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The Kaipara mullet fishery: nineteenth-century management issues revisited

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ABSTRACT: Grey mullet, *Mugil cephalus*, provided an important food resource for pre-European Māori in Northland and supported one of New Zealand's first commercial fisheries, notably in Kaipara Harbour. The abundance of mullet led European settlers to establish canning factories in the mid-1880s, the product being sold locally and exported. Both fishing and canning declined towards the end of the nineteenth century, and the government asked the eminent scientist Sir James Hector to examine this fishery, with particular reference to the need for a closed season. It was one of the first marine fisheries to be 'investigated' in New Zealand, and the lack of information on mullet biology limited the conclusions Hector could draw. Now, over 100 years later, the same mullet fishery (with associated Kaipara Harbour fisheries) is once more under scrutiny as catches decline. Again, there is insufficient knowledge of mullet biology on which to base an estimate of the sustainable yield, or from which to make an informed judgement on whether Kaipara Harbour mullet can be managed separately from those in coastal waters and adjacent harbours. We can still echo Hector's statement 'there is a great want of accurate information still required on the subject'.

KEYWORDS: New Zealand, mullet, *Mugil cephalus*, fishery collapse, fisheries management, Kaipara Harbour, history, new species record.

Introduction

Grey mullet – *Mugil cephalus* Linnaeus, 1758 (Fig. 1) – provided an important food resource for pre-European Māori in Northland, who caught the fish as required and also dried large quantities for winter use. The abundance of mullet in the region led European settlers to establish a mullet fishery, and canning factories were operating on the Kaipara Harbour by the early 1880s (Fig. 2). Following requests from fishermen, in 1886 the government established a closed season during December, January and February to protect the fish stock during the presumed spawning period. However, within a decade, competition between rival canneries and fishermen resulted in claims of a further decline in the fishery and calls for an extension of the closed season. Sir James Hector, Director of the Geological Survey and Colonial Museum, was asked by the government to examine the fishery in 1895–96. The lack of baseline information on the biology of mullet, and even the uncertainty of correct identification of the species taken, limited the conclusions that could then be drawn. An extension to the closed season was gazetted, then immediately revoked. Hector recommended further investigations, but the government directed resources into other research, such as experimental trawling and artificial propagation of foreign species to enhance the country's fisheries, and the mullet fishery was largely ignored over subsequent

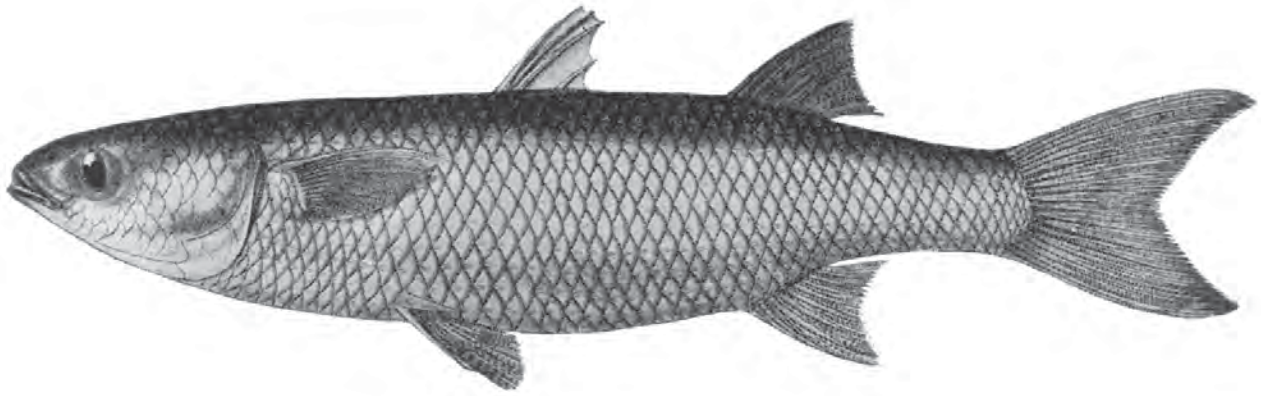

Fig. 1 Grey mullet, *Mugil cephalus*, is widespread in temperate waters; in New Zealand, the species occurs north of Cook Strait (after Scott 1962).

decades. Even today, little is known of the basic biology of *M. cephalus* in New Zealand waters. Fundamental issues such as the proportion of the population occurring on the open coast outside the harbours, and movements of fish between the open sea and the Kaipara and other Northland harbours, are unknown. Management of these mullet fisheries, without information on fish movements and regional mixing or distinction of populations is, at best, problematical. Hector's observation in 1897 that 'there is a great want of accurate information still required on the subject' is still valid today.

Kaipara Harbour, situated on the northwestern coast of North Island, is the largest enclosed harbour in New Zealand, and one of the largest in the Southern Hemisphere. It supports several interlinked harbour fisheries. In 2004, following a period of declining catches and disagreement between fishers as to the cause, discussions were held over the merits of developing a community-managed fishery centred on the Kaipara Harbour. The Ministry of Fisheries would formally manage the fishery, but decisions would more clearly be based on consultation with recreational fishers, Māori customary fishers, and commercial fishers using the harbour's resources. The Kaipara Harbour would somehow be allocated a quota of the mullet *Mugil cephalus*, separate from the quota for the mullet Fishstock in adjacent harbours and coastal areas outside the harbours in northern New Zealand (GMU 1). (A similar concept could be applied to the harbour's other main species: snapper, rig and flatfishes.) In theory, this would protect the harbour from the incursions of commercial fishers holding quota (Total Allowable Commercial Catch, TACC) in the wider Quota Management Area (QMA), who reportedly cause periodic local depletion in the harbour fishery by concentrating their fishing effort there, with severe impacts on local recreational and customary fishing in particular (Ecologic Foundation 2001: 20). This proposal, however, is based more upon management of the fishers rather than management of the GMU 1 Fishstock over its arbitrarily defined distribution. Such a management regime conflicts somewhat with the basic concept of the Quota Management System (QMS), which manages Fishstocks while allowing the economics and local social issues of fishers to sort themselves out. However, the grey mullet fishery is somewhat unusual in that the northern Fishstock, GMU 1, provides over 95% of total landings of the species; some subdivision of it may now be appropriate.

Fisheries managers will face difficult decisions. Although the mullet fishery is monitored through catch per unit effort (CPUE), with some further work on age and growth, much basic biological information is unknown, and only limited research on abundance and productivity has been proposed (Ministry of Fisheries 2004: 23). If subdivision of quota is seriously considered, Kaipara Harbour has an advantage in comprising a separate Fishing Statistical Area (044), distinct from all areas outside the harbour, and from Manukau Harbour to the south (043). These statistical areas are not part of the QMS, but are used in the complementary official, more detailed, records of catch and fishing effort. Theoretically, the ministry could use them to reallocate GMU 1 quota, creating a 'Kaipara Harbour Unit', although there may be legal

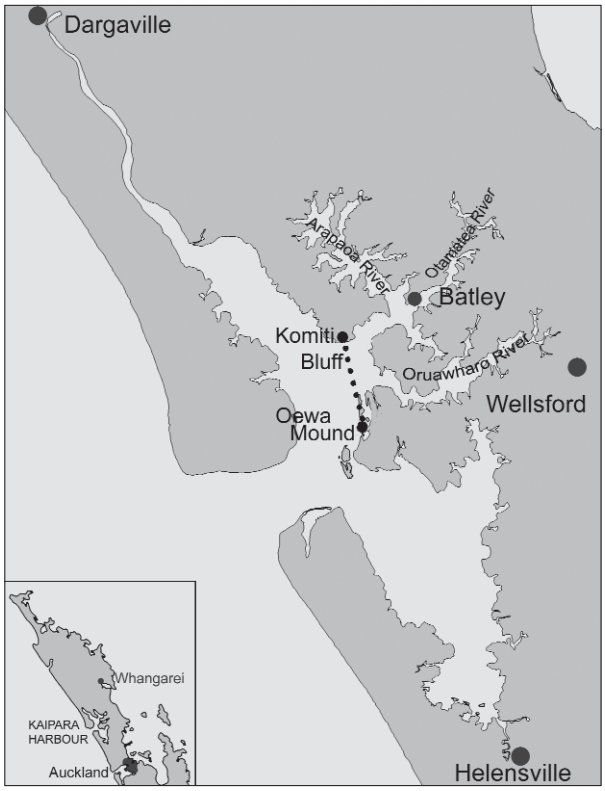

Fig. 2 Kaipara Harbour, Northland, New Zealand. The closed season for mullet applied to the harbour area 'inside a straight line drawn from the trigonometrical station on Oewa Mound to the trigonometrical station on Komiti Bluff'. The precise locations of the mullet cannery at Rangiora, on the Otamatea River, and the Masefield factory at Helensville are unknown.

constraints to this procedure. This might provide a mechanism for local management of the fishery, but it would not in itself attempt to prevent localised overfishing of the Fishstock, particularly within Kaipara Harbour where traditional and recreational fishers, being less mobile, can have a relatively greater impact on their 'local' fish.

A community-managed fishery will also have the complication of conflict between 'local' and 'visiting' fishers over who has right of access. This is an issue that has been debated widely in many fisheries, and in particular among those associated with the Kaipara Harbour fishery, in common with many other fisheries – for many years. The combination of excess quota (the GMU 1 TACC has been 5–40% above landings since 1990) and large size of the GMU 1 Fishstock (QMAs 1 and 9 combined) has led to the development of a mobile fleet of set-netters capable of depleting entire harbours to low stock levels of targeted species. Discord between mobile and local fishers increased in the 1960s, as trailer-boats became more commonly used by commercial and recreational set-net fishers. The activity of some mobile fishers has been to the detriment of local communities, non-commercial fishing interests and sometimes local commercial set-netters, and is a continuing cause of disharmony. Local fishers may maintain that it is 'their' harbour, that fishers from other areas are unwelcome 'invaders', and that it is their right to manage the harbour fishery to their own advantage. Visiting fishers may argue, however, that they harvest the entire stock on a rotational basis, moving between areas when catches fall in order to prevent localised overfishing, and that local fishers are the main cause of stock depletion in their own area. In practice, a 'Kaipara quota' could be issued to Kaipara residents, but the qualifying boundaries would necessarily be based on historical fishing rights, as these are the basis of the Individual Transferable Quota (ITQ) fisheries management system. The quotas are permanent but are restricted to a given species and location, and visiting fishers who have fished the Kaipara for many years must now be considered as much 'local' as are the actual residents.

The lack of baseline information on the biology of mullet in 1895–96 limited the conclusions that could be drawn then by the investigator, Sir James Hector. Today, the same mullet fishery, with associated fisheries for other species in the Kaipara Harbour, is again under scrutiny. Once again, there is insufficient knowledge about mullet biology, despite the passage of time and the fact that *Mugil cephalus* is a very widespread species in the world's tropical and temperate waters. Recent studies on the species elsewhere have focused on aquaculture aspects.

Māori fishing

Māori evidently first inhabited the Kaipara area in the fourteenth century (Buck 1949), and by the 1800s the harbour and surrounding forests were heavily populated and supported a substantial proportion of the total Northland/Auckland Māori population (Ngāti Whatua and Ngā Puhi; estimated at around 20,000) (Davidson 1978: 1). This population may have decreased 50% or more by the 1890s from disease and emigration following land alienation (Wai 022 1988: 62; Wai 045 1997: 34; Ward 1997: 1).

Māori were dependent upon the sea because of the limited horticultural resources available and local depletion of forest birds. Archaeological evidence shows that fishing

was a regular subsistence activity from the earliest dates of Māori occupation (Davidson 1984: 25), and large quantities of fish were dried for storage (Colenso 1869: 9; Hamilton 1908: 71) and trade (Colenso 1869: 17). As in other areas of New Zealand, in Northland Māori used lines and nets (Fig. 3) made from New Zealand flax (*Phormium* sp.) that were considered much superior in quality to those of the Europeans at the time (Savage 1807: 64; Nicholas 1817: 235; Polack 1838: 24–25; Cook *in* Beaglehole 1955: 456), and they regularly supplied European explorers and settlers with fish (Sherrin 1886: 3, Cook *in* Beaglehole 1955: 177, 195; Forster *in* Hoare 1982: 302).

> … after having a little laught at our seine, which was a common kings seine, shewd us one of theirs which was 5 fathom deep and its length we could only guess, as it was not stretched out, but it could not from its bulk be less than 4 or 500 fathom. Fishing seems to be the cheif business of this part of the countrey; about all their towns are abundance of netts laid upon small heaps like haycocks and thatched over and almost every house you go into has netts in its making. (Cook *in* Beaglehole 1955: 444)

> Their food in these parts of New Zealand consists chiefly of fish, which they very dexterously perform, either by letting down their nets or fishpots, or by hook & line; … They caught not only a sufficiency for their own consumption, but frequently brought large quantities of them to both our ships. (Forster *in* Hoare 1982: 302)

> The fishing nets of the people are often of an enormous extent, and are generally made, by each family in a village … many of these seines, which are the common property of a village, are one thousand feet in extreme length … The nets are very strong and the hekaho, or fishing lines, are infinitely stronger, and fitted to bear a heavier strain, than any made from European materials. (Polack 1838: 24–25)

There are few detailed or anecdotal records of fishing activity by Māori within Kaipara Harbour. Māori fished for mullet in all the northern harbours throughout the year, but at Kaipara the main fishery was on the ocean coast during late autumn and early winter when the fish were full of roe (Hector 1897: 2). Large numbers of fish were also taken inside the harbours and smoked or dried for winter use as reported by Yate (1835: 71) and Sherrin (1886: 57).

> … tribes go together to the little creeks where these fish frequent, and always succeed in capturing some hundreds of thousands before they return; the greater part of which they preserve for winter stock. They always catch them in the darkest nights … with their nets which are several hundred yards long, and drag them in vast numbers to the shore. (Yate 1835: 71)

> The Natives frequently capture them [grey mullet] on still, moonlight nights by paddling their canoes close to the banks of the streams; the fish are startled by the beat of the paddle, and, leaping up, fall into the canoe. (Sherrin 1886: 52)

Fig. 3 Māori used long-handled scoop nets to catch mullet off ocean beaches, similar to nets used for kahawai (photo: Te Papa, negative A4070 by J. McDonald).

At Kaipara Harbour, mullet were one of the important fish species for Māori, and their presumed extensive use appeared not to diminish the supply.

> The natives used largely (and of late years to less extent) to fish on the outside coast in the winter time, not in summer. The fish come close in shore in great schools during easterly winds. They are closely crowded together, with their noses protruding from the surface of the water, while they feed on brown scum that drives off-shore. The natives, armed with a long net, stand 6ft apart, and, at the proper time, dart into the water and surround the fish on the shelving beach, enclosing them in the net. In this manner enormous quantities are taken. They are all of one size, large and with firm flesh, being much superior to any taken within the harbour. In early winter (April and May) the fish are often greatly distended with fully-developed roe. The beach fishing is so important that it is subdivided and marked off by stakes, a section being allotted to each hapu or section of the tribe. (Hector 1897: 4)

> … they scoop the fish onto the beach out of the surf in large quantities … The largest hauls taken in this way are some 200 dozen, and the nets often break with the strain … The Maoris state they have seen shoals of mullet from 1 to 2 miles in length and covering a very considerable width, the surface of the water being quite black with them. (Sherrin 1886: 54)

Māori fishers seized the opportunity to supply Europeans with food and were the main providers of fish to the developing European settlements in the early nineteenth century. Polack (1838: 196–203) observed large Māori fishing parties, often involving several villages, while in 1885 Mair reported the use of 'a huge seine 95 chains (2,090 yards) in length – over a mile in length … [which] … not less than a thousand persons were unable to haul' (Best 1986: 11). Matthews (1911: 558), meanwhile, recorded an account of shark fishing in 1855 involving some 1,000 tribal members. However, by 1910 these large-scale fishing expeditions virtually ceased (Wai 022 1988: 91). The gradual decline in Māori fishing activity occurred during the mid- to late nineteenth century, when European food crops (e.g. wheat, maize and potatoes) and domestic stock (e.g. goats, pigs, sheep and cattle) became available for growing and rearing by Māori, who adopted a more agricultural lifestyle.

European settlement and establishment of a mullet fishery

The northern harbours of New Zealand were rapidly developed by European settlers and traders because of the ease of access the waterways provided to large areas of hinterland

Fig. 4 Advertisement for Ewing's canned mullet, from Sherrin 1886 *Handbook of the Fishes of New Zealand*.

in all weathers, and a number of major ports were established at Kororareka (Bay of Islands), Auckland, Manukau and Kaipara. The first Europeans ventured into the Kaipara in the early 1800s, seeking timber (kahikatea and kauri) spars for their sailing ships. Missionaries, including Samuel Marsden and the Rev. James Buller, also visited the area, establishing a mission at Okara Point Pa in 1820. The timber mills flourished, and large quantities of wood, both sawn timber and logs, were exported by ship. By 1840, European settlers had established farms and introduced new crops. However, by the end of the nineteenth century the accessible timber resources had been exhausted and emphasis in trade shifted to the export of kauri gum.

The increasing trade led to an influx of shipping that at one point made the Kaipara the busiest harbour in the country. The abundance of fish within the harbour was obvious, and settlers were keen to develop and diversify new industries based on the largely unexploited fish stocks in and around coastal waters. In 1885, McKenzie presented a paper to the government on the development of colonial industries and noted the abundance of fish:

> … the whole [Kaipara] harbour from Helensville, at one end, to Aratapu, at the other end, a distance of over 80 miles, seemed to be actually swarming with the largest and finest mullet in the world. (McKenzie 1885: 1)

Until the 1870s, canned, potted and smoked fish were regularly imported into New Zealand and available in all coastal towns. About that time, an increasing number of local fishermen were beginning to supply fresh and cured fish, although the lack of suitable inland transport

Fig. 5 Masefield Brothers canning factory at Russell (photo: Alexander Turnbull Library, Wellington, N.Z.; ref. No. F-52135-1/2. Reproduced here with permission).

restricted the distance fresh fish could be sent. An early Kaipara settler, P.W. Barlow, commented:

> I feel confident, however, that the fishery here only wants capital to develop it, to become one of the great industries of the north Kaipara. Its land-locked waters swarm with the finny tribe, and can be fished with impunity in any weather … Schnapper … can be caught line-fishing in the Kaipara, at the rate of sixty or seventy an hour per line of two hooks, and of an average weight of about 9 lbs [4.5 kilograms] each … (Barlow 1888: 130)

Because grey mullet were abundant and easy to catch, they soon became a popular food among the European settlers. Unlike many of the 'new' varieties of New Zealand fish available, the grey mullet *Mugil cephalus* occurs throughout the world; hence, they were familiar to many European settlers and more readily accepted:

> … the harbours abound in fish – abound is a poor word for it: they are literally alive with fish. M—— and myself now live almost entirely on them at evry meal; they are delicious, and in great variety. We have a fish here exactly like the salmon, and of as good flavour. On a sunny morning the surface of the harbour is a complete mass of fishy life. (Earp 1853: 105)
>
> The Kaipara waters swarm also with several other varieties of fish … mullet, resembling in appearance the grey mullet of the old country, but far richer and superior in flavour, are very plentiful during the summer months … are here in great numbers, and can be caught with a net in boat loads. (Barlow 1888: 132)

Fresh mullet were readily available in the Auckland markets, which were supplied by small boats operating in Manukau Harbour and Hauraki Gulf.

> … grey mullet is a very familiar fish to residents of the northern part of the Colony, where it forms a staple article of food among the natives at certain seasons, and is one of the commonest fish sold in Auckland. (Sherrin 1886: 52)

Fig. 6 The 26-ft mullet boat *Celox* under sail (photo: Kinnear Collection, Alexander Turnbull Library, Wellington, N.Z.; ref. No. PAColl 3053. Reproduced here with permission).

However, lack of refrigeration and rail transport from areas further north such as the Kaipara, Hokianga and Bay of Islands prevented any large-scale commercial fishery from developing until some means of preserving the fish was available (Johnson 2004: 50). Mullet were considered to 'excel all other New Zealand fishes in richness' and initially fish were processed locally, where they were cleaned and flattened out, then dried and smoked for 24 hours. Carefully packed in layers within boxes, mullet could then be transported and sold in Auckland, where several establishments canned the fish (Sherrin 1886: 52). Although this tinned product was highly esteemed (Fig. 4), it was considered inferior to freshly smoked and canned mullet:

> … there is no New Zealand fish which can be put up in tins fresh so well as the mullet. Its oily and rich nature makes it a general favourite with the public, and many epicures pronounce the fish quite as good as the salmon, and superior to any other smoked or put in tins. (Munro *in* Sherrin 1886: 55)

The first Northland mullet cannery was established at Whangarei in the early 1870s, but it was not until 1883 that John Masefield established a canning plant at Helensville on the Kaipara. 'Prior to that there was no systematic fishing by white folks' (Masefield, pers. comm. to James Hector, *in* Hector 1897: 5). Three factories were soon established on the Kaipara (Rangiora, Batley and Masefield), with others scattered through Northland. One of the main factories (see Fig. 5) was operated by Masefield Brothers. Initially, local Māori supplied fish for the new canneries, but soon each factory was employing up to five or six European boats (Fig. 6) and fewer Māori were involved.

> The Natives are the only fishermen who bring supplies (of mullet) to the factory … they have a net made of New Zealand flax, and one of the Natives takes the end of it and wades out through the surf up to his neck, and in this manner surrounds a lot of fish. Then three or four other Natives spread along to assist him, and by their

> united effort they scoop the fish onto the beach out of the surf in large quantities. (Sherrin 1886: 54)

The European boats (fast, shallow-draught yachts) were developed specially for the mullet fishery, and were (and still are) called 'mulletboats' or 'mulleties'. The boats used seine nets that were 350–450 m long and 1.5–1.8 m deep, and shot around a school in a semicircle. Sometimes fishermen joined forces – and nets – to create a 900-m barrier (Patrey, pers. comm. to James Hector 1896, *in* Johnson 2004: 50). By adjusting the weights, nets could also be used as drift nets or even joined, one above the other, to fish in deeper water (Ewing, pers. comm. to James Hector 1895, *in* Hector 1897: 7). By the mid-1880s, the canneries were well established and productive, and were featured in the New Zealand Industrial Exhibition in 1885:

> Masefield and Sons, Helensville, Kaipara, have a nice display of the celebrated New Zealand tinned mullet. Four fishing boats are employed regularly in this industry, the fish being found in unlimited quantities. Four hundred dozen are preserved every week, seventeen hands being employed in the canning factory and five in the tin smiths' shop. (Anonymous 1886: 5)

Mullet was processed all year, with no allowance for protecting the breeding stocks during the spawning season. Initially, catches were limited by the amount that could be processed, but subsequent opening of the Helensville–Auckland railway in 1881 greatly increased the potential market that could be supplied, and many expressed hopes of expanding the fishery:

> … thousands are to be seen in all the creeks … at night one can hear them swarming … Six months ago I got 300 dozen in one haul, of which I sent 180 dozen to market. About 500 dozen is the biggest haul of fish ever caught in Kaipara. During the close season … the fish accumulate in the Otamatea arm and its branches … when the canneries resume work enormous hauls are made, such as 400 dozen to 500 dozen per week to each boat. (Patrey *in* Hector 1897: 5)

> … at Kaipara … there would not be the slightest trouble in doubling the output were there a ready market for the canned fish. On average one mullet is put up in each tin … canning now between 500 and 600 dozen mullet weekly; we are also smoking them. (Masefield *in* Sherrin 1886: 55)

Perceived fishery decline

Although fish were available for most of the year, an unofficial 'closed season' was observed in late January and early February when warm temperatures limited fish processing. The canneries provided employment for many of the local population (Fig. 7), and the closed season was an opportunity for holidays, and to repair nets and boats.

Catches fluctuated for no apparent reason and ranged from 58,000 to 83,000 fish annually, with the highest catch in 1894. Fishermen expressed concerns about the effects of pollution from sawmills and disturbance of the fish by paddle steamers, but these were considered minor and unlikely to affect the fish stocks long term. There was no management or monitoring of the fishery, and as early as 1886 Sherrin had noted considerable wastage within the industry: '… unless the fish are carefully canned the loss is very great … consignments in which at least 50 per cent turned out bad. The roes are thrown away' (Sherrin 1886: 55). Eventually, the mullet fishermen petitioned government to have the fish protected, and an official closed season for mullet was established by Order in Council in October 1886 for the whole of the North Island. However, in 1888, this closed season was amended and restricted to a small portion of the Kaipara Harbour, 'inside a straight line drawn from the trigonometrical station on Oewa Mound to the trigonometrical station on Komiti Bluff [= Arapaoa, Otamatea and Oruawharo rivers]' (*New Zealand Gazette* 12 January 1888). (Oewa Mound is not listed as a New Zealand place name, but was located at 30°21.5' S, 174°15.5' E using the 1891 London Admiralty Survey Chart 2614 'Kaipara Harbour' (Alexander Turnbull Library MapColl 832.11aj/1891/Acc.42717). The topographical feature seems to have been a sand dune that does not appear on current topographical maps and has possibly been eroded away since 1891.)

Although some observers were commenting that the fishery required careful management, others claimed there was no apparent decline in overall mullet numbers. In 1895, many reports stated that mullet were scarce and the fishing was not as good as in previous years, but all expected the season to improve later in the year (Hector 1897: 12). Eventually, in response to further complaints to the government from rival canning factories in 1895 that stocks were being overexploited, Sir James Hector, Director of the Geological Survey and Colonial Museum, was asked to conduct an inquiry.

Fig. 7 Fish processing in a Northland factory *circa* 1920 (photo: Northwood Collection, Alexander Turnbull Library, Wellington, N.Z.; ref. No. PAColl 3077. Reproduced here with permission).

Sir James Hector's investigation

Sir James Hector's investigation was directed at the theoretical issue of having a closed season for the period during which mullet spawn, and the practical issue of preventing wastage of spent fish. Thus, although the 'mullet fishery controversy' dated back to 1885, the official terms of reference for the 1895 investigation are not included in Hector's report and the scarcity of mullet was only one of several points at issue. A telegram from the Marine Department to Hector (Museum of New Zealand archives MU000095/010/0096) asks Hector 'to be good enough to proceed to Kaipara, Bay of Islands, Hokianga and Whangarei to inquire into and report upon the most suitable time and period for a close season for mullet'.

As a pre-eminent scientist and an early Director of the Geological Survey and Colonial Museum from 1865 to 1903, Hector was frequently called upon by the government for scientific (and other) advice (Dell 1990). Hector reported, as an independent (although government-funded) scientist, to the Marine Department, which at that time had little or no scientific expertise in marine fisheries. Judging from his report and letters to the local newspaper, Hector appears to have been well received by most of the mullet fishers and canners he questioned, and was referred to more than once as 'a great man' or expert (albeit, not always in a complimentary way!).

Hector began his investigation in October 1895 but noted that it was not possible to assess the fishery properly on the basis of a single year's study. His report *Protection of Mullet* contains much information of interest and relevance to understanding mullet movements and the mullet fishery, both then and now. Although the incentive for the investigation was driven by a perceived decline in the fishery, Hector's primary interest was to ascertain whether

or not it was necessary to protect mullet within the Kaipara during the summer spawning season: '(1) To prevent the fish, while reproducing, being disturbed by fishing operations; [and] (2) to protect fry during development'. A third issue was involved: '(3) to prevent the market from being supplied with spent fish that are unfit for food.' Hector's brief appears to have been to determine whether the closed season was necessary, and whether it included the most appropriate months. His conclusion was that it was unnecessary, as the mullet moved out to sea to spawn, where there was little or no fishing, and consequently the argument over appropriate months was irrelevant. The 'spent fish issue' appears to have been real, but confused by rivalry between canning companies.

> … when Mr. Monk told them [Māori elders] that Government were going to protect the kanae from being destroyed or lost they were greatly amused, and asked how it was that when there were many more Māoris than there now are in Kaipara, and who fished for and lived on the kanae all the year round, the fish did not lessen in numbers … mullet … congregates along the coast in enormous schools. These used to be captured in large quantities by the Māoris with seine nets … the influence of the canneries has been greatly exaggerated, as since the commencement of the factories, or about fifteen years, the total number of fish taken, allowing 10 per cent for loss and waste has not exceeded two million fish … In former years, when the waters of the Kaipara were navigated by only the silent Māori canoe, the consumption of fish was probably as great as now, but the disturbing influences were less. (Hector 1897: 4)

Of the three factories established in the Kaipara Harbour at the time, one reported processing 4,840–6,940 dozen fish per year from 1884 to 1894, while the others reported processing 3,067–6,840 dozen fish per year, but did not operate every year. In 1895, the factories reported a 'bad season', when only 3,500 dozen fish were processed in eight months, while in 1896, despite the use of a smaller mesh size in nets from 1895 and nets of double the length, catches were no higher than the previous year. Significantly, it was reported to Hector, shortly before he submitted his report to the government, that smaller, non-spawning fish were the only ones taken once the smaller mesh nets were used, as the larger fish were 'very scarce and in deep water' (Hector 1897: 12).

Hector visited the area twice and travelled throughout Kaipara and Hokianga, as well as investigating landings at other ports around Northland and Auckland, and collected observations from fishermen, canners and local harbourmasters:

> 'Hardly ever seen fish leaping in numbers, except when the 'Osprey' is laid up. He thinks the paddle will drive them away, especially by stirring up the mud.'
>
> 'Never see such abundance now, and attributes the decrease to the steamer having frightened the fish entering the harbour channels.'
>
> 'It is the scales of the fish (not offal) that will drive the fish away … One of the chief causes of the frightening and driving of the fish is the use of the paddle steamer 'Osprey'. The fish are all cleared out of the channel she follows.'
>
> 'Have seen many fish killed with sawdust in the rivers.'
>
> 'The natural enemies of the mullet are shags and kahawai, which destroy them in great numbers … the steamer scatters the fish, but they are like sheep, and gather again in mobs.'
>
> 'The wind has more to do with them than anything else …with south-west wind the fish are caught in great quantity. With easterly weather the fish keep to the deep channels and none can be caught.' (Statements of evidence, *in* Hector 1897: 4–8)

Hector's report comprised (1) a summary of findings ('Memorandum re Close Season for Mullet'), (2) summaries of the evidence (from fishers and cannery operators) heard or received in written form by Hector; and (3) reprinted newspaper extracts and letters to the editor. Subsequent sections of this paper present the contents of Hector's report in more detail and discuss them in a wider context.

Identification of the mullet stock

While Hector admitted that 'there is a great want of accurate information', he was able to conclude that the mullet spawned in the open sea. He noted the fact that ripe mullet ova sank in sea water, indicating they were 'demersal', and that fish inside Kaipara Harbour were mostly three years old with undeveloped sex organs. Thus the breeding fish did not occur within the harbour and therefore were not subject to disturbance by fishing operations, which led Hector to suggest that the fishery had 'little sensible effect on the supply'. Hector recognised the importance of protecting the breeding grounds, but the lack of biological information and only anecdotal evidence of a decline in the fishery led to his conclusion that further investigations were needed.

The reproductive biology of grey mullet, *Mugil cephalus* (Fig. 1), has been well studied overseas, where the species occurs in coastal areas, estuaries and rivers between latitudes 42° N and 42° S (e.g. Thomson 1963, 1966; Pillay 1972; Johannes 1978; Whitfield 1990; Chang et al. 2000; Watts & Johnson 2004). However, only limited research has been carried out in New Zealand. Grey mullet spawn at sea, running-ripe females having been caught only off coastal beaches or in offshore waters. Their eggs and larvae are a component of the offshore coastal plankton at certain times of the year. Young fish may enter fresh waters at an early age (40–50 mm long) and are found in shoals, especially in the larger rivers and brackish estuaries of northern New Zealand (McDowall 1978, 1990). Fish mature at three years at an average size of 33 cm fork length (FL) (males) and 35 cm FL (females), and live to a maximum age of 14–17 years, reaching 60 cm in length (Hartill 2004).

Grey mullet typically breed during autumn to winter months in Australian (Kailola et al. 1993; Yearsley et al. 1999) and New Zealand waters (Ayling & Cox 1982; McDowall 1990). In contrast, Hutton (1872: 36) noted a summer spawning period, reporting that mullet in the Waikato River migrated to sea in November to spawn and returned in March. Hector concurred with Hutton, stating the 'evidence I have collected quite supports this statement' but went on to state that 'spawning takes place in the open sea at two seasons of the year – summer and winter; and that this difference probably represents two distinct species of mullet' (Hector 1897: 1).

In his evidence, Hector further commented on the two varieties of mullet within the fishery:

> The evidence … clearly indicates that there are at least two different and distinct varieties of mullet, but whether these are distinct species, or seasonal, sexual, or only younger and older individuals has not yet been made clear. First we have a mullet that feeds in the ocean, and congregates along the coast in enormous schools. These used to be captured in large quantities by the Maoris with seine nets, which were dragged on the sandy beach. They are late in their sexual development, female fish in roe being caught up to April and May, corresponding in this respect with the grey mullet of the Australian coast … These fish sometimes enter Kaipara Harbour in large schools, following the clean salt-water of the flood-tide up the deepest channels and returning again with the ebb … This variety of mullet is known to the fishermen and settlers as the 'clean-gut', 'clean-run' or 'sea-mullet'. They are always of large size, and whenever caught, at whatever season of the year, they are in prime condition.

Hector described the 'clean-gut' mullet as a 'large blue-backed kind that are rarely seen inside the harbour'. The second variety Hector referred to was known as the 'settler' or 'muddy fish'.

> The other variety ['muddy fish'] … when opened they are not clean and bright, with the stomachs and intestines apparently empty, as in the case of sea-fish, but are full of slimy mud, the strong muscular pharyngeal stomach being distended with a mass of tough brown clay … the muddy fish are caught inside the harbour only … [and] are full of roe about the beginning of the year. (Hector 1897: 10)

Hector examined both 'clean-gut' and 'muddy fish' at the Bay of Islands and commented that the latter fish were 'different to those examined at Mr. Empsom's factory' the previous day. The 'muddy fish' was the only variety caught and examined by Hector during his visit to Kaipara the following week and he noted that they differed 'greatly from *M. cephalotus* [= *Mugil cephalus*], to which species the New Zealand grey mullet has been referred' (Hector 1897: 11, 12).

> After a school of … [clean-run] fish has entered the harbour they are frequently caught … along with the other variety, but the fishermen never have any difficulty in distinguishing them. Unfortunately, out of several large hauls they did not find one 'clean-run' fish for my inspection.

A second species of mullet, the yellow-eyed mullet *Aldrichetta forsteri* (Valenciennes, 1836) (Fig. 8), occurs throughout New Zealand (McDowall 1990: 278). Yellow-eyed mullet are extremely common schooling fishes of coastal waters. They are often found in estuaries and, like the grey mullet, may enter fresh water and travel several kilometres upstream. As with grey mullet, very little is known of the biology of yellow-eyed mullet in New Zealand waters. Spawning occurs at sea during the early summer months of November and December (Kingsford & Tricklebank 1991: 15), and the eggs are pelagic (Manikiam 1963 *in* McDowall 1990: 280). The species has also been recorded from cool temperate waters of eastern and western Australia, but these records probably represent a separate taxon that can be distinguished by having fewer gillrakers and larger scales (Whitley 1951: 66; Museum of New Zealand unpublished data). Yellow-eyed mullet is regarded as only a minor commercial species, with total

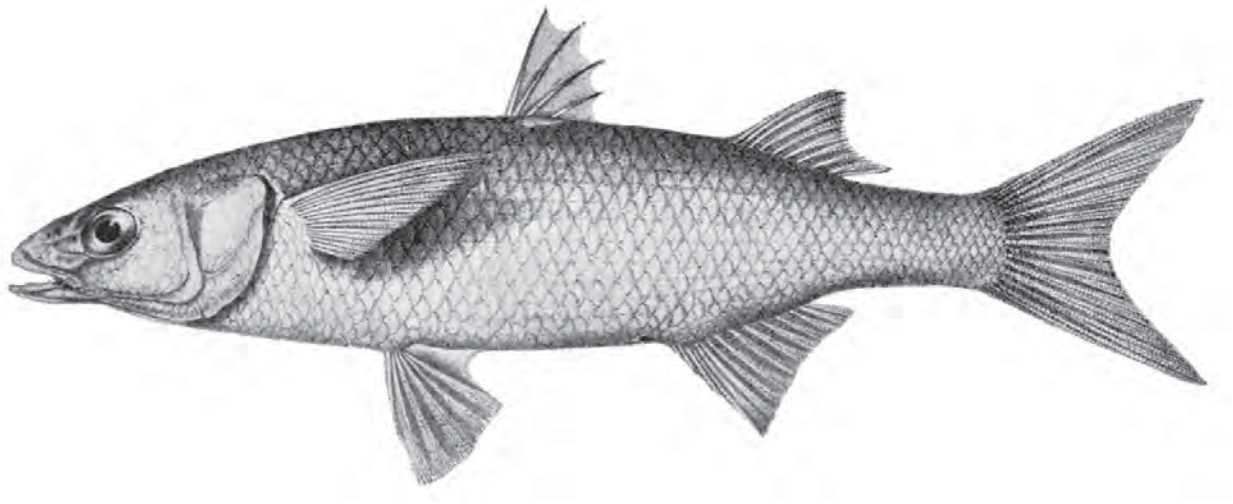

Fig. 8 Yellow-eyed mullet, *Aldrichetta forsteri*, is found throughout New Zealand and temperate Australian waters (after Scott 1962).

New Zealand annual landings (misleadingly listed as 'herring') generally less than 50 tonnes (Taylor & Paul 1998). Annual landings from the northwest harbours of QMA 9 (mainly Manukau) were less than 5 tonnes from 1934 to 1972, but rose to 60–70 tonnes in the mid-1980s before declining again. It is unlikely that significant quantities of this quite different species have been mistakenly reported as 'mullet' from the Kaipara Harbour.

Hector clearly was aware of the distinction between *Mugil cephalus* and *Aldrichetta forsteri*, the two recognised species of mullet in New Zealand waters, and commented to this effect on several samples presented to him from the Bay of Islands and from Kaipara that 'were supposed to be young kanae [grey mullet] but they proved to be small fry of the aua' [yellow-eyed mullet] (Hector 1897: 10, 12).

Hector noted differences in spawning condition of the two grey mullet varieties: the mullet taken 'in outside waters' at Russell, Bay of Islands, were 'in ripe roe, the spawn escaping freely on handling the fish', while of those examined from inside the bay at Pureroa, Bay of Islands, 'none showed any marked development of the reproductive organs', and specimens from inside Kaipara Harbour '[could] possibly spawn this season, but not for four months' (i.e. early winter or May). These differences prompted Hector to include detailed morphometric and meristic data for the two forms in his report. One form, which Hector referred to as 'the outside mullet', had 'broad flat heads with intensely black-blue back', and 43 scale rows and eight soft anal rays that correspond to diagnostic counts for *Mugil cephalus* (A III, 8; LL 37–43) (Thomson 1997). The second variety, referred to as 'muddy fish' that were 'caught inside the harbour only', had 45–46 scale rows and an 'extra soft ray in the anal fin'.

Hector described the 'muddy fish' from Kaipara:

> … snouts were rounded, not pointed, and the forehead was only slightly convex. They were light grey on the back, and the sides and abdomen were not brightly silvery, as in the black-backed kanae … Shape, profile of the head and back arched. The backward position of the first dorsal, the larger number of scales in the lateral and transverse lines, the extra soft ray in the anal fin, and few rays in the caudal fin, mark this as a distinct fish from those examined at Russell and in Wellington, and differing greatly from *Mugil cephalotus* [= *Mugil cephalus*]. (Hector 1897: 12)

The meristic counts of the 'muddy fish' given by Hector exceed the known range for *Mugil cephalus*, and are well outside the ranges for *Aldrichetta forsteri* (A III, 12; LL 58–62) (Thomson 1997).

The number of soft rays in the anal fin is diagnostic in species of Mugilidae. *Mugil cephalus* and four congeneric species have eight soft rays in the anal fin, while a further six congeners have nine soft rays (Thomson 1997: 480). Three species with nine anal soft rays have lateral-line counts that overlap Hector's 'muddy fish': two of these are tropical Atlantic in distribution and one is tropical Pacific (Galápagos) (Thomson 1997). Hector's description, however, does not provide sufficient detail to determine if his specimens belong in *Mugil*, or the closely related genera

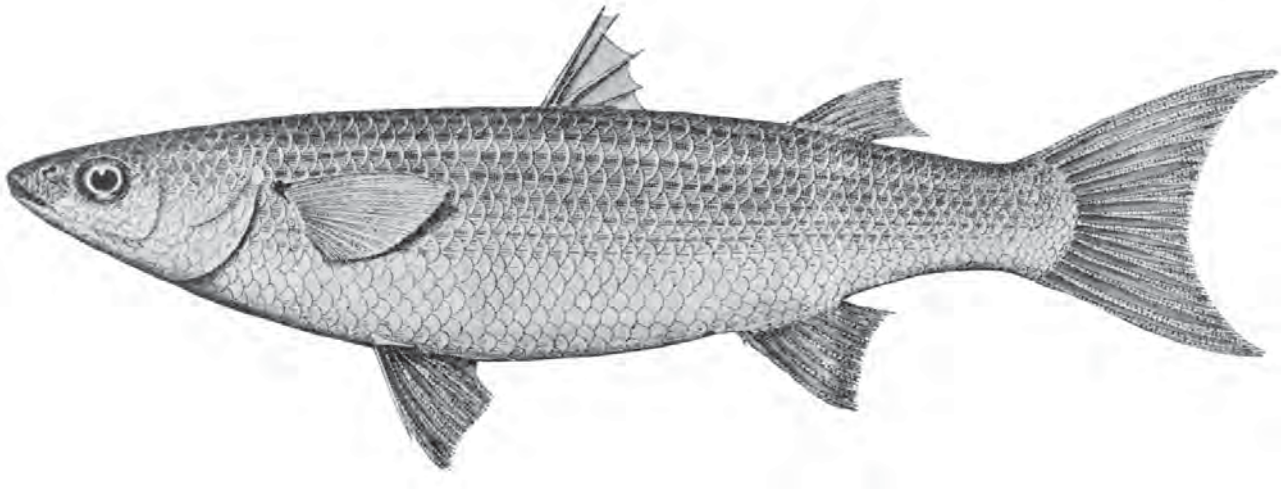

Fig. 9 Sand mullet, *Myxus elongatus*. The presence of this species in northern New Zealand harbours requires confirmation (after Scott 1962).

Valamugil, *Liza* or *Myxus*. Members of these latter genera differ from *Mugil* species in several character states, including the structure of the scales, relative positions of the nostrils, number and form of the gillrakers, the form of the preorbital structure of the maxilla, the extent of the jaw, the relative length of the paired fins and of their axillary scales, the number of pyloric caeca and the absence of adipose tissue covering the eye (Thomson 1997), none of which were noted by Hector. Significantly, however, Hector mentioned the presence of adipose tissue in specimens that can be identified as *Mugil cephalus*, but makes no mention of its presence or absence in the second 'muddy' form.

All known species of *Valamugil* have tropical distributions, and have nine soft anal rays and fewer than 42 scale rows. One species of the genus *Liza*, *L. argentea* (Quoy & Gaimard, 1825), is known from temperate Australian waters, but differs in having 10 anal soft rays and 35–38 scale rows. Two species of *Myxus* with nine anal soft rays are known from eastern Australian waters: *M. petardi* (Castelnau, 1875) differs in having 47–50 scale rows (Thomson 1997); however, *M. elongatus* Günther, 1861 (Fig. 9) has 43–46 (Thomson 1997), and thus falls within the range given by Hector for the 'muddy fish' variety.

In descriptions of the grey mullet *Mugil cephalus* from New Zealand, McDowall (1978: 138, 1990: 280) recorded anal soft ray counts of '8 or 9', which raises the possibility that his descriptions were based on mixed samples. Unfortunately, these descriptions cannot be verified because of lack of voucher material. McDowall (1978: 139, 1990: 281) observed that Whitley in 1956 had suggested that 'populations of grey mullet in Australia and perhaps also New Zealand belong to a distinct species', and commented that this view was not widely supported. (We note here a citation error: 'Whitley 1956a' in McDowall (1978) is correct, but in McDowall (1990) it should be '1956b'. We also note that our 'Whitley 1956a, 1956b' citations are not the same as McDowall's.) Whitley (1956b) referred New Zealand grey mullet to *Mugil broussonetii* Valenciennes, a rare species known only from the type specimens and restricted to the western Pacific (Thomson 1997). Although *M. broussonetii* has nine soft anal rays, the low scale row count (36–37) precludes identification of Hector's specimens with this species.

Thomson (1997) reported that identification characters for mullet species can be used confidently only with adult specimens. No large specimens from Northland harbours are held in Museum of New Zealand collections, and Roberts et al. (in press) record only two species of mullet (*Mugil cephalus* and *Aldrichetta forsteri*) from New Zealand waters. The presence of a possible third species requires further investigation. Because Hector's description of the 'muddy fish' species lacks details of characters that are now considered diagnostic (Thomson 1997), the exact identification of a second grey mullet species in the New Zealand fishery cannot be confirmed without voucher specimens.

The description and meristics of Hector's specimens preclude their identification as *Mugil cephalus* or *M.*

broussonetii, but closely match those of *Myxus elongatus* and *M. petardi*. Both *Myxus* species occur in temperate eastern Australian waters, and *M. elongatus* is also known from Lord Howe Island. *Myxus petardi* occupies a more freshwater habitat than other mullet species in Australian waters (Allen et al. 2002), a habitat similar to that of the 'muddy fish' noted by Hector, and McDowall (1990: 282) also noted 'Some grey mullet never enter fresh water at all.' Wells's (1984) work on the food of grey mullet, *Mugil cephalus*, in Lake Waahi and the Waikato River at Huntly is the only detailed study of the diet and ecological significance of the species in New Zealand waters. Again, regrettably, Wells did not retain voucher material. Because of the possible presence of an unrecognised *Myxus* species, careful examination and identification of specimens used in taxonomic, ecological and fisheries studies is necessary.

Government regulation

By the mid-nineteenth century, the government was beginning to realise that fisheries were not inexhaustible, and in 1865 Henry Sewell asked in the House of Representatives that a select committee be appointed to consider the protection of fisheries (Johnson 2004: 55). The Marine Department was responsible for New Zealand fisheries and, from 1877 to 1885, sea-fishery legislation was primarily concerned with protection of sealing and oyster fisheries. Mullet were among the first finfish to receive some management attention. The closed season for mullet from December through February established in 1886 followed representations by fishermen to government, but the parliamentary record provides no details or reasons. It was restricted two years later to a small portion of Kaipara. This change to a smaller area suggests that it was based on the erroneous assumption that the mullet breeding took place within the harbour, in streams and inlets where the juvenile fish were observed. Hector (1897: 2) noted that 'In summer, on the banks especially off Komiti Point they [mullet] run up and down into the furthest extension of the tidal rivers and creeks, as is generally supposed, for the purpose of depositing the spawn … but, so far as I learnt, no one has ever seen them actually spawning', and that this opinion was based on the fact 'that the muddy fish are in full roe at the beginning of the year …[and] that great swarms of young fish are seen in the tidal creeks in autumn and winter'. Hector commented that 'Observers have hitherto been misled by a supposed analogy to the salmon in the spawning habits of the mullet' and expressed his doubts that mullet spawned anywhere inside the Kaipara and certainly not in the 'soft slimy mud which forms on the banks of every stream … during the short time of flood tide', although he did allow the possibility of spawning on banks of shelly sand in the outer harbour that were not exposed at low water.

The closed season did not have a major impact, as most fishermen repaired nets and boats during this time, and the factories had difficulties as fish deteriorated in the warm temperatures before they could be processed. Also, if fishermen wanted to catch mullet they could claim they were fishing outside the closed part of the harbour. Some fish were taken if cool weather permitted it, particularly by those fishermen in proximity to the railway at Helensville, who could more easily get fish to the Auckland markets in good condition. It was resentment of this by other fishers, as well as a perceived decline in the fish stocks, that led some fishermen and canneries to petition government in 1893 for an extension of the time of the official closed season to include March, and to extend the area covered by including the entire harbour.

Based on the premise that mullet bred at sea, Hector considered that there was little reason to impose restrictions on the fishing within harbours. Hector urged that protective legislation should be aimed at protecting the fish from fishing operations during the time they were breeding, protecting the developing fry, and preventing the market being supplied with 'spent' fish that were considered unsuitable for food. Hector's initial report (5 November 1895), following his first visit to Kaipara, concurred with the harbourmaster there that:

> … the only way to stop the over-fishing of mullet and the disturbance of the fish at breeding times is to close the canning factories for that period, and, if the breeding grounds can be discovered, to prohibit all fishing there for some years at least. (Hector 1897: 3)

This, however, would have severely affected the livelihood of a large number of people. Hector's final report suggested some protective measures, but emphasised that further investigations were required, including regular sampling to determine the life history of the mullet. This limited contradiction with his initial report suggests Hector modified his opinion subsequent to writing the 1895 document after his second visit to the area in January 1896. In the final report, his strongest statement was that the closed season not be extended. He qualified his agree-

ment with the 'over fishing' claims made by some observers, and a need for protection during the breeding season, by adding a rider: 'In these views I concur, but there are many points … which cannot be resolved until the proper season … January' (Hector 1897: 3).

A further Order in Council extending the closed mullet fishery season to four months during the summer (December, January, February and March), and covering the entire Kaipara Harbour, was issued in September 1895 by the government as a result of submissions from some fishermen and canneries. The proposal to extend the closure by an additional month and cover a larger area was met with concerns not only from other canning factories, but also from fishermen, who were certain they would lose their livelihood and be unable to supply fresh fish while the canning factories continued to sell their product. The extended closed season was immediately condemned by all canners and fishermen in the Kaipara, with the exception of one canning factory, and the Order in Council was revoked in late November (before it was due to come into effect), after Hector submitted his initial report and following public outcry in the newspapers. However, the original closed season, which applied to only a small portion of the Kaipara Harbour, was continued.

During the early twentieth century, the northern New Zealand mullet fishery was managed by regulations that defined various input controls, such as restrictions on fishing gear, fishing methods, fishing seasons and fishing areas, which controlled fishing effort but not the overall catch. The regulations were based primarily on regulated open entry to encourage greater domestic participation in commercial fishing. New Zealand's implementation in 1986 of the QMS based on Individual Transferable Quotas (ITQs) was a radical departure from the previous fisheries management system. It quickly evolved to control the total commercial catch from all the main fish species found within New Zealand's 200-nautical-mile Exclusive Economic Zone (EEZ). Each species introduced into the QMS is defined as one or more Fishstock, the latter being a management concept and not necessarily a natural biological unit. Mostly, a Fishstock is a species within a defined QMA, which comprises one or more of the 10 Fisheries Management Areas (FMAs) that make up New Zealand's EEZ. In some cases, because of perceived difficulties in at-sea identification, related species are grouped into Fishstocks (e.g. flatfishes, jack mackerels, gropers, oreos). Fishstocks are managed, usually by changing the TACC, so as to provide the Maximum Sustainable Yield (MSY).

The quantity of fish that can be taken from each Fishstock by all (commercial and non-commercial) fishers is the Total Allowable Catch (TAC). Each year, an allocation is first made to provide for customary Māori use, then recreational fishing, and the remainder is made available to the commercial sector as the TACC. TACCs can vary annually, and each commercial fisher's quota is a percentage of the TACC for each species, not a fixed tonnage. The QMS operates on the assumption that the TACC set for each Fishstock controls exploitation and prevents overfishing. It controls output (catch) rather than input (fishing effort). However, there is increasing interest in developing additional management regimes for small areas. Places that are traditional Māori fishing grounds, with species of high customary value, are set aside as taiapure (customary fishing area) and managed by community groups. Places with broader fishing interests (Māori, recreational and commercial), and/or with ecosystems of significant conservation value, such as the southern fjords, are also being considered for management regimes that supplement the QMS. The Kaipara mullet fishery, together with the associated species in this harbour fishery, is perhaps an example of such an area. Integrating other management measures within the QMS will be difficult, but with goodwill it should not be impossible.

Fishery decline, natural fluctuation or attempts to influence Hector's findings?

In 1886, about a decade before Hector's inquiry, there had been considerable debate in the Auckland newspaper *New Zealand Herald* on the establishment of the closed season, with the majority of correspondents opposed. An editorial in the paper also decried the closed season and the 'secrecy' of the government:

> Friday last we published a telegram from Wellington stating that, as representations had been made to government on the subject, it had been determined to have a close season for mullet … strong evidence had been furnished that these valuable fish do not now appear on our coast in anything like their former abundance … we are further told that the government had taken much trouble to 'procure all available evidence as to the increasing scarcity of fish' … We publish elsewhere a

> communication from Mr. Bishop, of Customs Street, who ought to know if any inquiry at all had been made, and who says he cannot find anybody in Auckland who had heard anything about the proposal … as to the mullet becoming scarce from the fishing that has been carried on, we simply do not credit the statement. If the few people now in New Zealand have already decreased the number of fish on our shores, when the colony is thickly populated we shall not have a fish left. The assertion seems to us ridiculous … At all events we protest against the secrecy with which it has been done. (Editorial, *New Zealand Herald* 26 October 1886)
>
> This prophecy of [marine fisheries] approaching exhaustion is by no means a new cry and if regarded as a general statement can only be taken as absolutely ridiculous … the mullet carries an average 500,000 eggs, so we need not fear our mullet supply being exhausted. There are various causes for their being scarce at times, but there are more mullet on our coasts than there were years ago. Pardon me for trespassing on so much of your space, but I could not let this pass without showing your readers the absurdity of having a close season for mullet. (C. Bishop, Fishmonger, letter to *New Zealand Herald* 26 October 1886)
>
> I write this … to express my surprise that men endowed with reason can think, in this nineteenth century, that five hundred bundles, or even five million bundles of fish can have any effect on the numbers of fish in the sea. Nature is so prolific that the more we catch the faster they multiply … In spite of those facts I have alluded to, the Government are advised to proclaim a 'close' season for mullet thereby depriving a number of men of the means of living, and making their instruments of production worthless, in order the next generation may not go short of mullet. It is all bosh! There is selfishness at the back of it. (A. Sanford, letter to *New Zealand Herald* 15 November 1886)
>
> … why this cry to Government for a close season for mullet? The only answer I hear is for Ewing & Co. to sell their canned product, while we hard working fishermen have to remain idle for three months and let the sharks and yellowtail eat the mullet that ought to be coming to market and sold as food for man … I may say that all of us fishermen caught more mullet last winter than were ever caught before in my experience. (J. Cope, Fisherman, letter to *New Zealand Herald* 23 November 1886)

The *Herald* sought the opinion of Thomas L. Cheeseman, Curator of the Auckland Museum, and published an article 'Our harvest of the sea – should it be protected' in December 1886. Cheeseman, in answer to questions put to him by the *Herald*, noted the lack of knowledge about the life history of the mullet, and drew parallels with shad and cod fisheries on the Atlantic coast of the United States, where protective measures had recently been introduced in response to localised overfishing. Cheeseman was of the opinion that a short closed season for mullet was in fact required because of the limited distribution of mullet and their dependence upon sheltered harbours for food.

> … it would be a very easy matter to reduce their number. I do not have any evidence that the mullet has already been seriously interfered with so far as numbers are concerned, because we have no statistics, but a short close season could do no harm … There is no greater fallacy than the belief, which many people entertain, that because any fish, or any other animal, is found in large numbers that consequently there is no fear of those numbers being reduced … we must not believe that because the mullet is plentiful it is going to stand the very large and fixed drain upon its numbers. We should rather attempt to anticipate matters, and, by means of a close season in spawning time, effectively prevent the fish being disturbed … About two or three months … at the hottest part of the year, when one would think, at any rate, the canning operations were rather risky. (T. Cheeseman, extract from the *New Zealand Herald* 20 December 1886)

Hector's inquiry, although prompted by claims of falling catches, was not directly related to investigating overfishing, but rather the need or otherwise for a closed season to protect the mullet during breeding, and to prevent the market from being supplied with fish that were unfit for food. Statements to Hector from fishers and canners with a vested interest in the industry reflected the opinions that had been expressed 10 years earlier:

> '… on the banks they are as plentiful as ever. Last season (1894) was an exceptionally good one for the canneries …'
>
> 'Henry Bailey … has fished in the Kaipara for twenty years. Mullet are not so scarce as they were many years ago, but less plentiful again of late; still, plenty.'
>
> 'Patrey … has been fifteen years at Helensville … Does not find the fish scarcer, but they vary in different seasons.'
>
> '… the little fish, larger than the fry, are still seen in millions up the river. They are not getting much scarcer.'
>
> 'Charles Simich … fished the Kaipara for thirteen years … Do not think the fish are scarcer now than they were formerly.' (Hector 1897: 2–8)

Correspondence in the *Herald* also mirrored that of a decade earlier:

> Formerly there was a nominal close season for mullet, but the law was framed in such a way that it could be, and

> was evaded every year. A close season was established last year, but for some reasons has been altered, and a great scientist investigated the matter, with the result that things were worse than before. Certain fishermen have started fishing and canning a fortnight ago, although it is only the middle of the spawning season, and we maintain, with all due deference to scientific or any other opinion, that mullet is unfit for canning purposes during that time; and we further maintain that the mullet industry will die a natural death if a close season is not properly and strictly enforced. We want to look to the future, and do not want to see the industry we have started killed by a lot of short-sighted people. (Masefield Brothers' letter to *New Zealand Herald* 3 February 1896)

There are three undesirable outcomes from any fishery based on spawning fish: disruption of spawning caused by fishing on the breeding grounds; loss of egg production by the capture of fish in roe; and direct and excessive removal of highly aggregated adults from the population. Kaipara fishermen believed these did not apply to their fishery. Many were convinced that the mullet did not spawn in the harbour or the rivers and creeks that flowed into it, but rather in the open sea, and thus the effects of harvesting within the harbour were negligible. Hector's report reflected this attitude. He agreed that mullet did spawn at sea, in moderate to shallow bays, and entered the harbour waters to feed at only certain times, and that because of this fish in roe were not taken by the fishery, nor was there any evidence that the mullet were being overfished. At the time, many people (particularly those with vested interests in the fishery) were of the opinion that fish that spawned in the sea could not be overfished:

> In a thousand years there has never been any fear that the enormous takes of spawning fishes should have any effect on the schools … These facts apply to all our fishes in New Zealand, so that we need not fear that in a few years there will not be any fish, or that any particular kind of fish will be destroyed by overcatching at spawning time … [we] will not be frightened by the silly remarks of some of your correspondents. (C. Bishop, Fishmonger, letter to *New Zealand Herald* 13 February 1896)

Commercial rivalry and economics may have had a greater influence on the debate than scientific evidence, as the Zealandia Canning Company – which was in competition with Masefield Brothers (but situated further away from the fruit orchards and railway at Helensville, where Masefield Brothers was based) – complained to government:

> … anticipating that Sir James Hector's report would be unfavourable to their views [the Masefield Brothers] say in their letter what they maintain is right [and] scientific opinion made by a gentleman totally unbiased and enjoying high reputation; the experience and knowledge of others engaged in the mullet-preserving industry, are of no value … Why this firm contend upon this question as they do may be easily explained by those who are aware of the facts. It may suit Messrs. Masefield Brothers splendidly to discontinue the mullet canning industry from the 1st December to the 31st March, so that they can utilise the same plant to carry out their fruit canning … we most strongly object to having to close down for months to serve the private interests of an opposing firm. (Zealandia Canning Company, letter to *New Zealand Herald* 12 February 1896)

Despite the different opinions expressed by factory owners and the fishermen, it does appear that the larger fish were becoming scarce. As noted above, in 1895 some fishers began using smaller mesh to target the smaller fish still present in the harbour, and by 1896 nets double the usual length were used in order to make adequate catches. Although catches were diminishing, the industry still employed the same number of men and boats. Some correspondents to the local newspapers used anecdotal evidence to condemn the fishermen, describing huge hauls of fish, taken in nets up to 1,000 yd long:

> The largest haul on the Kaipara was said to be about 6000 [mullet], caught in the winter of 1894. The net had to be cut away and was picked up later, full of rotten fish. (Patrey, pers. comm. to James Hector 1895, *in* Hector 1897: 5)

As mentioned previously, shags, sawmill pollution, offal and coastal shipping steamers were blamed for decline in fish. Locals generally agreed, however, that fish were not nearly so plentiful, and Hector included their comments in his report:

> 'Formerly you could not pull a boat about the harbour without a number [of fish] jumping into it; that never occurs now.'
>
> '… fourteen years ago … there have been many changes since then. There was no systematic fishing by white folks before I began. Fish was scarcer in 1884, at which time we left … They increased again, but are now not nearly so plentiful … Now the fishermen have to go out of the river to the banks; formerly they got plenty in the river. Now they are not even plentiful in the channels and on the banks.'
>
> 'The total white population of the Kaipara district, for instance, is not one-tenth of what the Native population used to be, and yet the Natives were almost wholly

> dependent on the mullet for food at certain seasons. Either the Maoris must have thoroughly understood how to conserve the fisheries while our people have lost the art, or else there must be some mistake about the great falling off in the supply.' (Notes of evidence *in* Hector 1897: 14–17)

In his final report, dated 12 November 1896 and written following a second visit to Northland and correspondence with fishers and canners throughout the year, Hector concluded that:

> Having, by observation and correspondence, continued to study the mullet question, at your request, throughout the entire year, I have come to the conclusion (from the evidence I submit with this) that no close season for mullet-fishing is required, and that all restrictions should be withdrawn … The permanent falling off in the number of mullet in Kaipara has not been proved. It is true that there are not so many seen in the river as in former years, but, on the whole, on the banks they are still as plentiful as ever … the influence of the canneries has been greatly exaggerated, as since the commencement of the factories, or about fifteen years, the total number of fish taken, allowing 10 per cent for loss and waste, has not exceeded two million fish, a number that would be produced from the spawn of four or five females. (Hector 1897: 1–2)

Government subsidies and new competition

In the 1880s, New Zealand was in an economic depression, and the government passed a number of acts to encourage commercial investment and boost employment. In 1885, the Fisheries Encouragement Act was passed with the purpose of establishing or supporting new fisheries and aiding the production of locally canned and cured fish, and it introduced bonus payments for exports of these. Payments were fixed at a rate of a penny per pound for canned fish up to 200 tons avoirdupois, and a halfpenny for every pound after the first 200 tons. Between 1886 and 1904, a total of more than £13,000 was paid out under the Act, with the bulk of it going to exports of barracouta from Otago and mullet from Auckland (Roth 1963). The bonus encouraged investment in the canning industry and made otherwise marginal or uneconomic activities profitable.

However, by the late 1890s the Kaipara canning factories faced new competition from trawling. Large steam vessels fitted with trawls had begun experimental fishing around New Zealand with government subsidies from about 1895. The invention of otter-boards to hold the trawl net open revolutionised this fishing method, and soon vessels were operating in the Hauraki Gulf and landing catches into Auckland. The new steam trawlers could supply fresh or frozen fish in all but the worst weather. Thus the Kaipara mullet fishery not only had to contend with fluctuating stock sizes, but also competition with trawlers working out of Auckland, and often in the years when mullet were plentiful no profitable market could be found for the fish.

The deciding factor in the collapse of the Kaipara mullet fishery was the removal of the government export bonus in 1905. Although the canning factories continued operating for a few years, the low price of the product and the periodic shortage of fish contributed to their demise. Refrigeration enabled unprocessed mullet to be stored and transported to Auckland markets via the new railway, but once there they faced direct competition with other more desirable species. It can be inferred from fisheries inspectors' statements in Annual Reports on Fisheries during the period 1906–23 that the fishery was limited by market demand, with more desirable fish species being landed directly into Auckland – the main market after export subsidies ceased.

Fishing continued and after 1906 when economics forced several of the plants to close, the downward trend continued for over a decade. But plant closures meant reduced fishing and less pressure on the resource, so that by 1920 the mullet stocks had partially recovered and several plants reopened (Wai 022 1988: 94). Local demand was, however, still limited, and continuing difficulties of transport to Auckland and other markets, as well as competition from the trawlers, prevented expansion of the industry.

In 1937, a report by a special governmental Fisheries Investigation Committee set out to review the 'condition and prospect of the sea-fishing industry of New Zealand, including investigations into any matter relating to the exploitation and conservation of the sea fisheries'. At Kaipara the committee attended a meeting at which 'all the commercial fishermen [were] represented, [as well as] a number of part time men and other interested parties', and reported that set netting was the main, if not the only, method of fishing primarily targeting flounder, which all witnesses stressed were being depleted. The committee further noted that the history of mullet canning had been 'chequered' in the Kaipara, but that no canning was carried out presently because of a 'want of supplies' (poor prices

discouraged the fishermen). The investigation resulting in this report coincided with the 1930s Depression, when prices were poor and mullet landings were low (8–9 tonnes/year). However, the report recommended a study of the fishery and suggested that if this showed possibilities, then assistance should be given in the establishment of a small canning factory in Kaipara as the mullet stocks were said to be plentiful (Thorn *et al.* 1938: 94).

Artificial propagation

Despite observations that some local fisheries were being depleted, towards the end of the nineteenth century government, general and scientific opinion was that the seas around New Zealand remained largely unexploited and there was no need for concern:

> The local fishermen tell me that some seasons all kinds of fish are scarce, but, as the fishing hitherto has only been prosecuted in-shore and in few places, the fishermen do not know much about the habits of the fish. (Sherrin 1886: 108)

> Some of the old fishing grounds within a certain distance of the larger centres are not now producing anything like the quantity of fish which they have done formerly, and in several places fishermen find it necessary to keep moving further afield in order to get the supplies required. The cause of this decline is, I consider, due to overfishing and the predominance of sharks, dogfish and other enemies of our market fish … The areas I have mentioned as suffering from overfishing are not very extensive; in fact they may be considered as a mere bagatelle in comparison to the fishing grounds round our coasts which have as yet not been exploited. (Ayson 1913: 8)

At the time, considerable success with the artificial propagation of fish stocks had been achieved in both America and Europe, and Hector used his report to refer the government to the success of these operations. He appended a paper by Thomson (1896), a Dunedin scientist and schoolmaster, to his report that promoted development of artificial propagation as a means of enriching the sea fisheries: 'The only measures to be recommended for the conservation of mullet and other fishes that spawn in the sea is artificial propagation.' (Hector 1897: 1)

Back in the 1880s, trout and salmon had been successfully introduced into New Zealand, and the prevailing consensus was that equal accomplishments could be achieved in introducing 'the finest food-fishes of Britain – the cod, the turbot and the herring' to create fisheries that would 'rank among the most valuable assets of the colony' (Thomson 1896 *in* Hector 1897: 22). Thomson was of the opinion that:

> … there is very little need for fisheries legislation at the present time in this colony, particularly as such legislation is apt merely to harass those engaged in a struggling industry, without any compensating advantage to either the community at large or to the industry itself. (Thomson 1896 *in* Hector 1897: 23)

Acting on this advice, the government directed fisheries research and resources into establishing the Fish Hatchery and Marine Investigation Station at Portobello, Dunedin, in 1904 to achieve the goals of acclimatising new species to New Zealand. The idea of a marine fish hatchery had been promoted widely by Thomson following the earlier success of hatcheries in the establishment of trout and salmon. Attempts in 1886 to import herring ova had failed, even though the eggs had been kept in iced water to arrest their development during the long sea voyage. Thomson considered such attempts doomed without a fish hatchery ready to receive live eggs, and he worked hard at promoting the idea of a marine station to scientific and commercial circles within the Royal Society.

By the turn of the century, the government also recognised a need to assist the developing fishing industry to exploit the fisheries, and, as well as establishing a marine hatchery at Portobello, the Marine Department invested in exploratory trawling with a series of surveys by the steam trawlers *Doto, Nora Niven* and *Hinemoa* between 1900 and 1907 (Roberts & Paulin 1997). No further investigations into mullet as suggested by Hector were carried out.

The Portobello hatchery's main role was to help establish European species of fish and shellfish, such as lobster, edible crab, turbot and herring, in New Zealand waters. However, although many species were released into Otago waters over those early years, none survived (Thomson & Anderton 1921). Although the marine fish hatchery did not achieve the success hoped for, finfish aquaculture has now become an established industry, and the mullet *Mugil cephalus* was, and is, regarded as an appropriate species to farm as it feeds at a low trophic level and grows rapidly. Some aquaculture farming of this species has been commercially successful in India (Matondkar 1978; Rajyalakshmi & Chandra 1987), and the species is regarded as ideal for artificial restocking in Australian waters (Taylor et al. 2005). Although Thomson's and Hector's championing of hatcheries for the purpose of introducing European fish

species may have been inappropriate, from a more general perspective they were certainly ahead of their time.

Māori fishing rights

The New Zealand government's legislative intervention in sea fisheries was a result of concerns for the conservation of resources, and the Crown appears never to have entertained any doubt about its right to assume control over Māori fisheries. From the first act of 1866 onwards, the legislation provided for the general public exploitation of the fish resource, and was based on the premise of the Crown's right to provide for this, notwithstanding the fishing rights guaranteed to Māori under the Treaty of Waitangi. As a consequence, no effort was made to consult with Māori before exercising legislative control over their fisheries. When sea fisheries were first made the subject of statutory regulation in 1877, Māori rights under the Treaty of Waitangi were preserved (Fish Protection Act 1877, s 8). This provision was omitted in 1894 and reinstated in 1903 in a vaguer form.

Māori were partly blamed for the decline in the mullet resource in Northland. In a report to the New Zealand House of Representatives dated 1895, it was stated that:

> Representations having been made to the [Marine] department that it would be desirable to prescribe a close season for mullet in all waters between Cape Wiwiki and the North Cape, and also to prohibit the Maoris from using certain methods of fishing which had the effects of depleting the fishery, in consequence of their taking small mullet in large quantities it is recommended that … Maoris be made amenable to the fishery regulations. (Anonymous 1895: 3)

In any event, on 21 December 1896 regulations under the Sea Fisheries Act 1894 set the style of nets and minimum mesh sizes according to non-Māori standards. Māori fishing activity was further diminished by requiring a larger mesh than they traditionally used, and their involvement in the commercial mullet fishery was reduced. Non-Māori fishing increased but the mullet resource continued to decline (Wai 022: 94) both in the Kaipara and throughout northeastern New Zealand.

The government viewed Māori involvement in the mullet fishery, along with oyster gathering, as a politically sensitive issue, and showed a paternal view toward Māori. Secretary for Marine, W.T. Glasgow, thought it 'very unfair to allow the Māoris to deplete the fisheries … in their own interests they should be protected from the effects of their ignorance and improvidence', although at the same time he was wary of 'any interference with their supposed rights' (Johnson 2004: 496). In submissions to the Waitangi Tribunal on the Muriwhenua Fishing Claim (which related to harbours and coastal waters on the northeastern coast rather than Kaipara), evidence summarised and presented by Dr George Habib alleged that non-Māori fishermen were primarily responsible for the depletion of mullet stocks (Wai 022 1988: 94). (Habib, in his capacity as expert adviser to the tribunal, reviewed and commented on all of the claimant's submissions and the Crown's evidence.) Habib further noted that although the taking of quantities of undersized fish was likely to harm stocks (and 'informing the Māori people of that fact was a proper action'), capture of excessive numbers of adult fish was equally a cause. In the Māori view it was the main cause, for adults are the breeding stock.

Conclusions

The trend of the mullet stocks within the Kaipara Harbour following the 1880–95 canning fishery period is difficult to determine. Subsequent to Hector's investigation, mullet landings were not specifically noted in Marine Department Annual Reports until 1905, when Kaipara mullet were reported as 'not so plentiful as formerly' and it was noted that 'about twenty thousand dozen mullet had been canned at Batley'. Irregular references to mullet in Marine Department reports from 1906 to 1930 suggest a general improvement, with the supply described as 'increasing' or 'plentiful'. Although usually recorded as relatively plentiful, mullet varied in abundance and availability within the Kaipara Harbour and the trend is unclear.

It is possible to make a general estimate of the average annual mullet catch in the early fishery. In his 1897 report, Hector stated 'the influence of the canneries has been greatly exaggerated, as since the commencement of the factories, or about 15 years, the total number of fish taken, allowing 10 percent for loss and waste, has not exceeded two million fish'. This total equates to about 11,000 dozen fish per year and matches values of about 6,000 dozen fish per year processed by one of the two main factories during this time. Fish weights in Hector (1897) are most often listed at 1½–2 lb (700–900 g), with the largest fish at about 3 lb (1.36 kg). This is similar to recent data, which have a length mode at 35 cm (*c.* 700 g) (McKenzie et al. 1999).

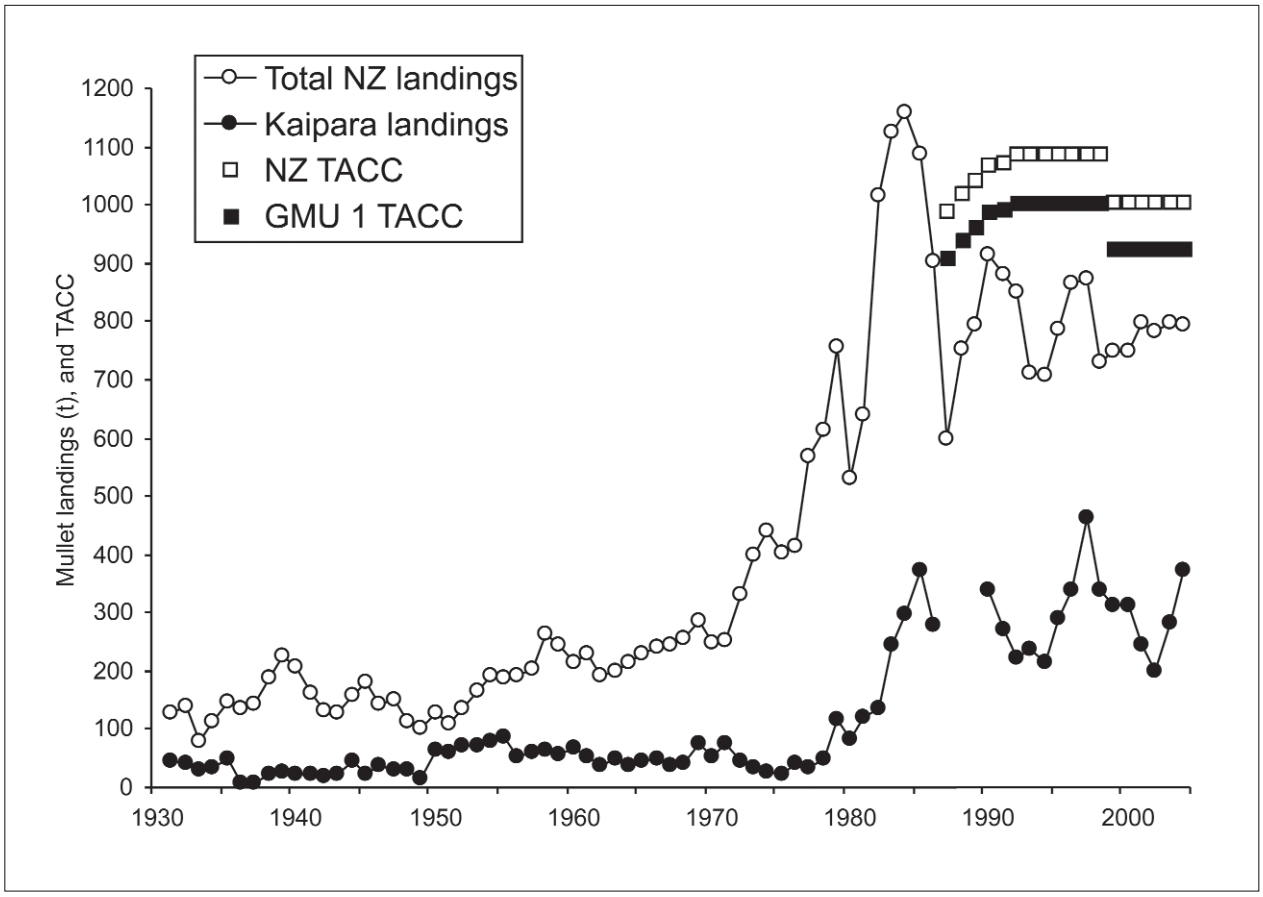

Fig. 10 Reported landings of mullet from Kaipara Harbour, and total New Zealand mullet landings, 1931 to fishing year 2003–04. Kaipara landing values for the three years 1986–87 to 1998–99 are not available because of changes to the recording system when the Quota Management System was introduced. Also shown are the Total Allowable Commercial Catch (TACC) values for New Zealand for 1986–87. 'Mullet' landings refer to grey mullet, *Mugil cephalus*, and possibly a second but unidentified species; they are unlikely to include yellow-eyed mullet, *Aldrichetta forsteri*, which is listed separately (but erroneously) in reports as 'herring'. Data from various sources, published and unpublished.

Consequently, annual landings in the 1880s–90s could have been 92 tonnes at a mean fish weight of 700 g, and 120 tonnes at 900 g.

Annual Fisheries Reports from 1930 (earliest listing by port and species) until 1978 record Kaipara mullet landings averaging 45 tonnes. There is no evidence that this was limited by fish abundance. Local market demand for mullet increased in the late 1970s, and Kaipara landings rose rapidly to fluctuate between 200 tonnes and 400 tonnes from the mid-1980s to 2000 (Fig. 10). The current (2006) TACC for GMU 1 (northern North Island) is set at 925 tonnes, but the grey mullet fishery has never achieved this since quotas were introduced in 1986. Concerns that this TACC was set too high and did not constrain fishing effort for mullet within the enclosed Northland harbours led to further research. Hartill (2004: 3) reported fluctuating and then declining grey mullet landings from Kaipara Harbour between the fishing years 1989–90 and 2000–01, but the trends were inconclusive. A CPUE analysis of the set-net fishery extended to the fishing year 2001–02 showed an overall decline for Kaipara during this period, though with an intermediate rise in the years 1992–93 to 1996–97 (Watson et al. 2005). Some other west and east regions of GMU 1 did not show a decline, but the adjacent Manukau Harbour did, and because these two harbours provide most of the total grey mullet landings there is some concern over sustainability. There are difficulties in determining a sustainable harvest level for grey mullet from fisheries data. Fishers may alternate between the two main fishing methods, set netting and ring netting, or change

permanently from one to the other, and they also participate to differing degrees in fisheries for the other main commercial species in the harbour.

Unfortunately, much of the research information supporting present-day fisheries management decisions is buried in 'grey' literature such as Plenary Reports, Fisheries Assessment Reports, discussion documents, client reports and data compilations that are held by few libraries. Plenary Reports, issued annually (printed, with recent volumes on CD ROM), supposedly supersede earlier issues, but changes are frequently not documented, and earlier useful data and comments are often dropped. Despite an abundance of information, relative to that available in the past, it is already difficult to follow the steps leading to some management decisions, and it will be more difficult to do so in future decades. This present account of the early mullet fishery, describing the relevance of some of its features to present-day management issues, has been made possible only because the detailed notes and recommendations made by Hector (1897) were published in a form that remains accessible over 100 years later. It is important that scientific studies are based on, and progress forward from, existing knowledge. The Kaipara mullet fishery may be small, but it has many characteristics of other New Zealand inshore fisheries. In addition, the complex procedures that will be required to integrate localised management of Kaipara fisheries with the broad-scale QMS make it desirable that the appropriate research results and management decisions are published in some permanent form. Management decisions on these fisheries made now will remain relevant to future researchers and managers, and the supporting studies should be adequately recorded in accessible documents.

Current fisheries management philosophy considers overfishing to be a level of fishing that takes the resource below the state at which it is most productive, rather than the more general acceptance that there are fewer fish around than formerly. Management of the grey mullet fishery is being undertaken without clear information on stock size in relation to the level that would produce the maximum sustainable yield (MSY) (Hartill 2004). MSY itself is a concept that has been painstakingly developed, intensely debated and prematurely eulogised, and has ultimately evolved into a complex blend of language, mathematical theory and law (Field 2002). Basic assumptions of MSY are that stocks can be managed outside their role in the ecosystem; that density dependence is the main regulating factor in population dynamics; and that if one simply has enough information on the stock, then it is possible to control fully the trajectory of the stock (Goodman et al. 2002). Marine fisheries management has traditionally been based on the biology and population dynamics of individual target species, with management controls generally exercised through limits on individual fish sizes, seasons of harvest, catch limits and restrictions on gear efficiency designed to protect reproductive stocks. For more than three decades, fatal flaws in single-species and population-based MSY approaches to fisheries management have been seriously discussed in the scientific literature (Roedel 1975; Larkin 1977; Barber 1988; Davis 1989; Struhsaker 1998).

The premise behind the concept of MSY is that there are estimable levels of surplus production that may be safely removed from a given population. It has long been assumed that fish stocks and populations, and the ecosystems in which they exist, are healthy as long as they are maintained close to the levels or state that provide MSY. Nevertheless, a growing body of ecological, genetic and theoretical evidence suggests that this may not necessarily be so, for either exploited species or their ecosystems. Errors in measuring MSY leads to poor management decisions, consequent changes to the life history of target species, and unforeseen impacts on food webs. In addition, large-scale variations in productivity can occur naturally as a consequence of climatic variability affecting the natural balance within marine ecosystems. All these complicate management efforts to define MSY (sometimes crudely interpreted as 'harvest as much as possible'), often leaving stocks, and increasingly ecosystems, in jeopardy (Field 2002).

Broad-scale management by the QMS does not necessarily recognise areas of local depletion or abundance. For example, localised areas of fish abundance in New Zealand waters, such as marine reserves, are excluded from Ministry of Fisheries' control, with management vested in the Department of Conservation. Such designated 'harvest refugia', or fisheries reserves, should be evaluated as management tools to enhance or sustain coastal fisheries. Elsewhere in the world, such refugia provide recruits to adjacent fishing grounds, protect the genetic diversity of wild stocks, serve as experimental controls for determinations of potential yield (Davis 1989), and can be used to determine natural and fishing mortality estimates (Willis & Millar 2005). An unintentional consequence of the ban on set netting along the west coast between Dargaville and New Plymouth (in place from 2003 to protect Hector's

dolphin) is effectively to protect mullet from exploitation whilst at sea (i.e. during spawning). The effect of this protection on the stock is completely unknown, but in theory beneficial.

All exploited coastal fish species have declined in abundance since colonial times. Too often, fisheries management is driven by 'market forces' as a result of inadequate resourcing of management agencies, and at the expense of understanding the basic biological parameters of targeted species. Collapse of a fish stock usually results from very complex scenarios, which include fluctuating environmental factors impacting ecosystems, incorrect identification of fish species, inadequate biological and ecological knowledge of target species, and hasty management decisions such as overestimation of stock size, or proposed quotas that do not allow for natural declines in populations. Fisheries issues include the target species as a bycatch in other fisheries, and technological changes enabling greater gear efficiency. Socio-economic factors include quotas set above scientifically determined levels – often as a consequence of fishers demanding greater access to fish, politicians not responding to warnings from fisheries biologists and managers, illegal fishing, subsidies that enable fishers to continue fishing when it becomes uneconomic, as well as slow management response when initial signs of a collapse become apparent (Berrill 1997; Mason 2002).

Establishing a Kaipara Harbour community group should enable an agreed management plan to be drawn up, and to be overseen and enforced by the Ministry of Fisheries. Significant difficulties, however, will remain. As with most New Zealand Fishstocks, it is not known whether the recent mullet catches in GMU 1 are sustainable, or whether they will allow the harbour sub-stocks to move toward a size that will support MSY (Sullivan et al. 2005). The most recent studies, in fact, show a declining catch rate and suggest overexploitation. Also, a separate allocation of quota for the Kaipara Harbour is not based on knowledge of movement of fish between different harbours, and between harbours and the sea. Thomson (1955) and Kailola et al. (1993) record that mullet migrated quite extensively along coastlines in Australia. Hector noted that Kaipara mullet migrated to coastal waters outside the harbour, where they can potentially mix with fish from other harbours, such as Manukau. If the mullet from different harbours are the same biological stock, the Kaipara fishery cannot easily be managed as an independent fishery.

While the anecdotal comments in Hector's report do suggest a decline in the mullet stocks within the Kaipara following 10–15 years of exploitation, the trend is obscured by other comments made by competing fishermen and canneries, a lack of catch data and the suspicion that a second species was also being fished. Ultimately, the collapse of this early Kaipara mullet fishery around 1900 can be attributed to unfavourable economics caused by competition from trawling in Hauraki Gulf that targeted more desirable species and the withdrawal of government subsidies to the canneries, rather than complete collapse of the fish stock, which recovered in the early twentieth century following reduced fishing pressure. Today, the commercial fishery for grey mullet on the Kaipara is showing a decline in catch rate, and the fall in landings suggests the size of the stock has undergone a significant reduction (Hartill 2004). Hector's 1897 report remains relevant: small fisheries are still complex, and good management requires an understanding of the way these fisheries operate, including the interaction between different groups of fishermen, and between the associated fisheries, as well as reliable species identification and adequate knowledge of their biology.

We can only speculate that the 1880s European mullet fishery within Kaipara Harbour was partly based on an as yet unconfirmed and unidentified mullet species, possibly conspecific with *Myxus elongatus*, a species occurring in eastern Australia, as well as the grey mullet *Mugil cephalus*. If so, it could have been a collapse of the '*Myxus*' stock inside the harbour that contributed to the decline of the fishery. The earlier Māori fishery on the outer coast, and the harbour fishery that continued through the twentieth century, were almost certainly based largely or entirely on grey mullet *Mugil cephalus*. The possible second species may now have disappeared, or it may still be present but unrecognised. If the latter, there are implications for both interpreting the historical catch record and for future management of Kaipara mullet.

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