

Schedule 2 – Fish spawning and migration calendar

The fish calendar is summarised in Table S2 1 and Table S2 2. If the recruitment of all species in the Bay of Plenty is considered, there is no time when an activity will be allowed. It is in a developer's interest to identify what species are present and what recruitment activities are likely to be affected by a given activity. Whitebait runs, inanga spawning, elver migrations, downstream adult eel migrations and trout spawning represent the main recruitment events for freshwater fish in the Bay of Plenty. Development is unlikely to affect more than one or two of these activities and so restrictions on development will usually be short. For example, only activities that affect the tidal reaches of rivers have the potential to damage inanga spawning sites. Some streams are inaccessible to whitebait and therefore allowing for migration is not always a consideration. In some cases it may be worthwhile monitoring fish directly to determine when recruitment starts. For example, whitebait could be monitored to track when migration reaches the affected site to allow an extra few days/weeks of instream works. The more effort put into identifying the affected ecosystem the narrower the restriction period is likely to be. The following steps are recommended when using the calendars:

- 1 What fish are present in or pass through the affected reach?

Identifying the species present might involve fishing, reviewing existing records (e.g. NZ Freshwater Fish Database), extrapolating from fish records of nearby streams, or taking an educated guess at what species are likely to occur there. The latter options will need to be more conservative (i.e. produce longer species lists).

- 2 What recruitment activities do these species carry out in the affected reach?

Do the species identified in step 1 spawn in or migrate through the affected reach? For example, inanga spawning takes place in the tidal reaches of rivers and streams, adult trout migrate up river to spawning streams.

- 3 Use the calendar to identify what times of year this recruitment takes place.

For example, if bridge supports are to be constructed in a small coastal stream that supports inanga only, construction should avoid the August to October period when whitebait are likely to be migrating upstream.

Further Considerations

Decisions on a final time frame should take into account the importance and vulnerability of the fishery. For example, giant kokopu and shortjawed kokopu are threatened species and so the exclusion period should extend through the peak and range of activity. The same might apply for significant inanga spawning sites.

The times of year given in the calendar for diadromous migrations (whitebait and elvers) apply to coastal streams. The young fish can take a while to reach inland sites. For example, elvers that entered the Rangitaiki estuary in September don't reach the Matahina Dam until January. Migrations speeds were estimated by some authors and are presented in the literature review. These could be used to estimate time of arrival for inland sites.

There is little or no information available for the spawning and migration of many species. Timing of these events varies from year to year and between regions, so results that are based on single river season studies have predictably narrow periods of activity. Further research is needed, but in the meantime caution is needed when interpreting results for less studied species.

Table S2 1 Whitebait and Juvenile Migration Summary

Peak activity is shown in black, range of activity in grey

	Winter			Spring			Summer			Autumn		
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Inanga ¹												
Banded Kokopu ¹												
Koaro - sea run ¹												
Koaro – lake run												
Giant Kokopu												
Smelt - sea run												
Smelt – L. Rotorua ²												
Redfinned Bully												
Common Bully												
Eel ³			4.	4.	4.							

- 1 Principal whitebait species.
- 2 Principal whitebait species in Rotorua Lakes.
- 3 Two species of eel moving at overlapping times of year.
- 4 Glass eels moving into harbour mouths and estuaries.

Table S2 2 Spawning Summary

Peak activity is shown in black, range of activity in grey

	Spring			Summer			Autumn			Winter		
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Inanga												
Banded Kokopu ¹												
Koaro ²												
Giant Kokopu ¹												
Shortjawed Kokopu ¹												
Smelt - ocean run												
Smelt – L. Rotorua												
Eel ³												
Trout spawning ⁴												
Trout egg develop. ⁵												

- 1 Spawning migrations away from adult habitat poorly known or infrequently documented.
- 2 Spawning migrations not likely.
- 3 Two species of eel moving at overlapping times of year.
- 4 Brown's and Rainbow's migrating upstream and spawning.
- 5 Brown's and Rainbow's egg and elver development in gravel's.