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FISHERIES AND WILDLIFE

FISHERIES AND WILDLIFE IN VICTORIA

Fisheries and Wildlife Division

Introduction

The fauna of Victoria, the fishes, mammals, and birds, can be placed in two categories. The first category comprises the species which have special value as forming part of the unique ecosystem of the continent and which, because of environmental changes taking place about them, require skilled management of their populations if they are to be maintained. The majority of native freshwater fishes, many of the marsupials, and some birds, fall into this category. The second category contains those which, because of their abundance and capacity for survival are available for food or provide recreation for the community. Examples are large numbers of fish species, (mostly sea-water types), ducks, quail, and deer.

Conservation of Victorian fisheries and wildlife requires the management of widely diverse species and the habitats which support them. With sound management goes the research upon which it is based. Consequently the responsible authority, the Fisheries and Wildlife Division of the Victorian Ministry for Conservation, deploys its resources to priorities prompted by the intrinsic value of the State's fauna and the recreational and commercial needs of the community.

Until the 1940s, fisheries and wildlife activities in Victoria were mainly restricted to limited enforcement programmes and the stocking of streams and lakes with trout. Before Federation, these functions were the responsibility of the Department of Trade and Customs, and after 1901, were transferred to the Department of Public Works. In 1909, the activities were taken over by the Department of Agriculture, and in 1913, a Fisheries and Game Branch was formed, under the control of the Chief Secretary. In 1933, a 50 cent trout licence was introduced, and by 1940, the Branch had an annual budget of $21,000.

The development of a research and management organisation began in the 1940s. By 1952, the Branch had a staff of 40 persons with a budget of $82,000, $5,000 of which was spent on research. Research into ducks resulted in a $2 game licence being introduced in 1959.

In January 1973, a Ministry of Conservation was formed and the functions of the Branch, and the Branch itself, became the Fisheries and Wildlife Division in the new Ministry. By then, there were 250 persons on the staff and half of the $1.8m budget was spent on research. Conservation research had become a most important function in 1973, and there were 18 scientific officers and 45 support staff in the Marine Pollution Section of the new Division. Early in 1978, the Marine Pollution Section was transferred to the Ministry proper to join a newly formed Marine Studies Group. During 1979, the responsibility for the biological component of marine fisheries research was transferred to the Marine Studies Group, coinciding with its translocation to a site at Queenscliff. The Commercial Fisheries Section, as a result of this re-organisation, has been able to expand and consolidate its management obligations to the fishing industry.

Notwithstanding this loss of staff, the Division's permanent and exempt establishment numbered 287 persons by mid-1979, supported by a budget of $5m. Research also covered

a variety of other fields, including commercial marine fishing, inland stream and lake stocking, and fauna control and environmental studies.

Wildlife

Historically, most wildlife management and research in Victoria has been orientated towards game or pest control. Work of this nature is continuing, but in recent years the need to undertake other kinds of research has been recognised. This additional requirement may be related to a general community interest in conservation.

At one time, control of wild animal pests in agriculture and forestry sought to explore techniques of removing as many of the offenders as quickly and cheaply as possible. This older approach has gradually evolved into the specialised management of wildlife which requires the basic understanding of the ecology of each species, its relationship with other species, and the use of that knowledge as a basis for control. The control of rabbits by myxomatosis is an example. Studies of native fauna in Australian universities have influenced this change in approach. The knowledge gained has been of marked potential value to the wildlife manager.

Research undertaken by the Fisheries and Wildlife Division is now orientated towards providing a sounder basis for management decisions. Programmes are now increasingly directed towards conservation, although the long established monitoring of duck and seal populations will continue, even if on a smaller scale.

Research, which has long-term objectives, or objectives which are difficult to define, does not easily attract the necessary funds. This type of research contrasts with that in which short-term objectives have popular appeal. Recently, government support has been made available for a number of such longer-term projects which would not have previously attracted financial assistance.

Current wildlife research studies

A survey and classification of wet-lands of Victoria is now in progress. Although this work has strong links with game management objectives, its significance is much greater because for the first time, inland waters are being related to wildlife survival. From the results of this work, it will be possible to draw up a list of priorities for the conservation of wet-lands on the basis of their values to many species beyond those of game interest.

Similarly, a general survey of the distribution and abundance of vertebrate animals in Victoria is a long-term undertaking which will provide the basic information against which future changes in the status of wildlife can be measured. In the course of this general survey, several species have been recognised which require urgent investigation because of their limited distribution or their declining status. In some cases, the Division is studying these species or encouraging other research organisations to do so. Current research of this kind deals with the mountain-pygmy possum, the long-billed corella, leadbeater's possum, the helmeted honeyeater, and the ground parrot. The peregrine falcon is also being studied because it is declining in numbers throughout the world, apparently as a result of the effects of pesticides which reduce the strength of its egg-shell.

Another study concerns native rodents which seem to be especially responsive to the effects of fire on heath lands. Studies on the characteristics and acceptability of artificial nest boxes and dens may help to offset some of the effects of commercial forestry on native animals.

Reserves management

Fish and wildlife require a congenial environment if they are to thrive or, in some cases, even survive. Therefore, to offset ever increasing demands made by an expanding human population, areas reserved for the natural propagation and maintenance of fauna and fish must be adequate. In order to be self sufficient, the Division's policy is directed to making reserves large and free from undesirable influences exerted on them by surrounding land which may be used for agricultural or other purposes. A continuing land purchase programme is in operation.

Reserves which have been proclaimed or purchased now total 88 and cover about 98,500 hectares. The Division is continuing to establish and consolidate the habitat of wildlife throughout Victoria by purchasing land and recommending additions to the existing sanctuaries to form wildlife management co-operative areas. The Land Conservation

Council has made final recommendations involving an additional 35 reserves of about 7,000 hectares in total area.

Wildlife habitat on reserves and other Crown land is either restored to the natural regime or maintained by the replanting of vegetation, the installation of water control structures, and sometimes by releasing wildlife formerly present in the area. Koalas are regularly captured and re-located and emus and magpie geese have been re-introduced into areas around Puckapunyal and Sale Common, respectively. Rare species are propagated at the Division's Wildlife Research Station near Lara.

Mud Islands

Faunal reserves are usually associated with areas deep in the forest where native animals are provided with an environment free from the disturbance of man's workaday and leisure activities. A faunal reserve of a somewhat different nature is Mud Islands, situated towards the southern end of Port Phillip Bay. Although not well known to all Victorians, the islands are familiar to Melbourne residents who spend leisure time boating on Port Phillip Bay.

Mud Islands consists of four main islands known as Western, Middle, Eastern, and Boatswain Islands, and has a total land area of about 100 hectares. The islands consist of a series of sand and shell banks built on a platform of sedimentary rocks. The islands are the only place in Port Phillip Bay where consolidated dune rock is exposed above the high-water mark. The base formation is lightly covered with a shallow layer of sandy soil which supports a variety of vegetation.

When Acting-Lieutenant John Murray of HMS *Lady Nelson* discovered the islands in 1802 he named them Swan Isles because of the many swans and pelicans found along the beaches and in the lagoon which lies between the islands. The official name of the group was changed to Mud Islands in 1836 when the first detailed survey was made.

Although the islands are still the resting place and contain the rookeries of breeding birds, considerable changes appear to have taken place in the vegetation and shore line in recent years. It has also been noticed that the number of persons visiting the island has increased rapidly. While the physical nature of the islands is changing continuously because of ever moving sand and sand banks formed by winds and wave action, the islands are stable enough to ensure preservation of the main sea-bird colonies. The real dangers, therefore, to the bird life are the vegetation changes and influences of visitors.

Recently, Fisheries and Wildlife Division staff conducted a survey with the object of documenting the present size and extent of the sea-bird colonies and of measuring the various factors which influence them. In this study the level and effect of visitor pressure, and of other animals such as rats and rabbits on the viability of sea-bird colonies was investigated. A surprising number of bird species, 73 in all, has been recorded on the islands. Although they are used predominantly by terns, silver gulls, and stormy petrels for breeding, many unlikely birds use the islands. There are probably very few places where, for example, the common sparrow meets the wandering albatross or an orange-bellied parrot encounters a gannet, but this happens regularly on Mud Islands.

The popularity of the islands can be gauged from the results of a sixteen day survey during which 843 persons from 176 boats were interviewed. Their reasons for visiting were varied. Most came because they were curious, many thought that the islands were an attractive picnic spot, while others were interested in bird watching or flounder spearing. Almost three-quarters of the visitors were aware that they were in a faunal reserve and that there were colonies of sea birds nesting there even if the rookeries were not visited. Many persons seemed to be content to remain on the beach and did not venture into the interior.

This survey seemed to indicate that the impact of visitors to Mud Islands on nesting sea birds was not unfavourable. However, the birds have to contend with each other. There is evidence to show that the colonies of silver gulls and terns are increasing in area, while the petrel population is fairly stable. It remains to be seen, therefore, whether nature will achieve some sort of balance or whether the more timid species will be overwhelmed by the more aggressive ones.

Now that the present status of the fauna and flora of Mud Islands has been documented, it will be possible to compare the situation there today with that which

existed some years ago. The early visitors to the area, particularly the naturalists, have recorded what they saw and their reports form a useful basis for comparison purposes.

Liaison with service groups

The Division has continued to assist various government and private organisations concerned with wildlife. Groups such as the Bird Observers Club, the Victorian Field and Game Association, and the Victorian National Parks Association have benefited from Divisional participation. Among the government authorities involved are the State Rivers and Water Supply Commission, the Forests Commission, the National Parks Service, the Town and Country Planning Board, the Country Roads Board, and the State Electricity Commission.

Monitoring habitat

Visual observation often indicates that physical interference has unfavourably affected the indigenous animal inhabitants. However, at other times the interference may be much less apparent and sometimes insidious.

Nevertheless, the cost of monitoring and thereby forecasting threats to all of the State's habitats is excessive and too often, therefore, corrective action can only be taken after an adverse effect on land or water is observed in the animal or fish populations. This is usually indicated by an increase in the number of fish or animal deaths or by an easily detectable decline in numbers.

Lake Burrumbeet near Ballarat was the subject of investigation after excessive input of pollutants into the lake was first indicated by the production of dense masses of algae which caused the death of fish and livestock. Similar signs in the Gippsland Lakes have led to a comprehensive study of the lake system. This will incorporate investigations of water movement, inventories of aquatic and land species, and basic measurements of productivity, all of which are essential to the development of effective conservation policies and management techniques.

Fisheries management

The practical management of fisheries in Victoria is complex in the freshwater environment. Water, because of its susceptibility to physical and chemical influence, plays an important role in determining the range and density of fish populations. In the sea, the primary concern is the continued adequate yield of fish for either the fishing industry, for recreation, or both.

Victoria's commercial fisheries provide about 16,000 tonnes of fish worth around $18m annually, and thus considerable research and management is directed towards this industry. The Division also knows the importance of the recreational demands on the estuarine and inshore fish stocks. Some of the salt water species which are of primary importance to the fresh fish market (which constitutes about 17 per cent of the total Victorian catch), are also sought by anglers. Snapper, whiting, and flounder are examples, and in the case of snapper it is estimated that the quantity of the commercial catch is matched by that taken by amateur fishermen.

Unlike the recreational fishermen of the inland lakes and streams, those anglers who fish the bays and coastal waters of Victoria do not contribute to the special research and development trust funds partly financed from licence fees. Because of this, money set aside for marine fisheries investigations is mainly channelled towards commercial fisheries, which do make a contribution through substantial licence payments.

The unrestricted exploitation of natural resources often results in irreparable damage being done to the resource itself with the consequent unfavourable effects ultimately being passed on to the exploiter and the community at large. Many of Victoria's fisheries are therefore subject to controls which limit exploitation by way of imposing ceilings on either the number of fishermen or boats licenced and the quantity of fishing gear which may be used. The licensing provisions of the Fisheries Act are therefore particularly important in the process of managing the fisheries. They establish the Director's prerogative, on the recommendation of the Commercial Fisheries Licensing Panel and the Fisheries Management Committee, to grant or refuse an application for a licence. Such decisions are within the context of "having regard to the welfare of the fishery concerned as well as the persons engaged in the industry"

Thus, having the authority to refuse applications has provided the Director with a mechanism for limiting the number of fishermen and boats in certain fisheries. During 1979, limited-entry status was afforded the non-culture segment of the eel fishery and certain of the bay and inlet scale fish fisheries. Previously, licence limitation had been applied to the scallop, abalone, rock lobster, and some bay and inlet fisheries.

As well as maintaining research and monitoring studies on Victoria's established fisheries, the Division has directed its attention to the development of hitherto unexploited resources. Intermittently since 1975–76, the Division has operated its research vessel in the west of the State with the aim of establishing an off-shore trawl fishery adjacent to Portland. This work initially involved surveys of the seabed to determine suitable conditions for trawling and later led to the vessel being engaged, early in 1977, in simulated commercial trawling together with the vessel chartered by the Commonwealth Government. The results obtained were sufficiently encouraging to attract commercial interests, and participation in this fishery is now accelerating. The trawling ground so far discovered is in waters 300 to 400 metres deep and covers almost 300 square nautical miles. The fishery is based at Portland and is expected to support about 10 trawlers.

Fisheries extension work

Traditionally, extension or advisory work has been one of the duties of the Fisheries and Wildlife officers of the Field Operations Section. To a large extent this function remains, particularly in relation to advice on fisheries laws, licensing, and general information about the activities of the Division.

Recently, two extension officers were appointed to assist with the management and development of commercial fisheries. Their role is to communicate to fishermen results of research conducted both by the Division and other agencies, and to assist fishermen in understanding the principles involved in fisheries management and the development of new techniques for improving the efficiency and scope of Victoria's fisheries and fishermen. Conversely, these liaison officers provide an effective channel by which the views of fishermen can be conveyed to the Division. Apart from making individual contacts with men in the industry, the liaison officers organise seminars at fishing ports which discuss papers presented by government and industry. They have also been responsible for the planning and publication of a quarterly *Fisheries Newsletter* which seeks to keep the industry advised of research development and management activities relevant to commercial fisheries in Victoria.

Statistics

The following table shows certain particulars about the fishing industry in Victoria for the years 1973–74 to 1977–78:

VICTORIA — FISHERIES: MEN, BOATS, AND EQUIPMENT

Year	Registered crew members	Boats registered		Value of nets and other equipment
		Number	Value	
			$'000	$'000
1973–74	1,530	781	8,805	1,597
1974–75	1,533	772	9,469	1,633
1975–76	1,427	752	10,865	2,308
1976–77	1,565	825	r11,919	2,532
1977–78	n.a.	891	n.a.	n.a.

The following table shows the catch of fish, crustaceans, and molluscs for the years 1973–74 to 1977–78 landed at Victorian ports irrespective of the waters in which they were caught. Up to and including 1973–74, fish, etc., landed by Victorian fishermen in South Australia are also included.

VICTORIA—FISHERIES: QUANTITY OF CATCH
(tonnes)

Year	Fish *(a)*	Crustaceans	Molluscs	Total
1973–74	10,138	r 684	r 10,188	r 21,010
1974–75 *(b)*	9,445	387	r 9,084	r 18,916
1975–76 *(b)*	7,314	531	r 6,919	r 14,764
1976–77 *(b)*	10,089	316	5,868	16,273
1977–78 *(b)*	9,209	345	6,831	16,385

(a) Includes freshwater.
(b) Collected from main points of disposal. Collected from fishermen before 1974–75.

Trust fund projects

Trust funds now have a special relevance to the maintenance and development of inland fisheries. A recent amendment to the Fisheries Act provides for anglers' fees to be paid into the Fisheries Research Fund. A significant increase in these fees has now yielded an annual payment averaging $200,000 for projects which would otherwise not have been undertaken.

One such project is the study of the Seven Creeks River system, a small tributary of the Goulburn River. In the past, it has supported natural populations of Macquarie perch and trout cod which in recent times have been restricted to a limited stretch of the stream by changes in the environment and the introduction of carp. Because the Seven Creeks is one of the few remaining streams in which trout cod and Macquarie perch are known to breed, it is being used to provide the information on home range and movements of these species, their food requirements, growth, and spawning which will be used in the search for methods of artificial propagation and rearing. Both these species are regarded as endangered.

Murray cod — Lake Charlegrark

Another of the projects made possible by the establishment of a trust fund, into which the revenue from fishing licences is paid, is the Warm Water Fisheries Pilot Project at Lake Charlegrark in the far west of Victoria. This project, which was officially opened in 1976, was established to develop intensive culture techniques for Murray cod, taking advantage of a naturally reproducing population of cod in the adjacent lake.

A promising breeding technique using artificial spawning sites has been developed which eliminates the high stress and mortality rates associated with earlier hormonal stimulation techniques. A feeding regime for young cod has also been developed at the Pilot Project based on initial feeding with brine shrimp, before weaning the fish onto liver followed by a liver-pellet mixture, thus eliminating the need for extensive plankton ponds to produce food. These two innovations have eliminated the previous major barriers to intensively producing cod to a size where they could be safely stocked in waters containing populations of predatory fish such as redfin.

The Division is now in the process of selecting a site for a major warm water fisheries research station and hatchery where further development of culture techniques will eventually make possible the large scale production of Murray cod, trout cod, golden perch, silver perch, Macquarie perch, and catfish for release into their former habitats.

Trout surveys

In response to anglers' concern at the apparent general decline in the State's trout fishery, a Trout Management Group was formed late in 1977 to survey and report on the status of the species in all major streams.

Since becoming fully operational in February 1978, the Trout Management Group has travelled 45,000 kilometres throughout Victoria to sample 50 streams and 34 lakes and reservoirs. Survey results have indicated that although a few streams, notably in Gippsland and some sections of the Ovens River system, are still carrying low numbers of trout; most have recovered well from the decline of recent years. Even in some areas where numbers are still low there have been significant and widespread increases in the numbers and weight of trout present over the last twelve months.

Surveys in many South Gippsland streams revealed the presence of an endangered species, the Australian grayling. Trout stocking has been suspended in these waters pending the results of several studies at present being carried out on this species.

The situation in lakes was considerably better with thirteen waters carrying fish with an average weight in excess of 1.3 kilograms. Many of these waters are clearly under-exploited and could sustain considerably heavier fishing pressure.

Carp

In Victoria over the last decade the introduced species known locally as European carp *(Cyprinus carpio)* has received considerable attention because of its alleged ability to alter the habitats of native fish and wildlife. Although carp are considered a pest, their presence and abundance in Victoria has prompted the development of a commercial fishery. In the last five years, commercial fishermen have harvested more than 1,700,000 kilograms of the species, making the carp fishery one of the largest commercial fisheries in Victoria.

In 1976, the Victorian Government approved a three year study aimed at assessing the impact of carp on fish and waterfowl. The study was planned after consultation with other fishery authorities from adjacent States. Staff have been appointed and the initial phase of the investigation began late in 1979. Should this assessment programme show that carp are damaging the aquatic environment, remedial action will be considered. With this prospect in mind, a series of studies have been initiated to explore alternatives to netting and poisoning as means for controlling carp.

One method by which control over carp populations might be achieved is through the introduction of a virus *(Rhabdouirus carpio)* specific to carp and tests are being conducted in co-operation with the Fish Disease Laboratory, Weymouth, England. These tests have shown that carp are susceptible to the virus. Natives fishes are also being exposed to the virus to ensure that they will not be damaged should this method of control be attempted.

A second possible control technique being investigated, in co-operation with Hebrew University, Israel, is the introduction of a deleterious gene into resident populations of carp. This defect, in theory, might then be transmitted throughout the population, and affect the survival of offspring.

Environmental studies

Developmental projects involving Victoria's watersheds may produce marked alterations in stream flows which are of some consequence to the aquatic environment and the conservation and management of both amateur and commercial fisheries.

One example is the construction of major dams on the headwaters of streams which enter the Gippsland Lakes system. This activity may well result in a change to the existing salinity of the lakes and the fish populations supported by them. Before management procedures aimed at counteracting these effects can be implemented, base line data on the tolerance of individual fish species to changes in temperature, salinity, acidity, alkalinity, and dissolved oxygen are required. At the moment, little is known of the influence or effect of these factors on individual fish or on fish populations.

As a first step towards understanding the behaviour of native fish under different conditions, on-site studies of estuarine, warm, and coldwater inland species have commenced using a Divisional hut located on the Nicholson River in Gippsland which is equipped with constant temperature aquaria for carrying out several basic fish tolerance experiments. Initial observations related to the behaviour of fish under conditions of crowding and their acceptance of food of various types. The second stage of the experiment will determine the tolerance of the chosen species to changes in salinity, dissolved oxygen, acidity, and alkalinity.

Suitable subjects for fish tolerance studies will be chosen from a number of species undergoing examination, which includes bream, estuary perch, mullet, flathead, flounder, whiting, luderick, garfish, and anchovy.

Field operations

The day-to-day responsibility of maintaining contact with the outdoor public and of enforcing the provisions of the Fisheries and Wildlife Acts rests with the 45 Fisheries and Wildlife officers of the Field Operations Section. Twenty-eight of these officers are

stationed in strategic rural and coastal areas according to the fisheries and wildlife demands of the particular regions of the State. There are sixteen Fisheries and Wildlife officers in fishing ports concerned with commercial fisheries.

Inland, where wildlife conservation and recreational fishing are pre-eminent, the twelve districts into which Victoria is divided, each with its own resident officer, vary considerably in area and nature of responsibility. In 1979, a regionalisation scheme was implemented. In the six regions, the regional officer co-ordinates the activities of the district officers in his region.

The Victorian Fisheries and Wildlife officers also have the delegated responsibility of enforcing Commonwealth fisheries laws and regulations which apply to the adjacent off-shore seas. With the proclamation of the 200 mile declared fishing zone, this aspect of their work will increase and be assisted by a fast 17 metre sea-going patrol boat.

Angling information

One of the questions asked by anglers is where and when to catch fish. In many cases, information regarding the particular species and size is also sought. To answer these questions, the Division has published an *Angling Guide* which lists over 500 inland angling waters in Victoria and describes the type of water, the surrounding country, and any special problems or fishing restrictions likely to be encountered. The *Angling Guide* lists the fish type, their abundance and expected size, and in some cases it also gives advice on the most suitable times to go fishing and the methods most likely to be successful.

Chinook salmon

The chinook, or quinnat salmon, as it is sometimes called, is one of five species belonging to the group collectively referred to as "Pacific salmon". Most of the first class eating salmon which begin and end their lives in the rivers of North America belong to this group. They are generally short-lived, with life spans ranging from two to seven years and only spawn once during their lifetime. The chinook salmon can be regarded as the patriarch of the family, being the only species which reaches seven years, at which age it is likely to weigh up to 50 kilograms. These predominantly marine fish can be kept permanently in fresh water, although such an existence usually prevents the fish becoming mature and spawning. In fact, there is only one record of the chinook salmon establishing a self-perpetuating population in one lake in New Zealand and never in its natural North American habitat.

Artificial propagation of Pacific salmon is undertaken by capturing the fish on their way up-river during their spawning run. These mature fish are stripped and their eggs hatched in specially designed hatcheries. All attempts to strip and fertilise eggs from Pacific salmon artificially were unsuccessful until the late 1960s when chinook salmon were for the first time successfully bred from fish which had never been to sea. This significant success was made at the Division's Snobs Creek Hatchery.

Although the importation of chinook salmon into Victoria first took place as long ago as 1877, when 50,000 young fish were successfully hatched and liberated into a number of rivers, the stocking failed to establish a sea-run and all the fish were lost. The next attempt was made in 1936 when the then Fisheries and Game Department successfully hatched 5,000 young fish from eggs imported from New Zealand and placed them in thirteen lakes and reservoirs. This routine was continued over succeeding years using eggs from both New Zealand and the United States, but only two lakes, Purrumbete and Bullen Merri, produced fish of acceptable standard.

In 1967, this practice ended when the Commonwealth Government placed a ban on the importation of salmonoid eggs to prevent the entry of diseases carried by the salmon family. In anticipation of the ban, 1,000 fish were retained at the Snobs Creek Hatchery during the previous year and attempts made to produce brood stock from which eggs could be obtained. This task took ten years of artificial rearing and propagation after which time it was possible to place 15,000 yearling chinook salmon into Lake Purrumbete in 1976. The stocking was repeated in the following two years, forming the basis of a very popular amateur fishery. Over 5,000 anglers have taken out special licences to fish Lake Purrumbete and the catch has averaged two fish per head for each fishing day and up to 6,000 fish have been taken on a single day.

Chinook salmon present more problems in raising than do either brown or rainbow trout. Their diet is more expensive and the egg production and viability of the eggs are lower than for trout, which means that relatively large numbers of brood stock fish have to be maintained. They are also more susceptible to high water temperature in summer. Nevertheless, the success achieved so far has encouraged the Division to consider proposals aimed at producing chinook salmon in commercial quantities for human consumption and perhaps for ultimate liberation in suitable rivers to establish perpetual sea-run populations.

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