 percent of the states waterfowl hunters and employs 14 permanent staff. C.W.A. raises about $1½ million per year on similar lines as Ducks Unlimited, however they rely more on major sponsors, and foundation and government grants.

The California Waterfowl Association is a very political organisation which maintains lobbyists in the state and federal capitals. The lobbyists work for legislation which is in the interests of waterfowl and waterfowl hunters and fight legislation which is not. The organization is involved in two other major outreach programmes besides legislative, they are:-

- Landowner Contact; disseminates information to wetland and rice farm managers, to encourage marsh management and farm practices, which are most beneficial to waterfowl and upland game.

- Land Use Data Base; is developing a data base on land use for the major waterfowl areas of California, for the purpose of identifying potential wetland enhancement projects. Also write management plans for each area.

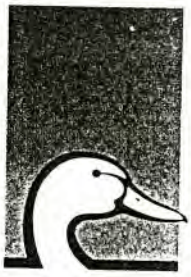
Biological research by the organization is usually in a form which will complement legislation and the work of other waterfowl groups, such as Ducks Unlimited.

11.3 RECOMMENDATIONS

In Australis at present, the Field and Game Association (F & G) is the only national volunteer organization which is conserned with wetland protection and management and the utilization of waterfowl for hunting. The F & G has broad organization objectives and is at present undertaking in the general sense, the combined roles of such organizations as Ducks Unlimited and The California Waterfowl Ass. During the investigation of both the U.S.A. organizations it was very clear that the main reason for their success, is the single mindlessness of the organizations. It is

recommended therefore that the Field and Game Ass. re-assess its aims and objectives, and consider narrowing it's ambit to enable greater success, in the lobbying for the rights to hunt game species.

Besides the U.S.A. there are Ducks Unlimited organizations in Canada, Mexico, New Zealand and Europe, which are achieving success in the field of wetland conservation. Australia's wetlands are facing many problems as we move towards the year 2000, salinity, competition for water, drainage, contamination, destruction and disturbance from high recreational use and introduced animals and fish. The management and protection of the nations wetlands cannot be left solely to governments, as they are experiencing declining resources and have other social priorities. It is strongly recommended that a national volunteer conservation organization, with similar objects as Ducks Unlimited, be established as soon as possible, to aid in the conservation of the nations wetlands.



DUCKS
UNLIMITED

LEADER IN WETLANDS CONSERVATION

12 Wetland Transportation

A number of transport modes are used within U.S.A. wetlands, horses 4x4 motor bikes, all terrain vehicles, canoes, modified motor boats and airboats. The more conventional transport modes are used on refuges with relatively small wetland management units. Those areas with large wetlands units, nearly exclusively operate airboats for transportation.

12.1 AIRBOATS

Airboats are extensively used in U.S.A. and are invaluable in traversing shallow heavily vegetated wetlands. Some refuges visited had 3 or 4 airboats and considered these crafts to be essential to the management of the area. Some wetland management programs which relied greatly on a reliable and efficient transport mode such as an airboat were, law enforcement patrols, wildlife surveys, exotic plant control, flora monitoring hydrological management and disease control.

The major disadvantage of an airboat, is the high noise level, however on areas where airboats are used regularly, wildlife disturbance is minimal as most species become accustom to the craft. One refuge manager told me "airboats don't scare birds away, guns do". It was widely excepted by wetland management staff that the advantages of having personnel access to previously unaccessable habitat, outwayed the disadvantages of operating an airboat.

In recent years the technology of airboat construction has advanced greatly, enabling the craft to traverse deep water, dense vegetation and dry land. After witnessing a number of different airboats operating and on discussion with operators, the following basic airboat specifications are recommended, (this craft would suit most types of vegetated wetlands).

Hull: 14'x 7', .100" thick 70-75-T6 aluminum alloy. The bottom of the hull should be covered with ¼" thick, white virgin polymes (VHMW) and extend up the sides, a minimum of 12". The polymes should be fastened by aircraft rivets or stainless steel bolts.

Engine: A overhauled Lycoming, 6 cylinder, 260 HP.

Steering: Left hand stick, positive (no cables) solid 7/8" rod.

An airboat manufacturer which was highly recommended and builds crafts to the above specification is:

Airboats Engineering In.
2715 South Street
West Palm Beach
Florida 33407 Ph 8339520

13 Acknowledgements

I express my sincere thanks to the Winston Churchill Memorial Trust and the S.A. branch of the Fellowship Award panel. Most importantly I greatfully acknowledge the Trustees of the Royal Australian Institute of Parks and Recreation, for their sponsorship of my Churchill Fellowship, through the A.I.P.R. Education Trust Fund. Acknowledgement is also extended to the South Australian National Parks and Wildlife, Reserves Advisory Committee for the Wildlife Conservation Fund Grant, to assist in the implementation of the Fellowship Award.

I am also grateful for the support and encouragement given to me by the Director-General of the South Australian, Department of Environment and Planning, Mr. Ian McPhail; National Parks and Wildlife Service, Executive Staff, Messrs. Bruce Leaver, Lindsay Best and Lindsay Jolley. Members of hunting and conservation organizations in South Australia, in particular Messrs. Bob Twyford, Peter Schramm, Tony Sharley, John Eckert, John Kentish and Jim Lightbody and my colleagues and friends who offered their encouragement. Thanks must be recorded to Yvonne Ashton and Karen Stewart for their help in preparing this report.

I am dearly greatful for the company of my wife Heather Harper who was of great assistance and gave moral support and encouragement during the study tour. I also thank my parents-in-law and parents for managing our family and affairs while undertaking this tour, of which would have been impossible without their help.

In the course of the tour over 75 people provided their time for discussion and assistance. Invariably this was done willingly and cheerfully, sometimes despite considerable personal inconvenience. While all their efforts are greatly appreciated, it is naturally impossible to mention all of them.

Outstanding assistance was provided by the following people;

Roger Johnson, Refuge Manager, Klamath Basin N.W.R., California.
Professor Standley Harris and Mrs. Harris, Humboldt State University, California.
Greg Menslk, Sacromento N.W.R., California.
R.B. Reno, Gray Lodge Wildlife Area, California.
Gary Zahm, Refuge Manager, San Luis N.W.R., California.
Michael Berger, Ducks Unlimited, Illinois.
Pamela Parker and Stephanie Williams, Chicago, Illinois.
Kerby Brown, Texas Parks and Wildlife Dept., Texas.
John Taylor and Rod Drewien, Bosque Del Apache N.W.R., New Mexico.

The award provided the Fellow with much more than just considerable technical knowledge, which hopefully is going to be beneficial to South Australia and Australia; many intangibles also occur to Fellows from such awards and tours, hopefully to the benefit of the whole community.

14 Appendix I - Itinerary

September 28

Travelled - Adelaide/Los Angeles, U.S.A.

September 29 - October 4

On leave California
Los Angeles/San Fransisco/Yosemite National Park (N.P.)

October 5 - 6

Drove from Yosemite N.P. through to Malheur National Wildlife Refuge (N.W.R.), Oregon. Visited Stillwater N.W.R., Nevada, water shortages, salinity problems.

October 7 - 9

Malheur N.W.R. with David Johnson, Refuge Habitat Management Specialist and other staff, investigated habitat management to increase waterbird breeding success, control of Typha sps. and Common Carp. Accompanied a duck trapping and banding team.

October 10 - 15
Klamath Basin N.W.R. Complex, Oregon with Refuge Manager, Roger Johnson and staff. Viewed techniques in large unit, moist soil management and the organisation and policing of duck and goose hunters. Discussed lead poisoning of waterfowl, the use of steel shot to hunt waterfowl, duck disease outbreaks.

October 16 - 18

On leave California, Redwoods, and Crater Lake National Parks.

October 19 - 22

Humboldt Bay N.W.R. and Lake Earl State Refuge, California with Professor Stanley Harris (Humboldt State University) and Refuge Manager Eric Nelson. Estuary protection, waders, sea ducks and goose management. Waterfowl hunting using skull boats and stilt blinds. State and federal wetlands and waterfowl protection and fund raising legislation.

October 23 - 26

Sacromento N.W.R., California, with Greg Menslk, Refuge Biologist and other staff on techniques in small unit, moist soil management and wetland easement programme. Talked with scientists studying Avion Botulism and lead poisoning. Observed a duck and goose hunt and the management of consumptive and non consumptive recreational visitor. Viewed the Butte Lodge Duck Club.

October 27 - 29

Gray Lodge State Wildlife Area, California. Spent time viewing a duck hunt and the management of hunters, general habitat management with Area Manager R.B. Reno, discussed duck hunting club management, hunter eduction programmes and the collection of waterfowl hunter bag statistics.

October 30 - 31

Sacromento, California Waterfowl Association and Ducks Unlimited Inc. personnel, discussed organizational aims and objectives, fund raising and management projects.

November 1 - 3

Visited San Luis, Kesterson and Merced N.W.R. California with Refuge Manager Gary Zahm. Viewed floodplain moist soil management, a wetland polluted with selemium and crane management.

November 4 - 15

Part on leave California/Illinois/Louisiana.

Monterery travelled San Fransico/Chicago, Brookfield Zoo, Palos Hills Forest Preserve. Visited Ducks Unlimited Inc. Head Office Chicago, talked to Section Directors, Michael Berger and Brent Manning on development of habitat, fund raising and setting up a Ducks Unlimited organization in Australia. Travelled Chicago/Houston/New Orleans.

November 16 - 17

Williams Inc., Louisiana, viewed with Field Manager, Carl Vinning the management of wetlands by a private company. Duck hunting, crawfish farming, commercial hunting(alligator and fur bearers) and passive recreational use.

November 18 - 19

Lacassine N.W.R., Louisiana, with Refuge Manager, Bobby Brown. Viewed visitor management, natural wetland vegetation management, specialized wetland transport equipment and the impact of oil and gas exploration.

November 20 - 21

Rockerfeller State Wildlife Refuge, Louisiana with Waterfowl Biologist, Tom Hess. Visited the refuges Alligator farm and discussed wild and captive alligator management. Observed a waterfowl aerial census and the operation of an airboat.

November 22 - 23

Catahoula N.W.R., Louisiana with refuge staff viewing and discussing lead poisoning of waterfowl, general visitor management, observation tower and lookout ramp design.

November 27 - 30

J.D. Murphree Wildlife Management Area, Texas, with Waterfowl Biologists, Kirby Brown and Charles Stutzenbaker. Learnt of coastal moist soil management, levee and water control device construction. Mottled Duck management, lead poisoning and the use of steel shot in Texas.

Sea Rim State Park, discussed with Park Superintendant, Bill McDaniel, Junior Ranger and Volunteer programmes and waterfowl hunter management. Viewed day and camping visitor facilities.

November 31 - December 1

Anahuac N.W.R. Texas, with Refuge staff. Learnt of habitat management and monitoring. Grassland re-establishment, goose hunter management and visitor facilities (board walk and auto routes).

December 2 - 3

On leave
Houston - visited Nasa Space Centre

December 4 - 6

Aransas N.W.R. Texas, with Wildlife Biologist, Tom Stehn. Most time spent viewing Whooping Crane and visitor management. Talked to boat tour operator.

December 7 - 8

Rosenberg, Texas, participated in a Ducks Unlimited fund raising banquet.

December 9

Travelled - Houston/Albaquerque, New Mexico.

December 10 - 12

On leave New Mexico.
Visited Red Rock State Park, El Malpois and El Morro National Monuments.

December 13 - 15

Basque Del Apache N.W.R., New Mexico, with Refuge Manager Philip Norton and Biologist John Taylor. Viewed green tree reservoir management, control of moist soil pest plants, crop degradation by waterbirds, salinity control and Whooping Crane reintroduction programme.

Brief visit to La Joya State Game Reserve and Bernardo Wildlife Area. Both areas are in the locality of Bosque Del Apache N.W.R. but managed by the New Mexico Dept. of Game and Fish.

December 16 - 21

Travelled - Santa Fe/Albaquerque/Los Angeles/Adelaide

15 Appendix II - Contacts

David Johnson (Habitat Management Specialist)
Malheur N.W.R.
HC 72 Box 245
Princeton 97721
Oregon (503)4932612

Paul F. Springer (Research Scientist USFWS)
Hamboldt State University
Arcata 95521
California

Eric Nelson (Refuge Manager)
Humboldt NWR
Route 1 Box 76
Loleta 95551
California

Roger Johnson (Refuge Manager)
Klamath Basin NWR
Route 1 Box 74
Tule lake 96134
California

Professor Stanley Harris (Lecture in Wildlife Management)
Humboldt State University
Arcata 95521
California (707) 826-3953

Pat Ohaloen (Refuge Manager)
Sacramento NWR
Route 1 Box 731
Willows 95988
California (916) 934-2801

Greg Menslk (Refuge Biologist)
Sacramento NWR
Route 1 Box 731
Willows 95988
California (916) 9342801

Mark A. Strong (Wildlife Biologist, Easement Agreements)
Sacramento NWR
Route 1 Box 731
Willows 95988
California (916) 9342801

R.B. Reno (Wildlife Habitat Supervisor)
California Dept. of Fish and Game
Gray Lodge Wildlife Area
Gridley 95948
California

Bruce E. Deuel (Asst. Waterfowl Co-ordinator)
California Dept. of Fish and Game
1416 9th Street
Sacramento 95814
California (916) 4456897

Dr. M. Robert McLandress (Research Biologist)
California Waterfowl Association
3840 Rosin Crt.
Suite 200
Sacromento 95814
California (916) 648-1406

Roger Pederson (Regional Biological Supervisor)
Western Regional Office
Ducks Unlimited Inc.
9823 Old Winery Place
Suite 16
Sacromento 95827
California (916) 3638257

Gary R. Zahm (Refuge Manager)
San Luis NWR
PO Box 2176
Los Banos 93635
California (209) 826-3508

Michael E. Berger (Director of Government Relations)
Ducks Unlimited Inc.
One Waterfowl Way
Long Grove 60047
Illinois (312) 438-4300

Brent Manning (Director of Field Operations)
Ducks Unlimited Inc.
One Waterfowl Way
Long Grove 60047
Illinois (312) 438-4300

Carl Vinning (Field Manager)
Williams Inc.
PO Box 428
Patterson 70392
Louisiana (504) 395-9576)

Bobby Brown (Refuge Manager)
Lacassine NWR
Route 1 Box 186
Lake Arthur 70549
Louisiana (318) 774 2750

Tom Hess (Waterfowl Biologist)
Louisiana Dept. of Wildlife and Fisheries
Rockefeller Wildlife Refuge
Route 1, Box 20-B
Grand Chenier 70643
Louisiana

Eric Sipco (Refuge Manager)
Catahoula NWR
Box 1383
Jena 71342
Louisiana (318) 992 5261

Rod Cobb (Asst. Refuge Manager)
Tensas NWR
Route 2 Box 295
Tallulah 71282
Louisiana (318) 574-2664

Roger Saucier (Information Officer)
U.S. Army Corps of Engineers
Waterways Experiment Station
Environmental Laboratory
Vicksburg 39181
Mississippi (601) 634-3205

Kirby L. Brown (Wildlife Biologist)
Texas Parks & Wildlife Dept.
J.D. Murphree Wildlife Management Area
10 Parks and Wildlife Drive
Port Arthur 77640
Texas (409) 736 2551

Charles D. Stutzenbaker (Regional Waterfowl Biologist)
Texas Parks and Wildlife Dept.
J.D. Murphree Wildlife Management Area
10 Parks and Wildlife Drive
Port Arthur 77640
Texas (409) 736-2551

Bill McDaniel (Park Superintendant)
Texas Parks & Wildlife Dept.
Sea Rim State Park
PO Box 1066
Sabine Pass 77655
Texas (409) 971-2559

Ed Jackson (Ass. Refuge Manager)
Anahuac NWR
Box 278
Anahuac 77514
Texas (409) 267-3337

Tom Stehn (Wildlife Biologist)
Aransas NWR
Box 100
Austwell 779050
Texas (512) 286-3559

Barry Jones (Public Use Officer)
Aransas NWR
Box 100
Austwell 77950
Texas (512) 286 3559

Philip Norton (Refuge Manager)
Bosque Del Apache NWR
Box 1246
Socorro 87801
New Mexico (505) 835-1828

John Taylor (Refuge Biologist)
Bosque Del Apache NWR
Box 1246
Socorro 87801
New Mexico (505) 835-1828

Monty Woody (Project Leader-Game Management)
New Mexico Dept. of Game & Fish
State Capital
Santa Fe 87503
New Mexico (505) 827-7911

Les Gibson (Waterfowl Area Supervisor)
New Mexico Dept. of Game & Fish
200 Curfman, S.W.
Los Lunas 87031
New Mexico (505 8655110)

Tonie E. Rocke (Epizootiologist) (Botulism Research)
U.S. Fish and Wildlife Service
National Wildlife Health Research Centre
6006 Schroeder Road
Madison 53711
Wisconsin

John Y. Takekawa (Wildlife Biologist)
(White Front Goose Research)
U.S. Fish and Wildlife Service
Wildlife Research Field Station
6924 Tremont Road
Dixon 95620
California (916) 756-1946

16 Appendix III - Lecture / Slide Show Presentations

A Lecture/Slide Show on the Australian Wetlands and Waterfowl was presented at the following venues:-

Establishment	Audience Composition
Malheur NWR	Refuge Staf
Klamath Basin NWR	Refuge Staff
Homboldt State University	Lecturers in Wildlife Management
Sacromento NWR	Refuge Staff
San Luis NWR	Refuge Staff
Calahoula NWR	Refuge Staff
J.D. Murphree WMA	Management Staff
Aransas NWR	Refuge Staff
Bosque Del Apache NWR	Refuge Staff

17 Appendix IV - Books, Publications and Videos

Inventory of Data from Churchill Fellowship, USA, 1988

LARGE BOOKS

Return to Big Grass - by Ducks Unlimited

The Mottled Duck - by C.D. Stutzenbaker, Texas Parks & Wildlife Dept.

Wetlands - Increasing our Wetland Resources, Conference Proceedings Oct 1987 by - National Wildlife Federation

Malheur N.W.R. Mangement Plan Workshop March 1988 by - US Fish and Wildlife

Field Guide to Wildlife Diseases - by U.S. Dept. of the Interior

Lead Poisoning in Wild Waterfowl,
A Workshop March 1984 - Ed. by J.S. Feierabend & A.B. Russell

Wild Lands for Wildlife, America's National Refuges - by N. Grove

Birds of North America - by C.S. Robbins

PUBLICATIONS

Status Report on our Nations Wetlands - by the National Wildlife Federation

Humboldt Bay National Wildlife Refuge Environmental Assessment Update - by U.S. Fish and Wildlife Service

Malheur N.W.R. Master Plan/Environment Assessment - by U.S. Fish and Wildlife Service

A Plan for Protecting, Enhancing and Increasing California's Wetlands for Waterfowl - by California Dept. of Fish and Game

Management of Seasonally Flooded Impoundments for Wildlife - by L.H. Fredrickson & T.S. Taylor

Bring Ducks to your Land - by J. Jackson

How to Grow Watergrass for Ducks in California - by California Dept. of Fish & Game

Propagation of Selected Native Marsh Plants in the San Joaquin Valley - by California Dept. of Fish and Game

Planting Alkali Bulrush for Waterfowl Food - by California Dept. of Fish and Game

Management of Midges and Other Inverterbrates for Waterfowl Wintering in California - by N.H. Evliss

The Future of Waterfowl in Texas : An Issue of Habitat - by Texas Parks & Wildlife Dept.

Rockfeller State Wildlife Refuge : Evaluation of Wetland Management Techniques - by Coastal Environments Inc.

North American Waterfowl Management Plan - by U.S. Fish and Wildlife Service

Waterfowl for the Future - by U.S. Fish and Wildlife Service

Placing Wildlife Management in Perspective - by Wildlife Management Institute

Minimizing Sandhill Crane Damage to New Mexico Croplands - by New Mexico State University

Habitat Suitability Index Models : Greater White - Fronted Goose (Wintering) - by U.S. Fish and Wildlife Service

Habitat Suitability Index Models : Blue-Winged Teal (Breeding) - by U.S. Fish and Wildlife Service

A Plan for the Management of Waterfowl, Sandhill Cranes and Other Migratory Birds in the Middle Rio Grande Valley of New Mexico - by U.S. Fish and Wildlife Service

Whooping Crane Recovery Plan - by U.S. Fish and Wildlife Service

Avian Botulism - by U.S. Fish and Wildlife Service

Lead Poisoning in Wild Waterfowl : A Workshop, March 1984, Kansas - by National Wildlife Federation

Are we Wasting our Waterfowl - by Kansas Wildlife Dept.

Getting the Lead out - by Louisiana Dept. of Wildlife and Fisheries

Kesterson Reservoir and Kesterson NWR : History, Current Problems and Management Alternatives - by G.R. Zahm

1988 Status of Waterfowl and Fall Flight Forecast - by U.S. Fish and Wildlife Service

The Sport Hunting of Migratory Birds : A Environmental Impact Statement - by U.S. Fish and Wildlife Service

Summary of Federal Hunting Regulation 1988/89 - by U.S. Fish and Wildlife Service

Hunting on the Public Areas - by J.B. Cowan

Hunting Opportunities, Type 1 Wildlife Management Areas 1988/89 - by Texas Parks and Wildlife Dept.

1988 California Regulations for Hunting on State and Federal Areas - by California Dept. of Fish and Game

Waterfowl of California - by California Dept. of Fish and Game

Louisiana Dept. of Wildlife and Fisheries Waterfowl Guide

Ducks at a Distance : A Waterfowl Identification Guide - by U.S. Fish and Wildlife Service

Ducks Unlimited, Inc. 1987 Annual Report

Ducks Unlimited Banquet Guide

Ducks Unlimited Greenwing Event Guide

Ducks Unlimited Committee Treasure's Guidebook 1988 Edition

Landsat Application Notes : D.U. Wetland Habitat Inventory - by EOSAT

BROCHURES (a Selection)

Vanishing Gulf Coast Wetlands

National Wildlife Refuges : A visitor's Guide

The Way of the Whooping Crane

Co-opperative Project for Production of Wood Ducks and Black-Bellied Whistling Ducks

Butte Sink Waterfowl Habitat Preservation Program

Louisiana Hunting, Fishing and Motorboat Regulations 1988/89

Hunting in Oregon

Waterfowl Seasons, New Mexico 1988/89

Hunting 1987 Tule Lake and Lower Klamath National Wildlife Refuges

Waterfowl Hunters : Know the Black Duck

The "Duck Stamp" Story

The Texas Hunter Education Program

Lead Poisoning in Waterfowl

The Steel Shot Decision

Hunter's Guide to Steel Shot

Viewing Wildlife in California's Central Valley

Visitor Directory : Pacific Region : National Wildlife Refuges

Malheur National Wildlife Refuge

Malheur N.W.R. : Mammals

Malheur N.W.R. : Birds

Malheur N.W.R. : Self Guided Interpretive Auto Route

Malheur N.W.R. : Hunting and Fishing

Cajun Jack's Swamp Tours

Capt. Ted's Whooping Crane Tours

The Ducks Unlimited Story

Ducks Unlimited - A Living Legacy

The California Waterfowl Association Story

Conserving Wetlands for Wildlife : Help for the States

Wetlands America

Greater Sandhill Crane, Central Valley Population

VIDEOS

Lead Poisoning in Waterfowl - by U.S. Fish and Wildlife Service

Hunting Waterfowl with Steel Shot - by W.C. Badorek

Wetland - by Ducks Unlimited

Fund Raiser - by Ducks Unlimited

Partners - by Ducks Unlimited

OTHER

Fish screen site plan, Malheur N.W.R. - by USFWS

Airboat specifications (Stossel) - by Lacassine N.W.R., USFWS

Articles of incorporation of California Waterfowl Association

By-Laws of California Waterfowl Association

Certificate of Incorporation of Ducks Unlimited Inc.

18 Appendix V - Publications Donated

Publications donated to the Dept. of Environment and Planning Library. Contaminant hazard review series by the U.S. Fish and Wildlife Service.

No. 1	Mirex : Hazards to Fish, Wildlife and Invertebrates		
No. 2	Cadmium:	"	"
No. 3	Carbofuron:	"	"
No. 4	Toxaphene:	"	"
No. 5	Selenium:	"	"
No. 6	Chromium:	"	"
No. 7	Polychlorinated:	"	"
No. 8	Dioxin:	"	"
No. 9	Diazinon:	"	"
No. 10	Mercury:	"	"
No. 11	Polycyclic:	"	"
No. 12	Arsenic:	"	"
No. 13	Chlorpyrifos:	"	"
No. 14	Lead:	"	"