7 Porohe (Smelt)

Family: Retropinnidae

Species: *Retropinna, Stokellia anisodon*

There are two Aotearoa-NZ species in the Retropinnidae family, the common smelt (*Retropinna retropinna*) and Stokell's smelt (*Stokellia anisodon*) (Figure 61). This family of fishes, known as the southern smelts, is also found in Australia, but the two species we have here are unique to this country. Smelt are an impressive silver coloured with a pale amber to light olive coloured back and translucent muscle tissue (McDowall 1990). They are well known for the cucumber-type odour they omit. Smelt can be distinguished from other species by the presence of the adipose fin, a small fleshy lobe on their back between the dorsal fin and the tail. They also have scales, a distinctly forked tail, and the aforementioned cucumber-like smell. The two species that live in Aotearoa-NZ are very difficult to tell apart, and positive identification depends primarily on the size and number of the scales.

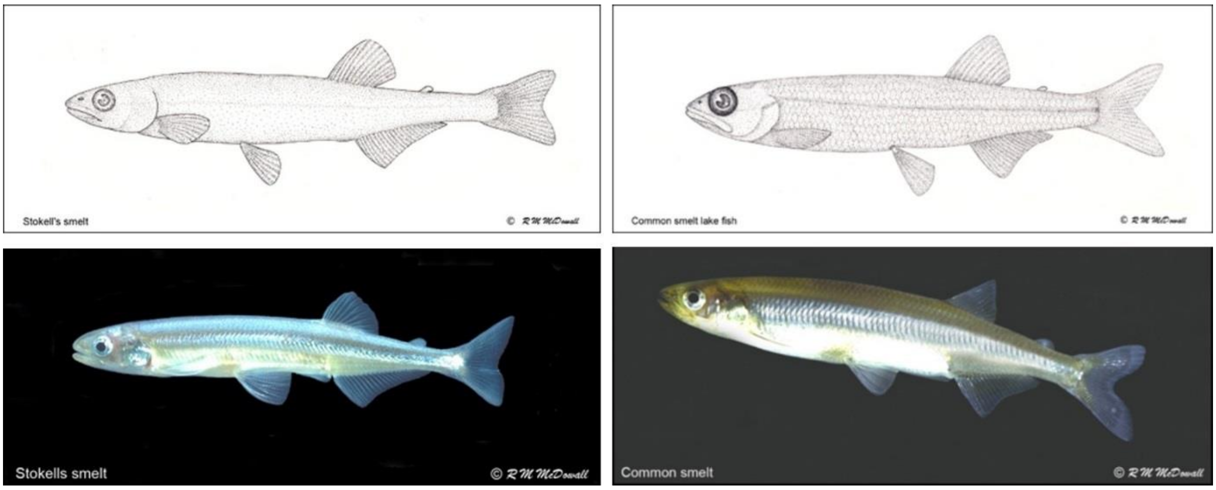

Figure 1: (Left) Stokell's smelt (*Stokellia anisodon*), and (Right) the common smelt (*Retropinna retropinna*). (Graphics and photos: Bob McDowall).

Smelt are a shoaling species, which means they swim in schools near the water surface. Thus, they are often seen out in the open in streams and lakes as they feed on drifting food organisms. They can appear in some very large numbers at river mouths throughout Aotearoa-NZ. In rivers, juvenile smelt are often captured by whitebaiters as they migrate upstream and mix with the whitebait, for example, in the lower Waikato River they are known as 'number two whitebait' (Mahuta et al. 2016).

The common smelt is widespread throughout Aotearoa-NZ including Stewart and Chatham Island. They live in flowing and still water, and there are both diadromous (sea-going) and non-diadromous (land-locked) populations in Aotearoa-NZ, although humans have established many of the latter. Smelt are good swimmers and will penetrate well inland into river systems that are not too steep (e.g., the Whanganui and Manawatū Rivers). They are particularly abundant in the Waikato River catchment. They can reach 165 mm, but more commonly do not exceed 120 mm.

Stokell's smelt superficially resembles the common smelt (Figure 61) but is sufficiently different to warrant a new genus name, *Stokellia*. Stokell's smelt has smaller scales than the common smelt and there are differences in the teeth that are used to tell the two species apart. The small, fleshy, adipose fin can be used to distinguish smelt from galaxiids, but smelt can be distinguished from the salmonids (which have an adipose fin) by the absence of a lateral line. Stokell's smelt are slightly smaller than common smelt, usually around 70–85 mm with a maximum length of around 100 mm.

7.1 Life Cycle

During a study of smelt populations within the Waikato River catchment, Booker (2000) identified three forms of smelt, based on life histories which have adapted to the different environments available to them since the hydroelectric dams have gone in: (1) Lacustrine (associated with lakes, e.g., Lake Taupō); (2) Reservoir (associated with the reservoirs, e.g., Lake Ōhakuri); and (3) Riverine/diadromous (have access between fresh water and the sea). Booker (2000) found that differences between forms and between populations occurred with changes in habitat structure and water quality. Differences include the number of gill rakers and vertebrae, size at maturity, maximum length and weight, fecundity, and relative density — as well as behavioural differences such as spawning period. Booker (2000) considered the reservoir form to be an intermediate form between the dwarfed Lake Taupō smelt and the larger diadromous form in the lower Waikato River.

In waterways where there are no significant barriers, common smelt is a diadromous species that usually spends most of its life at sea, with mature adults returning to fresh water to breed. Juveniles hatch in fresh water and migrate out to sea at around 15–30 mm in length before returning to spawn after they have matured. This species can live up to four years of age, maturing at one year with an average generation time of 1.5 years. The main elements of this riverine life cycle are duplicated in lake-dwelling smelt populations (Ward et al. 2005). Spawning takes place annually in shallow, sandy margins of lakes and sandy river banks; however, lake and riverine populations spawn at different times of the year.

Stokell's smelt is also a diadromous species that follows a similar life-history pattern to common smelt. Stokell's smelt probably spends most of its life in the marine environment and they only reach 1–2 years of age (McDowall 1990). They enter fresh water to spawn in late spring and summer, and can be extremely abundant at times. The adults are likely to die after spawning. The fry hatch out at around 5 mm in length and then little is known about their seaward migration and the marine phase of this species. Despite common smelt forming many land-locked populations throughout Aotearoa-NZ, Stokell's smelt are not thought to do the same.

7.2 Distribution

Common smelt are widely spread throughout Aotearoa-NZ and there are diadromous and land-locked populations throughout the country (Figure 62). Both diadromous and land-locked populations are included in the below plot because it is not possible to separate diadromous from non-diadromous stock within the NZFFD. Generally, the locations close to the ocean will be diadromous populations, but the records from inland areas (e.g., Te Arawa Lakes, Taupō-nui-a-Tia) will be land-locked populations because of stocking (Rowe & Kusabs 2007). Common smelt populations are intermittently found throughout the South Island, but are more commonly found in the North Island. The Waikato region appears to contain the highest numbers of common smelt observations in Aotearoa-NZ.

Stokell's smelt are only found in the Canterbury region, with only a few observations being recorded (Figure 62). It is likely that this species is more common than the NZFFD records represent, but they are simply under recorded because of the difficulties in identifying this species from common smelt. This means that some of the common smelt observations from Canterbury in the NZFFD may also include Stokell's smelt.

Figure 2: Locations of NZFFD records where (Left) common smelt, and (Right) Stokell's smelt are present (black circles) and absent (grey circles).

7.3 State and Trends in Abundance

Smelt state and trends in abundance were unable to be assessed by Crow et al. (2016). Trends in the relative abundance of common smelt and Stokell's smelt are not presently known.

Rowe and Kusabs (2007) explain that conventional sampling techniques (e.g., seine and fyke netting) are not effective for smelt population estimation because their catchability varies greatly with the weather (e.g., wind/wave action, cloud cover), the seasons, as well as with lake water conditions (e.g., temperature, turbidity). Mid-water trawling in lakes has been attempted and has limitations for daytime sampling; however, it may prove useful at night when smelt migrate to the surface waters of lakes and are likely to be more vulnerable to netting. Because of the lack of direct sampling methods for smelt population assessment, high frequency (200 kHz) echosounding was used to study their spatial distribution in the Te Arawa lakes (Rowe 1993; 1994; 2005, Rowe et al. 2001a; 2001b). This has been successful and we understand that acoustic methods are being used by Environment Bay of Plenty and DOC to estimate smelt populations in the Te Arawa Lakes and Taupō-nui-a-Tia.

7.4 Threat Rankings

The latest New Zealand Threat Classification System assessment classified *R. retropinna* as 'Not Threatened' and *S. anisodon* as 'At Risk – Naturally Uncommon' due to their restricted range (Goodman et al. 2014). In 2014, *R. retropinna* was assessed by IUCN as being of 'Least Concern'. Although this panel recognised that populations are likely to have undergone historical declines since the arrival of European settlers (from which they did not recover), they considered that the population has stabilised (Franklin et al. 2014) (Table 10).

Stokell's smelt is classified as being of 'Least Concern' by the IUCN threat ranking system because this species is extremely abundant locally within its limited range along the Canterbury coastline, although it is not common in smaller rivers (McDowall 2000). No information is available on population trends for this species (David et al. 2014) (Table 10).

Table 1: Threat rankings for Aotearoa-NZ porohe species according to the New Zealand Threat Classification System and IUCN. (see Section 2.3 for more information about these assessment methods).

Species	DOC Ranking	IUCN Ranking
Retropinna	Not Threatened	Least Concern (Populations stable)[1]
Stokellia anisodon	At Risk–Naturally Uncommon	Least Concern (Population trend unknown)[2]

7.5 Pressures on Populations

Several pressures on smelt populations have been identified (Figure 63), many of them common to whitebait species. Smelt are very sensitive to changes in their physical environment and are one of the most sensitive native fish species in Aotearoa-NZ (e.g., Hickey 2000, Rowe et al. 2002a, Landman et al. 2005).

[1] http://www.iucnredlist.org/details/197325/0
[2] http://www.iucnredlist.org/details/197327/0

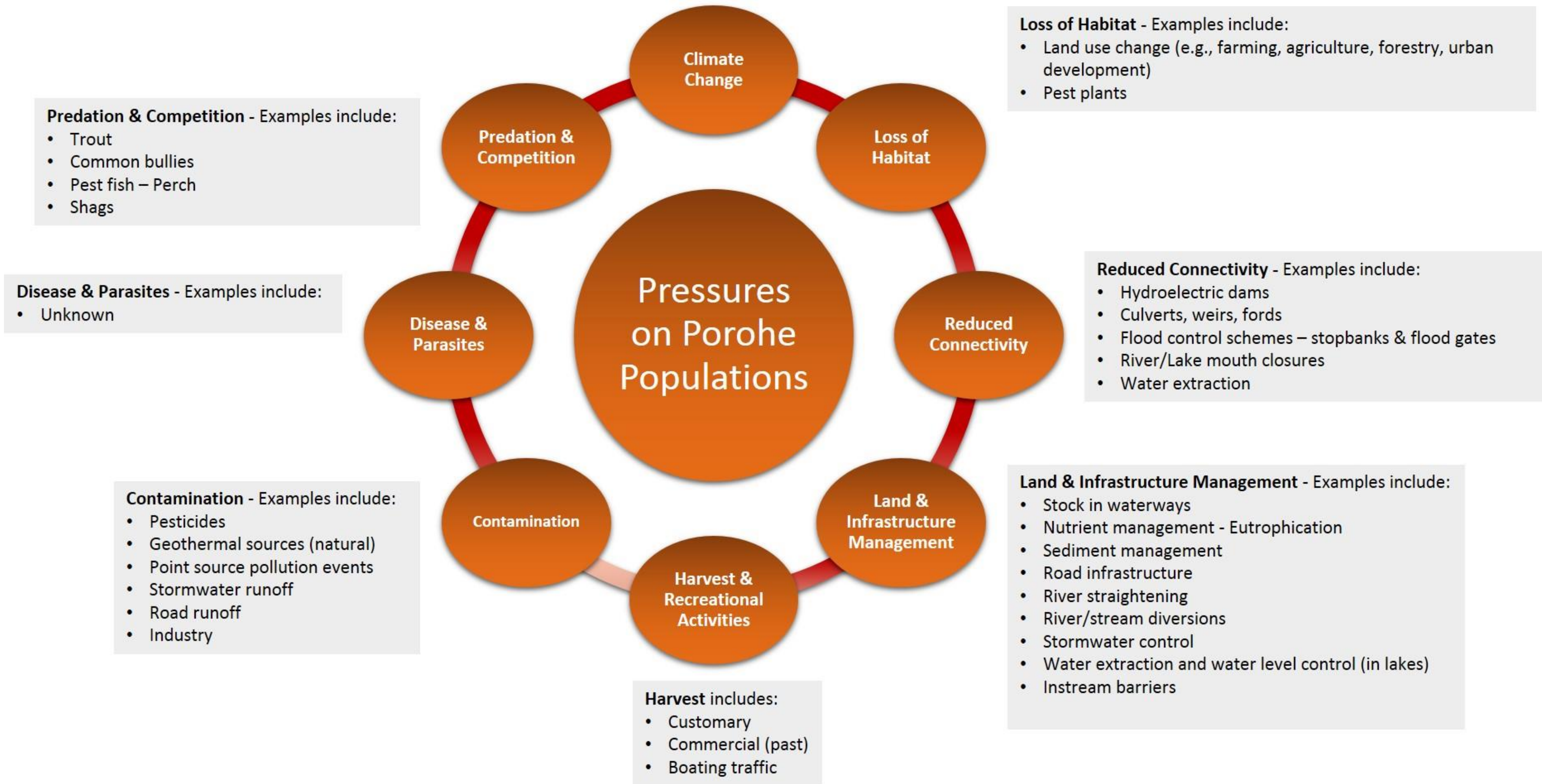

Figure 3: Examples of some of the pressures on Aotearoa-NZ smelt populations.

7.5.1 Land and Infrastructure Management

Smelt habitats are likely to be impacted by water abstraction, agricultural development and land-use changes resulting in the siltation of lowland spawning habitats in large rivers. Smelt are relatively more abundant in the clearer lakes than in the more productive, turbid ones (Peterson 1982, Rowe & Taumoepeau 2004). That said, increased turbidity does not appear to affect smelt directly as feeding rates are not reduced by turbidities up to 160 NTU (Rowe & Dean 1998, Rowe et al. 2002a). 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 for 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 recruitment has been shown to be reduced in the more productive, turbid lakes in the Rotorua district compared with the clear, less productive lakes (Rowe & Taumoepeau, 2004). Although field data on adult smelt abundance in the Te Arawa lakes are limited (Peterson 1982), they nevertheless support the suspected lower smelt abundance in the more productive lakes (Rowe & Kusabs 2007). The reduced recruitment of smelt in the more productive Te Arawa lakes has been attributed primarily to increased turbidity and the resultant siltation of sandy substrates, which degrades smelt spawning habitats on beaches (Rowe & Taumoepeau 2004). However, egg predation from the increased abundance of bullies may be an important contributing factor. Increased lake productivity not only increases siltation of lake beds by organic particulates, but it also increases both hypolimnetic de-oxygenation and the incidence of blue-green algae blooms. Hypolimnetic de-oxygenation, coupled with increased turbidity from high densities of planktonic algae, has been shown to reduce depth habitat for smelt in lakes (Rowe & Taumoepeau 2004). Increases in the trophic status of lakes therefore affect smelt in several ways, but the most important is likely to be a reduction in recruitment caused by high egg mortality (Rowe & Kusabs 2007).

Lake-level control may also affect smelt spawning habitat in lakes (Rowe et al. 2002b). The maintenance of clean sandy beaches in lakes is dependent on wave action (i.e., on exposure to prevailing winds and on fetch). In exposed areas of shoreline, wind patterns will have the main influence on smelt spawning habitat. However, in sheltered areas or small lakes, the presence of clean sandy beaches is more dependent on seasonal lake-level fluctuations which expose shorelines to desiccation and then re-inundate them, resulting in a clean sandy substrate. This natural cycle ensures that silt build up is minimised and more importantly, that macrophyte growth is restricted to deeper waters. When lake levels are controlled between very narrow limits (20 cm or less) macrophytes can be expected to invade shallow waters, reducing the inshore zone of sandy habitat (Rowe & Kusabs 2007).

7.5.2 Contaminants

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 the salmonids, which are often used as a benchmark species overseas for establishing water-quality guidelines to ensure fish are protected from human activities. Smelt have been promoted as an appropriate native species for establishing guidelines for Aotearoa-NZ waterways (Rowe & Kusabs 2007) and usually their presence indicates that the water quality is suitable for most other fish.

7.5.3 Predation

In most North Island lakes, smelt are the main prey species for trout and have been specifically introduced for that purpose. For example, smelt were not naturally present in Taupō-nui-a-Tia, they were introduced to support trout populations after they decimated the kōaro populations. A major threat to the smelt populations could be posed by the introduction of exotic fish. The main species of concern is perch (*Perca fluviatilis*). Because it is a limnetic piscivore (mainly eats fish), it could be expected to impact heavily on the inshore populations of smelt, bullies and kōura. Predation by perch would reduce these species especially in more productive lakes (Rowe & Kusabs 2007).

7.5.4 Other Factors

Rowe and Kusabs (2007) indicate that factors other than increased trophic status may also impact on smelt spawning habitats in lakes. For example, ski-lanes are often cited in the middle of clean sandy, shallow beaches around the lake and these beaches are intensively utilised over summer months by water-skiers. This use coincides with smelt spawning and may be inappropriate in some situations, due to the effects on eggs. Rowe and Kusabs (2007) express that there is a need to better coordinate between recreational use and smelt spawning requirements in the Te Arawa Lakes.

7.6 Management

In some rivers (e.g., the Waikato River), juveniles are captured by whitebait fishers as they migrate upstream and mix with galaxiids (Mahuta et al. 2016). There was a commercial harvesting operation of smelt on the Waikato River, and in the 1980's from the Ashburton Estuary, but this ceased shortly after starting. Commercial buyers of whitebait from the Waikato River purchased one to two tonnes of smelt per annum between 1974 and 1985 (Stancliff et al. 1988), but catches of smelt have declined in recent times (NIWA 2010). Between 1990 and 2005, annual purchases of smelt from the Waikato River were less than 0.25 tonnes per annum (Baker & James 2010). This decline was not due to a drop in smelt abundance in the river, and reflects the decreased importance of smelt in whitebait catches (NIWA 2010).

There are significant cultural harvests that still occur to this day in the Whanganui and Rangitīkei, with whānau still using traditional fishing methods (McDowall 2011).

There are currently no management or conservation initiatives for the smelt fishery in Aotearoa-NZ. If specific management 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 fishery in Aotearoa-NZ.