Is Canterbury's Stokell's smelt doomed for extinction like the Delta Smelt of California?

Two similar Northern and Southern Hemisphere smelt species are facing extinction due to changing land use and irrigation.

Stokell's smelt (*Stokellia anisodon or Retropina anisodon*) share many physical and biological similarities with their Northern Hemisphere counterpart the Delta smelt (*Hypomesus transpacificus*) Both species of smelt are on the endangered species list.

While there are sufficient physical differences between these smelt to warrant a different taxonomical classification, the range or ecological niche they occupy, their size, and life cycles are virtually identical;

The Delta Smelt

The Delta smelt inhabits the boundary between fresh and salt water in the Delta, where ocean tides that bring saltwater into the estuary from the Pacific Ocean meet freshwater flows from California's rivers. Though its historic range encompassed, at different times, the entire Delta and parts of Suisun Bay, our diversion of that freshwater for our own uses has changed the smelt's habitat.

As a result, the smelt has suffered badly. In 1993, it gained protection as a Threatened species under the U.S. Endangered Species Act, and that listing has played a role in some of the most contentious political rhetoric in modern California. But the controversy hasn't sustained the fish. Far from it: surveys earlier this year turned up a total of six smelts, and biologists warn the fish will likely be extinct in a few years -- if it isn't already.

The Delta smelt was historically found in low-salinity water where freshwater and brackish intermixed. That mixing zone was rarely static in the pre-development Delta, shifting toward San Francisco Bay during times of heavy spring runoff and inland during fall, or during drought periods. The smelt shifted positions within that mixing zone as well, seeking out depths that better matched its preferred salt concentrations, or moving into fresher water in the Delta's upstream tributary side channels in order to spawn.

In that sense, the smelt could almost be seen as an anadromous fish like the Chinook salmon that whizzed past it on their way to the open ocean or headwaters spawning grounds: both hung out in saltier water but headed for freshwater to reproduce. But the smelt never got all the way into undiluted seawater. The saltiest water in which Delta smelts have been found has a salinity of about 14 parts dissolved salt per thousand parts water. In general, the smelts seem to prefer water that's around 2 parts per thousand. Seawater runs about 35 parts per thousand.

And that's pretty much what's happened to the smelt's habitat. Our statewide thirst for fresh Northern California water has meant more water goes into canals and aqueducts, and less flows out through the Delta to San Francisco Bay. That lower freshwater flow means that the tides carrying salt water into the Delta meet less resistance on their way inland, which means saltwater intrudes deeper into the Delta, driving salinities way past the level Delta smelt can live with, and making that optimal salinity "mixing zone" a lot smaller.

Less than a century ago the Delta smelt was one of the most abundant fish in the Bay and Delta. Found in large schools throughout the Delta from Sacramento to Manteca, and as far west as Suisun Bay, there were enough Delta smelts in the estuary to support a commercial fishery until the mid-20th Century.

If we'd been able to keep that fishery going without doing the species in, the Delta smelt would have been an excellent sustainable seafood species. It was near the bottom of the estuary's food chain, the larvae and adults both subsisting on plankton animals such as copepods. Unlike long-lived ocean-going species such as the critically overfished swordfish, Delta smelts mainly live for just a year. About a tenth of the typical smelt population survived into a second year. That would have meant that if a few too many tons of smelt got taken in a particular year, a couple restricted seasons could have allowed the fishery to recover, as new smelt smolts tumbled downstream into the mixing zone and gobbled the plankton caught in the zone's turbid currents.

And the smelt's distinctive cucumber aroma when fresh might have added an interesting dimension to local sushi.

An adult Delta smelt about 6 centimeters long -- less than two and a half inches. | Photo: U.S. Fish and Wildlife Service

But there are no more "tons of Delta smelt" remaining in the Delta. At this point, the fish is only a little more abundant than unicorn tears. The last five years of drought may well have been the icing on extinction's cake for the smelt. In March of this year, an annual survey of smelt numbers conducted by fisheries biologists working with the California Department of Fish and Wildlife counted just six smelt. That was down from an already startlingly low 88 in March 2014, and hundreds in previous spring surveys.

That low count prompted smelt expert and veteran California fisheries biologist Peter Moyle of UC Davis to offer a bleak forecast to National Geographic's Jane Kay. In April, Moyle told Kay that he expected the smelt had little chance of surviving.

"The probability of the delta smelt surviving in the next three years is relatively low. The chances of its bouncing back from where it is today seem very unlikely," said Moyle. "There are a lot of things going on simultaneously. Everything that stresses that poor fish is out there. The drought is the final straw."

What the six fish found in March's sample means about actual numbers of remaining Delta smelt is a matter of dispute. It's exceedingly unlikely that the count got every last smelt in existence, after all, the difference between counted numbers and actual numbers has been a matter of some dispute in the last decade. That happened most notably when a federal court judge cited uncertainty of the smelt's numbers, and how many of the smelt are actually

getting "entrained" in Delta pumps, when he ordered the U.S. Fish and Wildlife Service to rewrite its 2008 Biological Opinion on whether continued operation of the State Water Project and Central Valley Project would hurt the Threatened fish.

The Delta Smelt: Keystone Species, Political Flashpoint, Possibly Already Extinct | KCET

Farmers vs. Fish: The Story of Delta Smelt – envirobites

Water, agriculture, almonds, smelt | The Sacramento Bee (sacbee.com)

Stokell's smelt

"Stokell's smelt is the species of the rivers of the Canterbury coastline, where it occurs in huge abundance and is an important food for sea run trout. It is found from about the (Canterbury) Waiau River south to the Waitaki River. It constituted a very small proportion of the fish population of the Waimakariri River, in contrast to the Rakaia, where it dominated". (McDowall 1990).

The smelt have been recorded as being most abundant in the Rangitata, Ashburton, and Rakaia Rivers. (All rivers heavily exploited by irrigation extraction).

The smelt only live for 1-2 years so a single season of failed breeding success could spell disaster.

Spawning adults are 65 mm or more long, and have a distinct cucumber aroma just like their Northern Hemisphere counterparts.

It would be most accurate to state that the trends in the abundance of Stokell's is not presently known by New Zealand's regulatory authorities (Ecan), the Department of Conservation, (DOC is the government department charged with conserving native fish), and NZ scientists, although anecdotal angler reports from locals who reside at the Rangitata and Rakaia river mouths show alarm and despair at the dramatic decline in this cornerstone species.

A Personal Crusade

At the Hearing constrained by legislation passed under urgency in order to circumvent the existing protections afforded by the Rakaia River Water Conservation Order (1988), (RWCO), the Environment Canterbury Temporary Commissioner and Improved Water Management Act 2010, (Ecan Act), I made a submission against the Lake Coleridge Project (LCP).
This Hearing was convened,(in the form of an Ecan irrigation hearing), to consider Trustpower's application, (the LCP), to amend the RWCO in order to make possible the abstraction of a previously allocated but restricted 70 m3/sec of Rakaia flow for both the Central Plains Water and Barrhill Chertsey Irrigation schemes.

I devoted two pages of my submission to Stokell's smelt, pointing out that none of the applicant's expert witnesses had considered what effects the LCP might have on this species, indeed that not one of these expert witnesses saw fit to visit the Rakaia hapua zone where 90% of the Rakaia River fisheries exist (S.F. Davis, 1983).

Included in this section I expressed concern that the distribution Stokell's smelt may be limited by oceanographic features namely the near shore low salinity plume that extends from the Waitaki River along the Canterbury coast line around Banks Peninsular to Pegasus Bay.
This was an intuitive concern due to my belief that this low salinity inshore plume would best explain the geographic distribution of the "marine" life stage of these smelt.

The independent Hearing commissioners' response was as follows:

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Mr Peter Trolove provided us with detailed and wide-ranging evidence.
He is a qualified veterinarian and also has a qualification in fish health.
He is also a passionate angler. He was critical of the fact that no evidence has been given regarding the effect of the proposal on fish in the hapua. In response to this concern Dr Alibone, a witness for the applicant, noted Mr Trolove's concern at the lack of specific assessment on the effects on Stokell's smelt. Dr Alibone discussed this species and concluded that the activity of Stokell's Smelt in the river (and we assume he included the hapua in this description) would continue to be unaffected by the project. We are not aware of any way in which fish in the hapua itself would be adversely affect(ed) *by the proposal and indeed we are satisfied that there would be no adverse effect. There is of course possible effects on fish entering the hapua from the sea if the mouth were to be closed for significant periods of time. However, as will appear later, we are satisfied such an event is highly unlikely. Mr Trolove also expressed concern that the abstraction of 70 cubic metres of water from the river for irrigation purposes would affect the low salinity plume in the sea. In our view although the plume is affected by changing river flows, this occurs naturally given the wide variation in flows down the river."*

Since the Hearing I have observed Stokell's smelt to be concentrated in very localised areas close to where the river meets the sea especially in times of sustained low flows. Anglers who are so inclined are able to catch kahawai with virtually every cast due to the focal concentration of the smelt. Is this a sign that water of suitable (low) salinity is limited?

Since the Hearing I have read further reports about the currents and mixing of freshwater & sea water along the Canterbury Bight. I believe these later studies support my theory that the smelt may be constrained by the freshwater/saline interface. This is worth investigating.

Water quality - sediment and temperature.

To someone trained as a fish vet, water quality is all important, more so when it is known that New Zealand smelt are very sensitive to changes in their physical environment and are one of the most sensitive native fish species in Aotearoa (Hickey 2000, Rowe et al. 202a, Landman et al. 2005).

"Although turbidity per se does not appear to affect smelt in lakes, the settling of silt, which is often responsible for increased turbidity does. The suspended solids responsible for increased turbidity in lakes are thought to reduce spawning habitat or smelt by smothering sandy substrates with a layer of fine silt (Rowe & Taumoepeau, 2004). This either prevents smelt from spawning or results in increased egg mortality where spawning does occur (Rowe & Kusabs 2007).

Smelt are one of the most sensitive fish to handling, pollutants like ammonia, and stressors such as high water temperature. In some cases they are as intolerant as salmonids, which are often used as a benchmark species overseas for establishing water-quality guidelines to ensure fish are protected from human activities.

There are currently no management or conservation initiatives for the smelt fishery in Aotearoa-NZ. If specific guidelines for the smelt fishery were to be developed, this is likely to be within the jurisdiction of DOC given that they manage the whitebait fisheries in Aotearoa-NZ"

[Understanding Taonga Freshwater Fish Populations in Aotearoa New Zealand – Sept 2017]

The Rakaia River water frequently carries variable amounts of glacial sediment which can work to the angler's advantage unless the river is experiencing a major flood. Trout and smelt seem unaffected by this discoloured water. Fresh run salmon appear to be unable to accurately navigate the really big floods and are often found dead in side braids or stranded on silt coated vegetation when these floods subside.

Smelt like cooler temperatures between 15 C and 17 C although they are able to cope with temperatures up to approximately 27 C.

(I had also pointed out at the Hearing that the possible effects of the LCP on water temperature in the lower braids had not been covered in the applicant's evidence).

In laboratory experiments, smelt were the most sensitive native fish to low dissolved oxygen levels below 3 mg/L." (Science website).

Observations at the Rakaia River mouth

Since the 2012 LCP Hearing legitimized the taking a further 70 m3/sec of the Rakaia flows, Stage I and Stage II of CPW have been completed as has the BCI scheme.

The health of the lower Rakaia braids is now dependent on heavy rain events on the West Coast to provide the floods required to flush silt and sediment which accumulates when low summer or winter flows are sustained for long periods of time. The minimum flows proscribed in the RWCO have now become a target for the irrigators. The opaque reporting of the use of "stored water" and the widely fluctuating flow records at Fighting Hill are a source of contention between Ecan and the Salmon Anglers Association.

From 2015 until 2019 sustained low flows saw the lower and tidal braids covered in mud and algal mats. This would have done little for the breeding success of Stokell's Smelt who need to breed on clean coarse sandy/gravel areas in the tidal braids.
The lagoon margin and tidal reaches of the spring creeks connected to the lagoon have had their once shingle margins coated in mud. The mud has allowed grass like rushes to colonise the margins producing feed for Canada geese and spawning habitat for whitebait.
As the smelt disappeared, whitebait runs seemed to increase in size and duration.

In 2018/19 the smelt were virtually non-existent. The once prolific sea trout fishery collapsed, and over 90% of the Black Bill Gull colony nests contained dead chicks.

I took Rex Gibson to visit the lower braids in July 2019 to show him the mud and algal mats made visible by low and clear winter flow. He posted his article **"I Have Seen Armageddon"** on the strength of his visit.

For the past 18 months or so there has been a regular series of floods due to heavy West Coast rain events. The mud and embedded gravels of the lower braids have been largely cleared as a result.

There have been more smelt observed by whitebaiters and anglers in 2020/21. The very low numbers of smelt are still a concern.

Ecan's River Works

Up until 2019 Ecan has sprayed the braid bed of the Rakaia River annually with up to 5 x label dose of glyphosate to kill invasive weeds, (and I suspect to compensate for the low flows being unable to transport eroded gravels to the coast). When travelling over the bridge on SHWY 1 the brown vegetation then subsequent defoliation becomes evident.

I suspect fine soils from the once vegetated and stable islands have dropped out in the tidal zone contributing to the mud/sedimentation described above.

When I wrote to Ecan about my concerns they replied that they were unaware there was a problem.

Finally some action

Belatedly staff from Ecan, NIWA and F&G completed intensive netting to assess the stocks of Stokell's Smelt at Canterbury's river mouths in October 2020

Apparently they are due to repeat the sampling in March.

I have not seen the report on the October sampling but I have requested a meeting with DOC and hope to bring other advocates for the Rakaia and Rangitata fisheries with me to the meeting.

I doubt there is sufficient baseline data to give meaning to a single sample.

An unhappy result for anglers

A promotional pamphlet produced by the Selwyn Te Waihora Water Zone, Ecan, and the Selwyn District Council, touted the success of the CPW irrigation scheme in 2017 as a $300million increase in GDP.

What was not mentioned was that this was exactly the same cost estimated to restore Te Waihora/Lake Ellesmere from degradation due to nutrient pollution resulting from irrigation and land use changes.

The Rakaia River was once an outstanding internationally and nationally recognised recreational fishery located less than an hour's drive from Christchurch.

With the loss of Stokell's Smelt, an important keystone species, this is no longer the case. There has never been compensation or mitigation offered to anglers.

An unhappy result for the Rakaia river mouth (hapua)

If the Stokell's smelt become extinct, the species that rely on these fish for food have the potential to become extinct as well.

It's like a red light – you have to stop or there will be a crash.

We are seeing indications of this already with the endangered black billed gulls that breed at Canterbury's braided river mouths

Reports of gull chicks dying near the Rangitata River | Stuff.co.nz

Anglers Strive To Save Degraded Rangitata River | NZFFA The New Zealand Federation of Freshwater Anglers

Foot Note

5 billion m3 of water a year has been consented in Canterbury. 72% of the consented water is used for irrigation. The irrigation season is from 1st September to 29 April.

This is the equivalent of 400,000 Olympic sized swimming pools or 5 **cubic kilometres** of water!

448,000 hectares of irrigable land equates very roughly to one Olympic pool/ha annually.

Consented water, from *Update of water allocation data and estimate of actual use of water use of consented takes 2009-10*, Aqualinc Research Limited, 2010

The latest Statistic NZ figures report there are over 500,000 ha of irrigable land in Canterbury.

Growth for the sake of growth is the ideology of the cancer cell. Edward Abbey,
The Journey Home: Some words in defence of the American West.