

# Modelling the water balance of Te Waihora for the National Water Conservation Order amendments

Graeme Horrell



# Te Rūnanga o Ngāi Tahu (Ngāi Tahu) and the Department of Conservation (DoC) jointly applied to amend the National Water Conservation (Lake Ellesmere) Order 1990

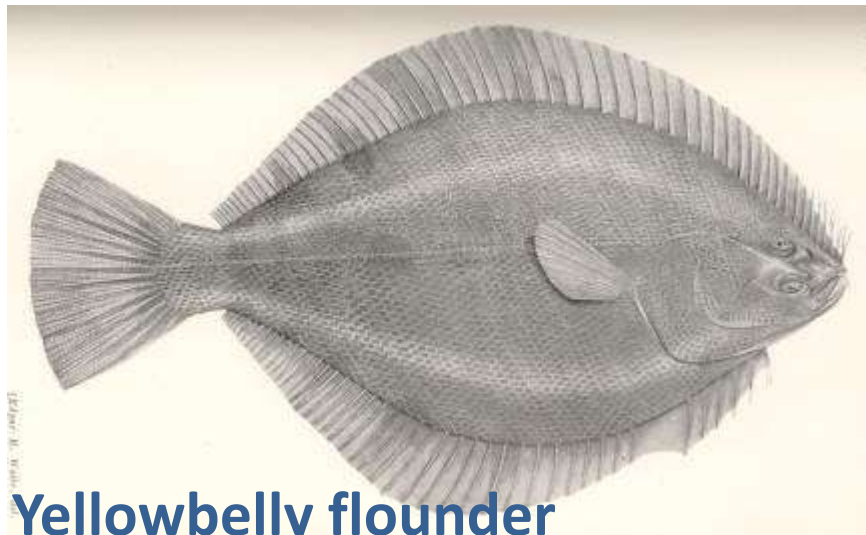
- Previous WCO identified wildlife habitat as the only outstanding feature – limited to birdlife habitat
- Expanded to include aquatic species such as tuna (eel) or patiki (flounder)

The aim of managing for indigenous fisheries is to get the openings at a time that assists fish passage for recruitment and migration thereby protecting and enhancing mahinga kai of Te Waihora.

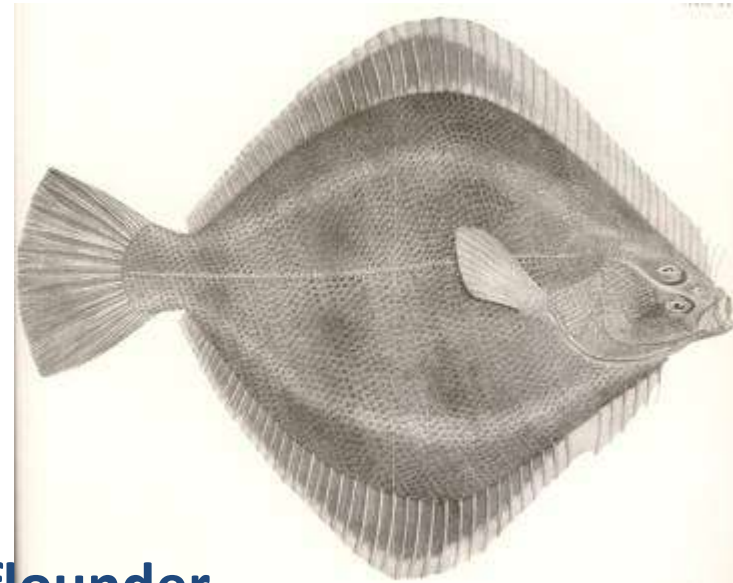


# Recruitment (Don Jellyman)

- Whilst the preferred recruitment time is mid August to mid November.
- However the mid September to mid October opening, would be good for glass eels, reasonable for Yellowbelly and Sand flounder, but not so good for Black flounder.



Yellowbelly flounder



Sand flounder

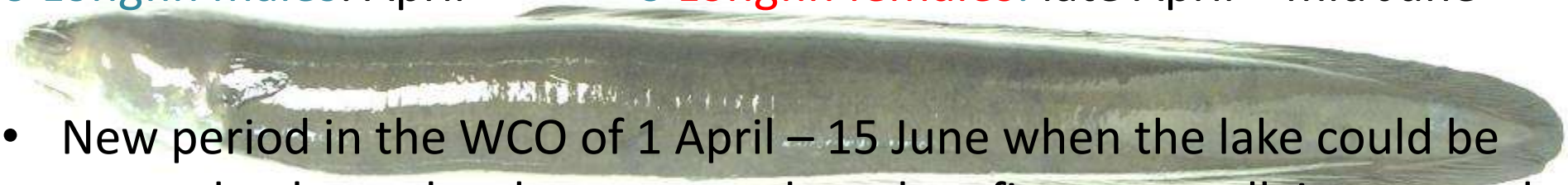


# Migration (Don Jellyman)

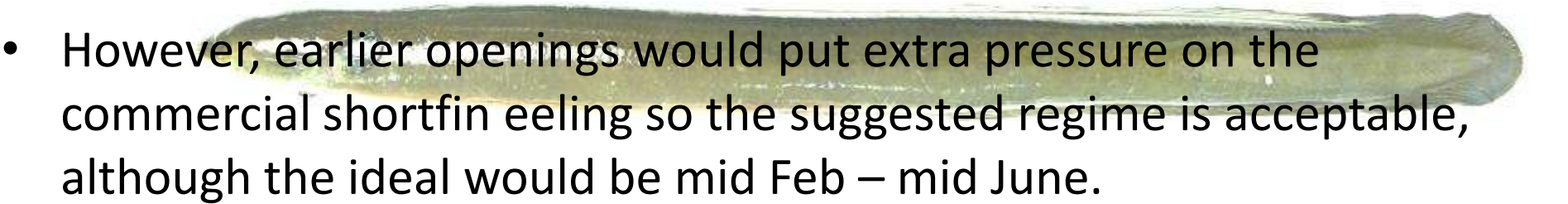
The main eel (tuna) migration periods are:



- o Shortfin males: mid Feb – mid March
- o Shortfin females: March
- o Longfin males: April
- o Longfin females: late April – mid June



- New period in the WCO of 1 April – 15 June when the lake could be opened at lower levels accommodates longfins very well, is not good for shortfin.
- However, earlier openings would put extra pressure on the commercial shortfin eeling so the suggested regime is acceptable, although the ideal would be mid Feb – mid June.
- For flounders (pātiki), the suggested regime should be adequate, although they would probably have a preference for later e.g. May – July.
- If flounder miss the opportunity to migrate to the sea they will stay in the Lake for another year and get bigger.





Inflows

38 years of daily information

**$I_t$  = tributary inflows**

**$I_r$  = inflow due to rainfall on the lake**

**$I_s$  = Kaitorete Spit seepage inflows**

**$I_g$  = groundwater seepage inflows**

**$I_{as}$  = artificial opening sea incursion inflow**

**$I_{rs}$  = rough weather sea incursion inflow**

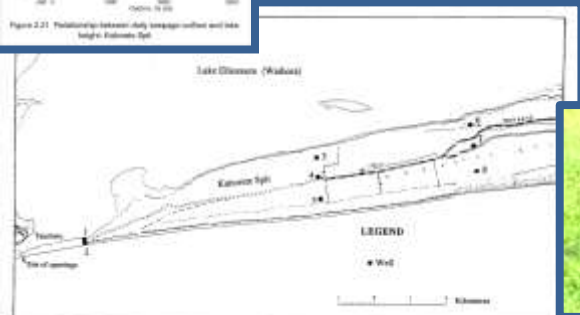
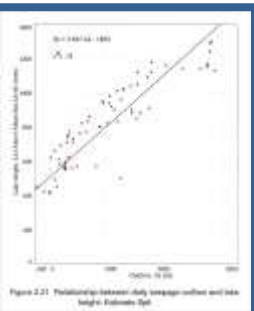
**$O_s$  = Kaitorete spit seepage outflow**

**$O_e$  = evaporation**

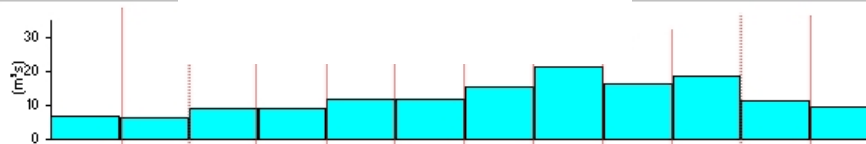
**$O_a$  = artificial opening outflows**

**$\Delta S$  = change in storage**

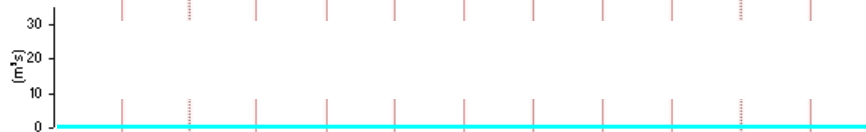
Outflows



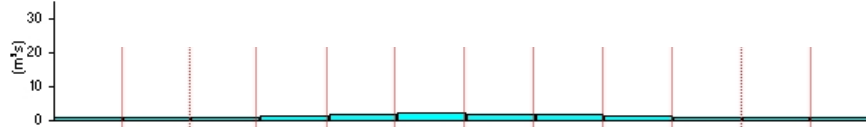
Tributary inflows



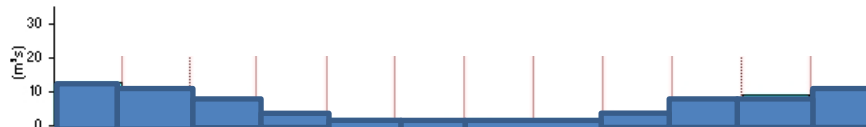
Groundwater inflows



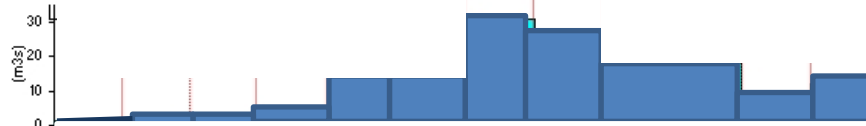
Rough weather sea incursions



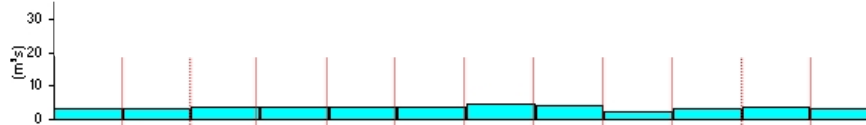
Evaporation



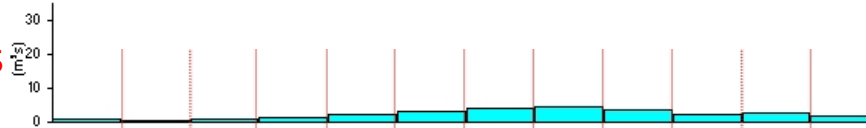
Outflows



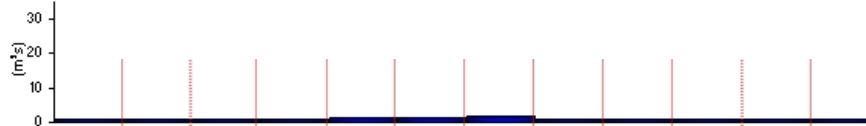
Rainfall



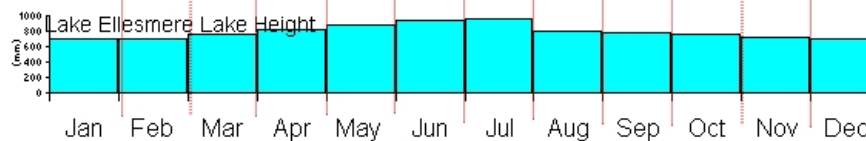
Artificial opening sea incursions



Kaitorete Spit seepage



Lake level

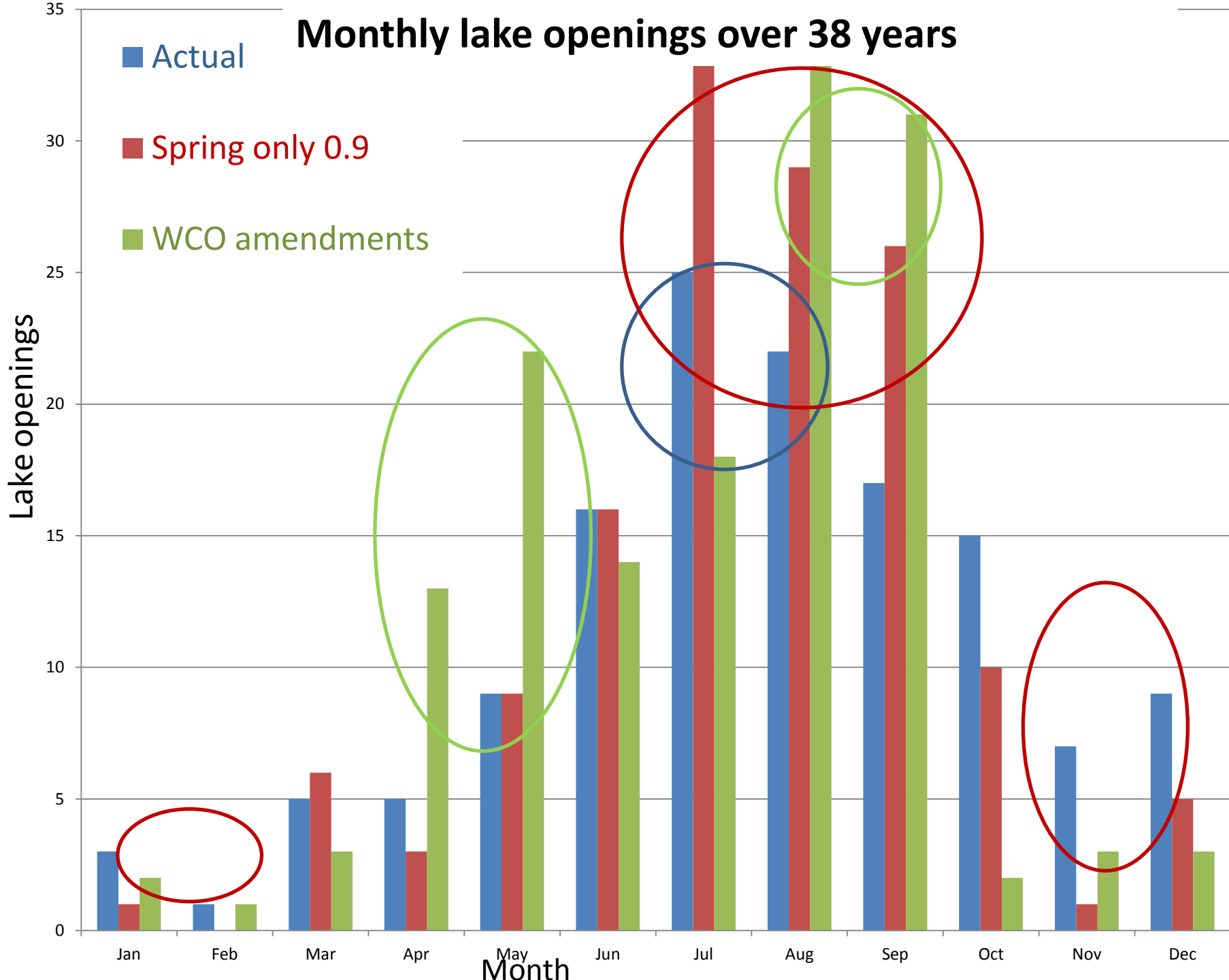


# Lake water balance modelling

- **Scenario 1 “Actual”** – what actually happened during the last 38 years
- **Scenario 2 “Spring only 0.9”** – using the previous WCO opening opportunity between 15 Sept – 15 Oct but at 0.9 m lake height and
  - 1.05 m 1 August – 31 March
  - 1.13 m 1 April – 31 July
- **Scenario 3 “WCO amendments”**
  - 1.05 m 1 August 1 – 14 Sept
  - 0.9 m 15 Sept – 15 Oct **Spring recruitment**
  - 1.05 m 16 Oct – 31 March
  - 0.9 m 1 April – 15 June **Autumn migration**
  - 1.13 m 15 June – 31 July 31



# Monthly lake openings over 38 years



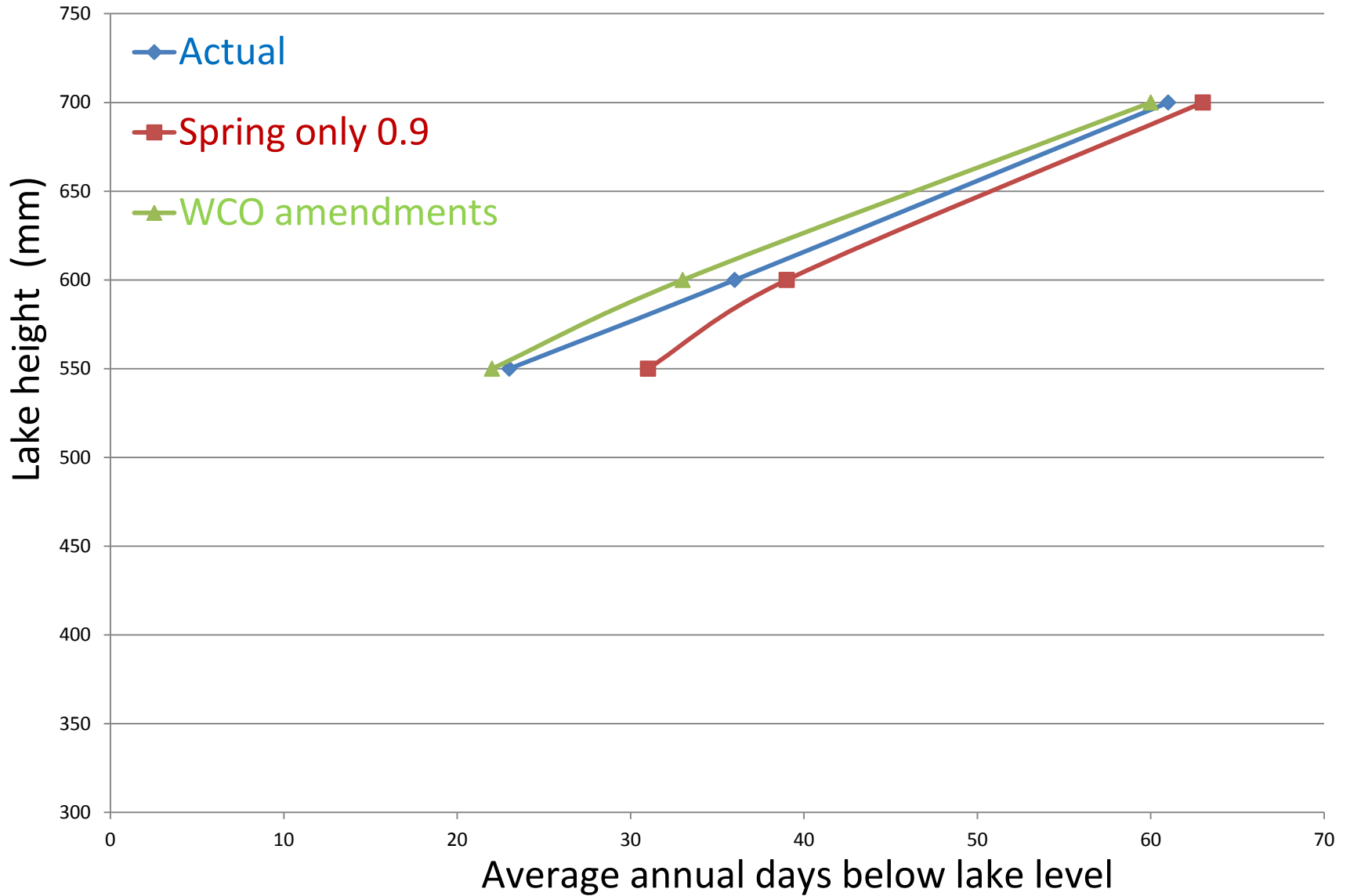
# Modelling results using 38 years of daily information

	<b>Autumn Migration</b>		<b>Spring Recruitment</b>	
	Years with openings between 1 April and 15 June		Years with openings between 15 Sept and 15 Oct	
<b>Actual</b>	18		13	
<b>Spring 0.9 m</b>	16		26	
<b>WCO amendments</b>	30	70% increase	22	70% increase

# Summer low lake levels to be avoided

- Low lake levels decimate the lake edge wetlands which is the key feeding habitat for international migratory birds.
- These birds come to Te Waihora to feed, then return to the Northern hemisphere to breed.
- There are international agreements to preserve the habitat for migratory birds.

# Days lake level is low between December and April (on average annually )



# Summary - WCO amendment improvements

- 70% increase in the number of years with spring openings will enhance fish recruitment
- 70% increase in the number of years with autumn openings will enhance fish migration
- Reduction in the duration of low lake levels in summer will improve the habitat for migratory birds



Taihoro Nukurangi