Lake Arapuni Triploid Trout Final Report June 2026

Executive Summary

- A sterile trout stocking trial was conducted in Lake Arapuni between 2020 and 2023, involving the release of 4,000 tagged sterile (triploid) trout and 4,000 tagged control (diploid) trout.
- Tag return data collected through to June 2026 showed that sterile trout accounted for only 38% of all reported recaptures, despite being stocked in equal numbers to the control fish.
- Growth analyses from reported returns indicated that sterile trout did not exhibit faster growth rates or greater growth potential than the control trout population within Lake Arapuni.
- The lower recapture rate and lack of growth advantage suggest that sterile trout provide reduced angler returns compared with standard diploid trout. Consequently, any future stocking of sterile trout in Lake Arapuni is not considered justified.

Background

The sterile trout investigation was initiated in 2020 to evaluate the hypothesis that stocking reproductively viable hatchery trout may negatively affect the spawning success and genetic integrity of wild rainbow trout populations within Lake Arapuni.

The potential benefits of stocking sterile trout included:

1. **Protection of wild trout genetics** by preventing hatchery-reared fish from interbreeding with naturally spawning resident trout. Hybridisation between hatchery and wild fish may reduce the expression of locally adapted traits and diminish the overall genetic fitness of wild populations. Overseas studies have demonstrated that offspring produced by naturally spawning wild trout often exhibit significantly higher survival rates than offspring originating from hatchery or hybrid parentage.
2. **Improved fishery quality** through the potential production of larger, trophy-sized rainbow trout resulting from increased growth rates or extended lifespans associated with sterility.
3. **Enhanced management flexibility** by providing fisheries managers in other regions with a stocking option that may be more acceptable to regulatory agencies, as sterile fish are incapable of establishing self-sustaining populations.

Study Design

In 2020, a total of 1,000 sterile rainbow trout and 1,000 diploid (reproductively viable) rainbow trout were released into Lake Arapuni. Fish from each treatment group were tagged in sequential batches (e.g. 1001- 2000 triploid/ 2001-3000 diploid), allowing subsequent angler recaptures to be identified as either sterile or fertile individuals.

The study continued for a further three years, concluding after the 2023 annual release. Over the four-year period, a total of 4,000 sterile trout and 4,000 fertile trout were stocked into Lake Arapuni.

The objectives of the study were to:

1. Assess whether the production of sterile rainbow trout is feasible and cost-effective under New Zealand hatchery conditions.
2. Compare the growth performance of sterile and fertile stocked rainbow trout.
3. Compare the relative survival of sterile and fertile stocked rainbow trout within the fishery.

Methods

Rainbow trout broodstock were collected from the Te Wairoa Stream, a tributary of Lake Tarawera, and transferred to the Ngongotaha Hatchery for spawning. Following fertilisation, trout ova designated for the sterile treatment were subjected to a hydrostatic pressure shock of 10,000 psi to induce triploidy and produce sterile offspring.

Triploidy of the first treatment batch was verified by staff at the University of Waikato through analysis of a subsample of progeny, confirming successful sterilisation.

Triploidy Induction Procedure (Sterilisation)

Following fertilisation, eggs were subjected to the following pressure treatment:

1. Fertilised eggs were held for 300 temperature-time units (calculated as 300 divided by water temperature in °C; approximately 27 minutes at 11°C).
2. Eggs were maintained in aerated or circulating water and placed within the pressure chamber prior to treatment.
3. The pressure chamber was completely filled with water to eliminate trapped air and ensure proper sealing of the O-rings.
4. The chamber lid was secured and all air purged through the bleed valve before placement into the hydraulic press.
5. At the prescribed treatment time, pressure was rapidly increased to 10,000 psi and maintained for five minutes. The objective was to achieve full pressure precisely at the required developmental stage.
6. Pressure was then released, and the eggs were returned to standard hatchery incubation procedures.

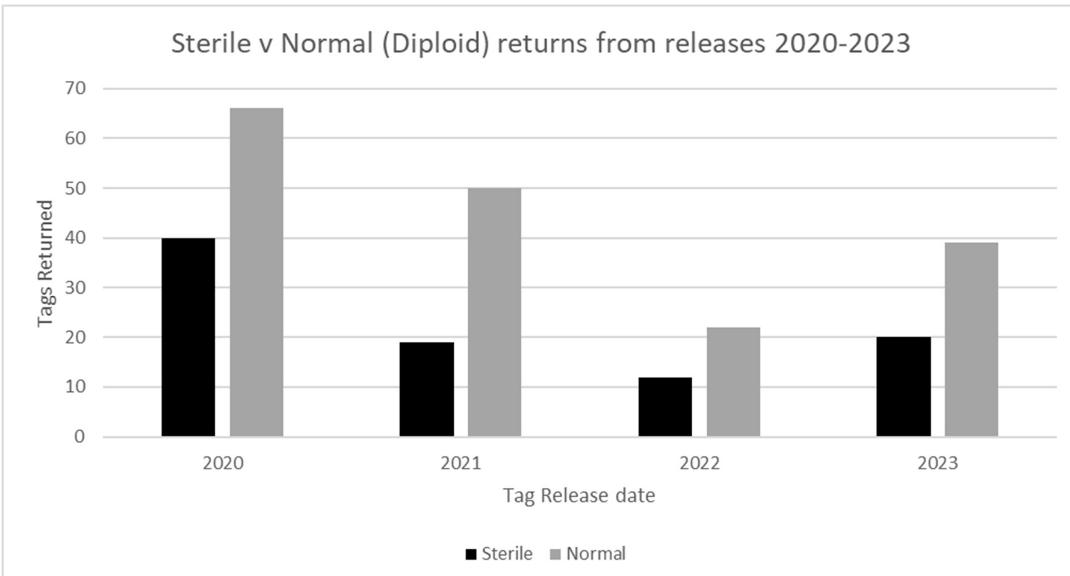
Following pressure treatment, sterile and control groups were reared under identical hatchery conditions. Both groups were incubated, fed, tagged, transported, and released using the same protocols. Although fish were maintained in separate troughs and tanks to preserve treatment integrity, husbandry practices and feed allocations were consistent between groups throughout the rearing period.

Tag Reporting

Anglers were fundamental in the reporting of tagged fish recaptures. An annual Lake Arapuni fishing competition was also attended by Auckland/ Waikato Fish and Game Staff who were assessing fish metrics, catch rates and in latter years (2025/ 2026) angler satisfaction.

Results

Tags Returned



Graph 1. Actual reported returns of sterile and normal fish

	2020	2021	2022	2023	Average
Sterile	38%	28%	35%	34%	34%
Normal	62%	72%	65%	64%	66%

Table 1. Percentage of tagged fish returns (Sterile programme) by year of release 2020-2023 reported during the period 2020-2026

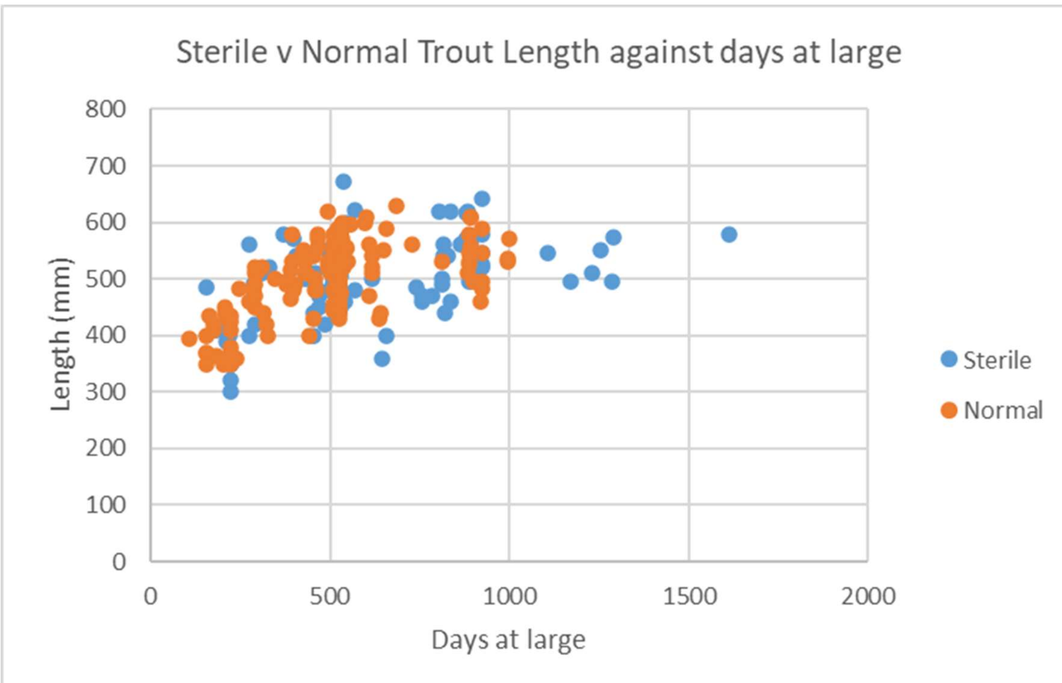
Over the period of the investigation 2020 to 2026, the normal (diploid) fish averaged 66% of the total reported returns from their liberation years.

Five tagged fish were recaptured downstream in Lake Karapiro. These fish had migrated downstream over the dam bypass during one of the regular spilling events. Four of those fish were from the 2020 liberation undertaken in October. Four of the fish were from the 'sterile' tag groups. It is unknown at which stage they passed into Karapiro – either closely following liberation or later, but they showed no greater growth or size than the fish returned from Arapuni. Other tagged fish could also have slipped over into Karapiro or even been minced through the turbines.

Tag	Sterile	Release	Capture	Length
741	Yes	Dec 23	Dec 25	?
4224	Yes	Oct 20	Mar 25	580
5301		Oct 20	Jan 22	480
4641	Yes	Oct 20	Jan 22	490
4514	Yes	Oct 20	Jan 22	510

Table 2. Downstream migrants reported as captured in Lake Karapiro

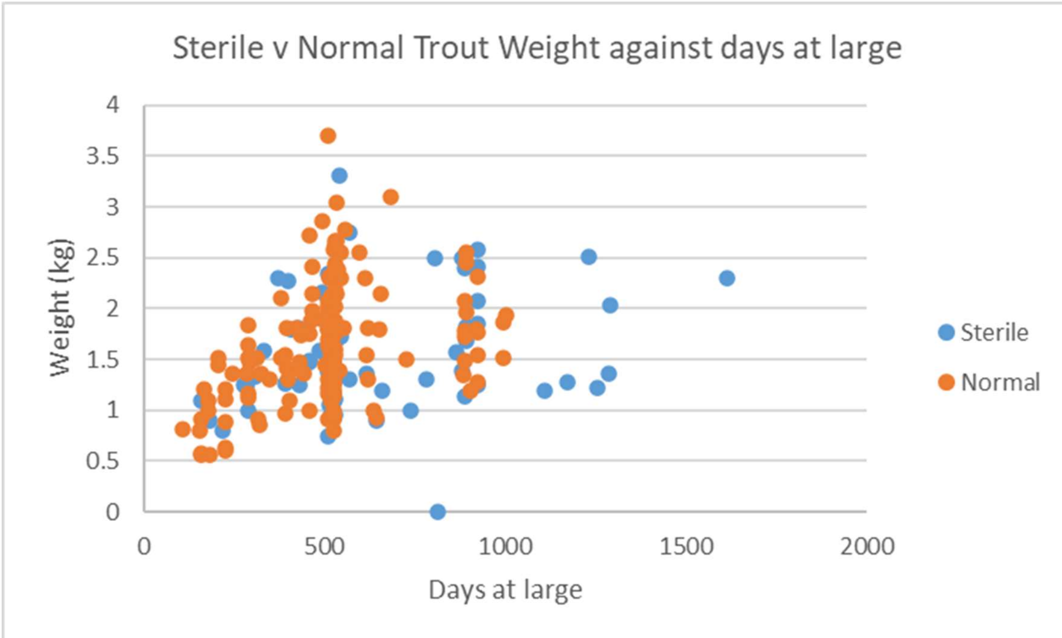
Growth of Sterile versus Control (diploid) trout.



Graph 2. Length (mm) at capture of Sterile v Normal trout against days post release.

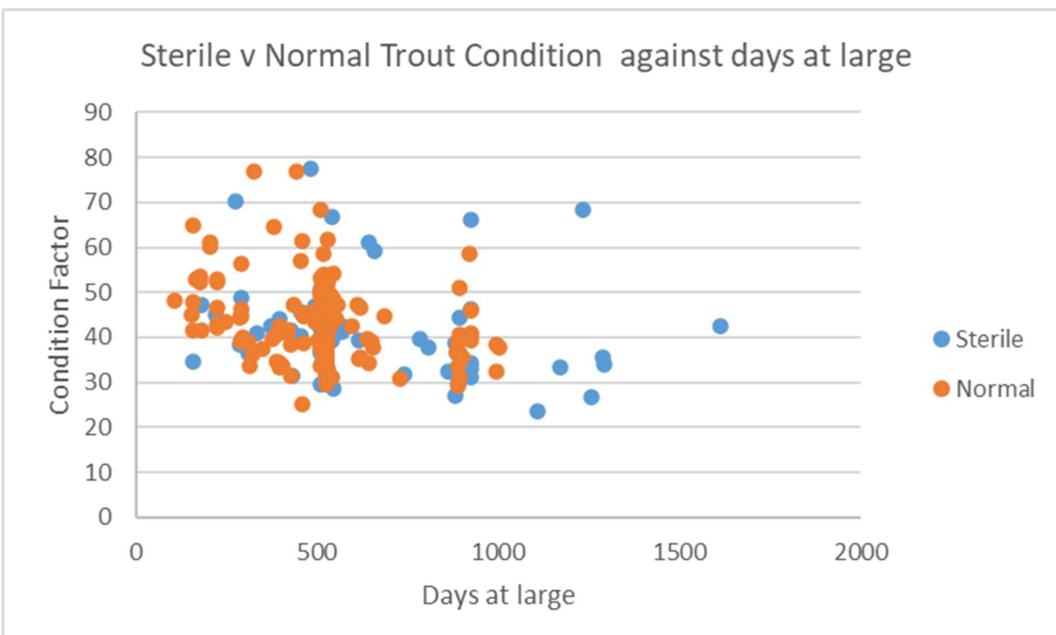
Sterile trout, as a group, did not exhibit a greater capacity to attain larger sizes than the control group of normal (diploid) trout. The largest fish recorded during the study was a sterile trout released in 2023, which reached 673 mm in length and 3.31 kg in weight. However, this individual may represent an outlier rather than a general trend within the sterile population (Graph 2).

The seven trout with the longest periods at large following release (1,108–1,613 days) were all from the sterile treatment group. These fish ranged in size from 485 to 580mm and did not achieve larger sizes than comparable fish in the diploid control group despite their extended time at large in Lake Arapuni.



Graph 3. Weight (kg) at capture of Sterile v Normal trout against days post release.

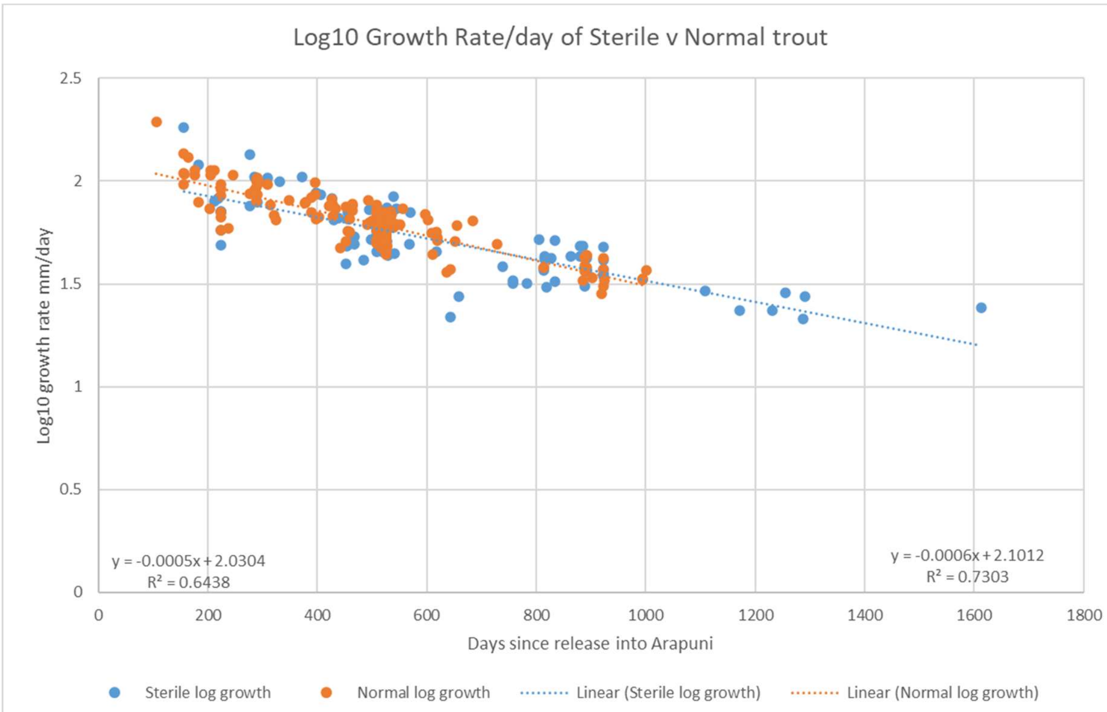
Both sterile and diploid (control/ normal trout) displayed almost identical returns in weight gain following release into Arapuni (Graph 3).



Graph 4. Condition factor at capture of Sterile v Normal trout against days post release.

Condition factor calculated from tagged fish return reports displayed very similar trends between sterile and diploid (normal) trout across the time frame at large albeit with occasional outliers. This could be a function of reporting errors. Fulton's condition factor was used which gives higher ratings for shorter, fatter fish compared to longer skinnier fish.

Growth analysis indicated that diploid trout exhibited higher growth rates than sterile trout during the first 600-700 days after release. This period coincided with the onset of sexual maturation in the diploid fish prior to spawning. Beyond this point, growth rates of the sterile trout slightly exceeded those of the diploid group; however, the difference was marginal (Graph 5/ Table 3).



Graph 5. Growth rate of Sterile v Control released trout (2020-2023) against days post release.

age	2yrs		3yrs		4yrs		5yrs
days post release	365		730		1095		1460
Sterile Trout Growth per day compared to Normal trout (mm)	-0.0406		-0.0041		0.0324		0.0689

Table 3. Estimated growth rate of sterile and normal trout from sterile trout investigation.

Arapuni Fishing Competition

The Arapuni fishery is heavily dependent on hatchery releases with wild fish averaging 26% (11-35%: Table 4) of the total fish competition catch in Lake Arapuni in the 10-yr-period prior to the sterile trout investigation (2010-2020).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Ave
Hatchery	42	34	64	39	40	53	71	47	24		32	45
Wild	23	14	33	13	17	9	9	6	28		10	16
%Wild	35%	29%	30%	24%	29%	15%	11%	11%	54%		24%	26%

Table 4. Arapuni fishing competition returns 10 years prior to sterile trout trial (diploid released trout)

	2021	2022	2023	2024	2025	2026	Ave
Hatchery	54	28	43	30	40	27	37
Wild	23	13	41	24	46	36	31
%Wild	30%	32%	49%	44%	53%	57%	44%

Table 5. Arapuni fishing competition returns with sterile + diploid released trout (to 2024)

During the Sterile trout (triploid) investigation, wild trout averaged 44% (2021 – 2026 Arapuni fishing competitions) (Table 5.)

Discussion

For the purposes of this study, it was assumed that both tag retention and post-release survival were equivalent between sterile and diploid trout. There is no evidence to suggest systematic differences in either parameter between the two treatment groups.

One possible explanation for differences in angler recapture rates is behavioural rather than survival related. Diploid trout undergo sexual maturation and may congregate around tributary mouths during autumn and winter as they prepare to spawn, increasing their vulnerability to anglers targeting these locations. In contrast, sterile trout do not mature and may remain distributed throughout the lake during this period, potentially reducing their catchability relative to diploid fish.

Growth data indicated that sterile trout did not exhibit faster growth than diploid trout prior to the onset of sexual maturity. In fact, diploid trout generally displayed higher growth rates during the first 600–700 days following release. As diploid fish approached maturity, growth rates declined as energy was increasingly allocated to gonad development, spawning activity, and post-spawning recovery. Although sterile trout should not undergo reproductive development, the reported trout from the sterile group also demonstrated a reduction in growth rate with increasing age. The seven sterile trout recaptured after the longest periods at large (1,108–1,613 days, equivalent to approximately 4–5 years of age) measured only 495–580 mm fork length, indicating that extended longevity did not necessarily translate into substantially larger fish. Teuscher et al. 2003 indicated that returns of sterile rainbow trout in Idaho Reservoirs were prone to producing highly variable performances in growth rates within triploid batches. We assume also that the efficiency of the sterilisation procedure was 100% successful throughout all subsequent treatments even though only the first treatment was verified.

Sterile Trout and Growth Potential

Although laboratory testing confirmed that the pressure-shock treatment successfully produced 100% triploid offspring within the sampled fish, it is unlikely that all sterile trout possess the capacity to attain exceptionally large sizes.

Triploidy is induced by retaining an additional chromosome set following fertilisation. As a result, female triploids possess three X chromosomes (XXX), while male triploids possess an XXY chromosome complement. Female triploids are functionally sterile and do not produce eggs. Male triploids, however, may still undergo partial sexual development and produce milt, although the sperm is infertile. Consequently, male triploids may exhibit spawning-related behaviours, including attendance at spawning sites and interactions with reproductively viable fish. Such behaviour has the potential to disrupt natural spawning activity through competition with fertile males, despite their inability to successfully fertilise eggs.

Very few anglers recorded the sex of recaptured fish during the study. Of the sterile trout for which sex was reported, ten were identified as female and one as male. Within the diploid control group, 38 fish were reported as female and two as male. The limited sample size prevents any meaningful assessment of sex-specific performance or behaviour.

To maximise the growth benefits often associated with triploid trout programmes, hatcheries typically produce all-female triploid stocks. This is achieved through hormonal treatment of broodstock to generate all-female offspring prior to triploid induction. Such techniques may be considered a form of genetic manipulation and would require careful consideration of regulatory requirements, public acceptance, and social licence before implementation in New Zealand fisheries.

At the commencement of this study, it was stated that any potential genetic benefits to the naturally spawning rainbow trout population in Lake Arapuni would likely require the exclusive stocking of sterile trout over an extended period, potentially a decade or more. Only over such a timeframe could changes in wild fish abundance, condition, or recruitment success be adequately assessed.

Given that stocked fish currently comprise approximately 75% of the trout harvested from Lake Arapuni, the success of a sterile trout programme would depend on maintaining acceptable angler catch rates. If sterile trout are substantially less vulnerable to angling than either stocked diploid fish or naturally produced trout, any long-term benefits to wild spawning success would need to be weighed against potential reductions in fishery performance and angler satisfaction.

Conclusions

1. Feasibility and Cost-Effectiveness of Rearing Sterile Trout

The results of this study demonstrate that the production and rearing of sterile (triploid) rainbow trout is technically feasible in New Zealand. Once the necessary equipment and expertise are available, triploid induction can be undertaken with relatively low additional effort and cost. However, successful implementation requires adequate hatchery infrastructure to maintain separation between sterile and reproductively viable (diploid) stocks throughout the rearing process.

2. Growth Performance of Sterile Trout

Sterile trout exhibited slightly lower growth rates than diploid trout during the period prior to sexual maturity. Following maturation of the diploid fish, growth rates of sterile trout were calculated as being maintained for a longer period albeit at a reducing rate, consistent with the absence of energy expenditure associated with gonad development, spawning, and post-spawning recovery.

Although sterile trout theoretically have the potential to attain larger sizes through increased longevity and continued somatic growth (non-reproductive growth), this outcome was not strongly supported by the results of the present study. While an individual sterile trout reached large sizes, there was no clear evidence that sterile trout consistently achieved greater lengths or weights than diploid trout under the conditions encountered in Lake Arapuni.

The findings suggest that sterile trout do not grow faster than diploid trout. Rather, any size advantage is likely to result from prolonged survival and continued non somatic (non-reproductive) growth over time. Achieving substantially larger sizes may also depend on the availability of suitably large prey resources capable of meeting the bioenergetic demands of big fish growing on.

3. Relative Survival and Fishery Contribution

Based on tag returns from fish released between 2020 and 2023 and subsequent monitoring through June 2026, 38% of reported recaptures were sterile trout, while 62% were diploid trout. These figures represent angler recaptures rather than direct measures of survival and therefore may reflect differences in catchability, behaviour, or reporting rates between the two groups. However, it can’t be discounted that there may be higher mortality of triploid fish post release.

Regardless of the underlying cause, the lower proportion of sterile trout reported by anglers has important implications for fishery management. The primary objective of stocking is to provide angling opportunity and maintain fishery quality for licence holders. If sterile trout are recaptured less frequently than diploid trout and do not consistently achieve larger trophy sizes, the benefits of stocking sterile fish are diminished.

Furthermore, stocked trout are estimated to contribute approximately 75% of the fish harvested from Lake Arapuni. Given the recent impacts of flooding on spawning tributaries, future stocking programmes may be better served by the release of reproductively viable trout capable of contributing to natural recruitment and population recovery through successful spawning.

Recommendations

1. **Discontinue stocking of sterile (triploid) trout in Lake Arapuni.**
   The results of this study do not support continued use of sterile trout as a fisheries management tool in Lake Arapuni. Sterile trout generated lower angler return rates than diploid trout and showed no consistent improvement in growth or trophy-size potential.
2. **Continue monitoring the Lake Arapuni fishery.**
   Ongoing monitoring should be undertaken following the cessation of stocking after the 2024 release of 2,000 reproductively viable (diploid) rainbow trout. Monitoring should focus on angler catch rates, fish condition, population trends, and overall angler satisfaction.
3. **Review future stocking requirements if fishery performance declines.**
   Should angler catch rates remain low for several consecutive seasons, or if measures of angler satisfaction decline, Council should reassess the decision to cease stocking and consider whether supplementary releases of reproductively viable trout are required to maintain the quality of the Lake Arapuni fishery.

References

Teuscher, D.M., Schill, D.J., Megargle, D.J. and Dillon, J.C. (2003), Relative Survival and Growth of Triploid and Diploid Rainbow Trout in Two Idaho Reservoirs. North American Journal of Fisheries Management, 23: 983-988. https://doi.org/10.1577/M02-026