

REDUCTION OF OYSTER WASTE

Establishing best practices for controlling wild spat under commercial production



Department of Primary Industries

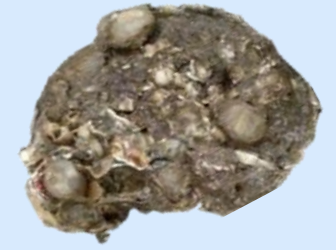


The work has been supported by the End Food Waste Cooperative Research Centre whose activities are funded by the Australian Government's Cooperative Research Centre Program.

2022-023: Reduction of oyster waste: Establishing best practices for controlling wild spat under commercial production, is supported by funding from the Fisheries Research and Development Corporation on behalf of the Australian Government.

The challenge

- **'Over catch' or 'fouling'** – juvenile oysters (wild spat) or other fouling organisms attach to semi-mature oysters
- Enormous losses and waste (unmarketable / mortalities associated with treatments)



30–50% wasted

SRO grown in Qld and NSW

\$13–30M pa

(excluding labour costs)

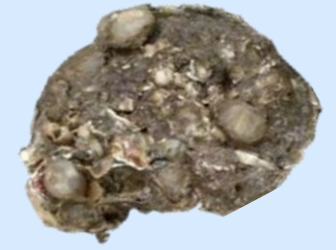


**Discards from
boiling deaths or
“clumpies”**

Source: Koorinal Oysters

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Overarching aim



Identify **best solutions** for controlling over catch while maintaining host SRO health; comparing **existing and emerging methods** under **commercial production**

Comparing 4 over catch control methods



1. Air drying



2. Boiling



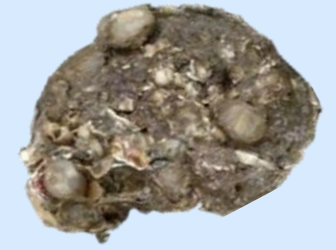
3. SED Graders Cold Shock



4. Floating bag system



Pressure washing



30–50% wasted

SRO grown in Qld and NSW

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(excluding labour costs)

On the menu...

- 1 Trial design**
- 2 Results from sixth response measures**
 - Host mortalities
 - Spat control
 - Total fouling control
 - Host growth rates
- 3 Trade-offs / practical balances**

Trial design

Treatment	Variation of treatment	No. bags / treatment	Response measurement	Response: No. oyster per bag
1. Air drying (4 variations)	• 3 days summer / 5 days autumn & spring / 7 days winter	10	3 months	25
	• 3 days →	10	3 months	25
	• 5 days →	10	3 months	25
	• 7 days →	10	3 months	25
2. Heat treatment (4 variations)	• 80°C; 2 sec (12 month) → 82°C; 3 sec (24 month)	10	3 months	25
	• 70°C; 3 sec (12 month) → 82°C; 3 sec (24 month)	10	3 months	25
	• 70°C; 3 sec →	10	3 months	25
	• 82°C; 3 sec →	10	3 months	25
3. SED cold shock (3 variations)	• -12°C; 30 sec	10	3 months	25
	• -14°C; 30 sec	10	3 months	25
	• -16°C; 30 sec	10	3 months	25
4. Floating bags (3 variations each)	• 3 days (every month flipping)	10	3 months	25
	• 5 days (every month flipping)	10	3 months	25
	• 7 days (every month flipping)	10	3 months	25
5. Control (no treatment)	• 10 with main trial	10	3 months	25
	• 10 with floating bags	10	3 months	25
5 Treatments		160 bags		

Trial design

- Trial stock grown to 12 months in BST baskets
- Graded
- Split into respective treatments

Trial design



Controlling overcatch using air drying, heat, cold shock

At KO the main trial has 12 treatments:

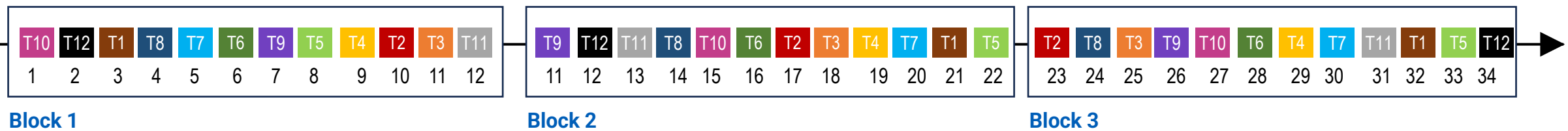
Treatment	Method	Variation	JTAGZ
1	Air drying	3 days summer / 7 days winter	RED
2	Air drying	3 days ->	GREEN
3	Air drying	5 days ->	BLUE
4	Air drying	7 days ->	YELLOW
5	Heat	80°C; 2 sec (12 month) -> 82°C; 3 sec (24	WHITE
6	Heat	70°C; 3 sec (12 month) -> 82°C; 3 sec (24	ORANGE
7	Heat	70°C; 3 sec (12 month onward)	PURPLE
8	Heat	82°C; 3 sec (12 month onward)	FLURO GREEN
9	Cold shock	-12°C; 30 sec; 180 g/L Nacl	BLACK
10	Cold shock	-14°C; 30 sec; 190 g/L Nacl	GREY
11	Cold shock	-16°C; 30 sec; 200 g/L Nacl	BROWN
12	No treatment		PINK

Controlling overcatch using floating FlipFarm

The FlipFarm experiment at KO has 3 treatments (flipped monthly):

Treatment	Method	Colour #	JTAGZ
1	FlipFarm - 3 days	1	RED
2	FlipFarm - 5 days	2	GREEN
3	FlipFarm - 7 days	3	BLUE
4	FlipFarm - Control	4	YELLOW

Main trial [10 x 12]



Floating bags [10 x 4]



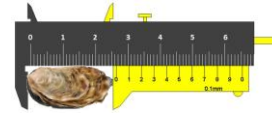
What we are measuring

Three monthly



Mortality (bag level)

- Live count #
- Dead count #
- Weight of bag contents, ex. bag (g)
- Weight of live contents, ex. bag (g)
- Individual weight of live oysters (g)

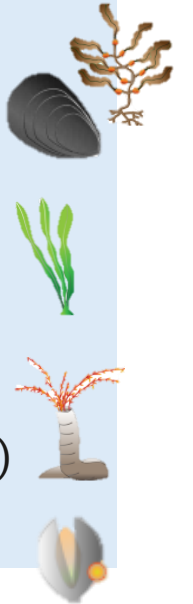


Size & shape (25 oysters / bag)

- Shell height (SH)
- Shell length (SL)
- Shell width (SW)
- Total wet weight (TWW)
- Fan and cup ratios

Fouling (25 oysters / bag)

- Oyster (wild spat) #
- Mussel #
- Barnacle #
- Hydroids #
- Tubeworm #
- Tunicates #
- Algae (% shell covered)
- Other



Final response measurement

Quality & condition

- Quality index
- Condition index
- De-fouled weight (g)
- Saleability?

AUSTRALIAN SEAFOOD COOPERATIVE AUSTRALIAN OYSTER GRADE	GRADE (minimum)		BODY & MANTLE CONDITION (this grading system applies to all size ranges)	SHELL FULLNESS (minimum)
	SYDNEY ROCK OYSTER GRADING SYSTEM	A SUPREME	Very good condition. Oyster with full fat cover across the body and mantle, oyster the shell and the gills, shell parallel, rounded across alignment.	 Body 0, Mantle 0 Body 0, Mantle 1
B PREMIUM		Relatively good. The addition of some mantle across the gills and partially extending out all the mantle. Some staining may be visible, shell parallel within alignment.	 Body 1, Mantle 0 Body 1, Mantle 1 Body 1, Mantle 2 Acceptable at Body 2, Mantle 0	1 B Grade 0 acceptable 1 acceptable 2 max 2 in sample acceptable
C THRIFTY		Merely a good condition oyster with some coverage over the body and mantle resulting in greater visibility of the mantle, gills, shell thickness and greater staining in alignment.	 Body 2, Mantle 0 Body 2, Mantle 1 Body 2, Mantle 2 Body 2, Mantle 3	2 C Grade 0 acceptable 1 acceptable 2 max 4 in sample acceptable

Sixth response measurements

March 2026

30 months

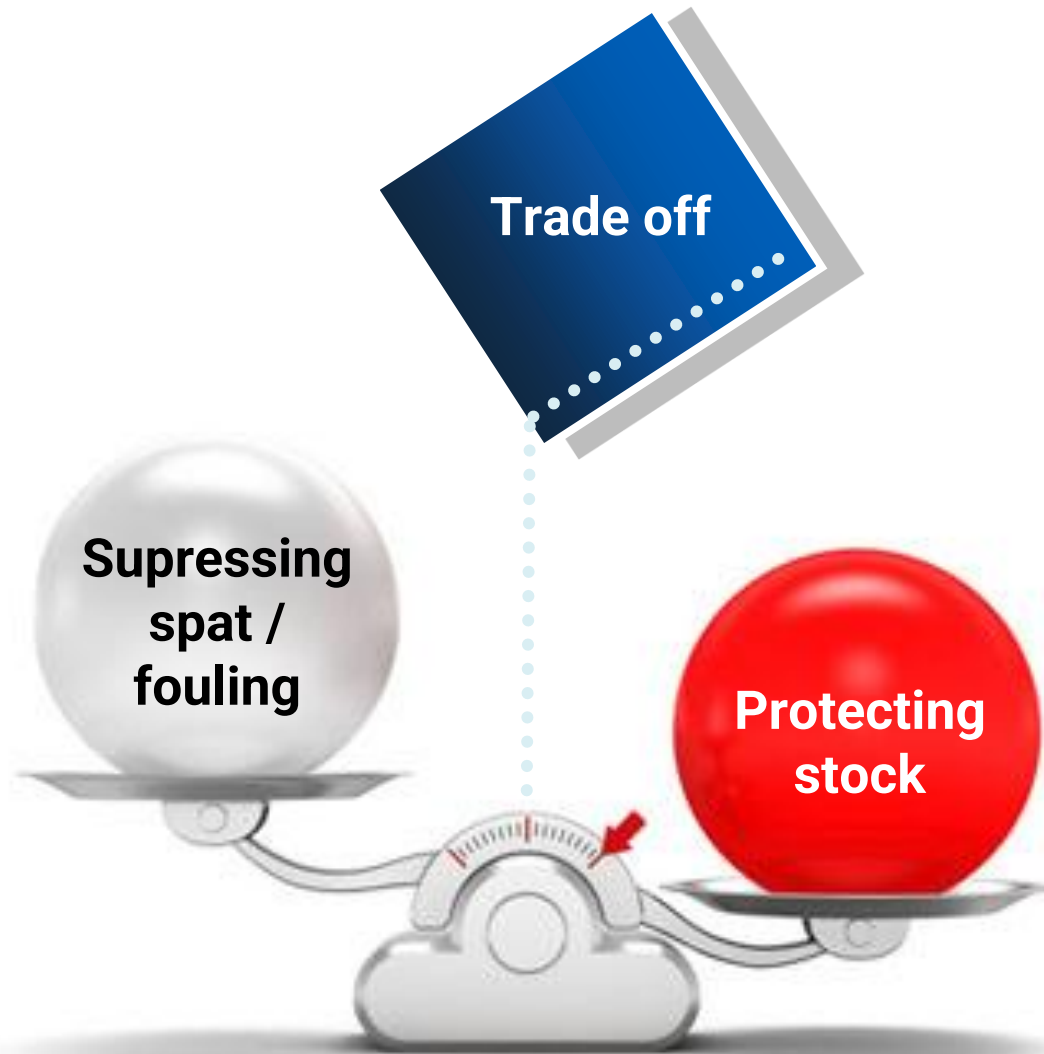
Response from 7th treatments

Treatment date: Aug 2024 / Nov 2024 / Feb 2025 / May 2025 / Aug 2025 / Nov 2025 / March 2026

Stock age: ca. 12 months / 15 months / 18 months / 21 months / 24 months / 27 months / 30 months

Response date: Nov 2024 / Feb 2025 / May 2025 / Aug 2025 / Nov 2025 / March 2026

The big picture



Measurement keys



Air drying (4)



Heat treatment (4)



Cold shock (3)



No treatment (**CONTROL**)



Pressure wash (1)



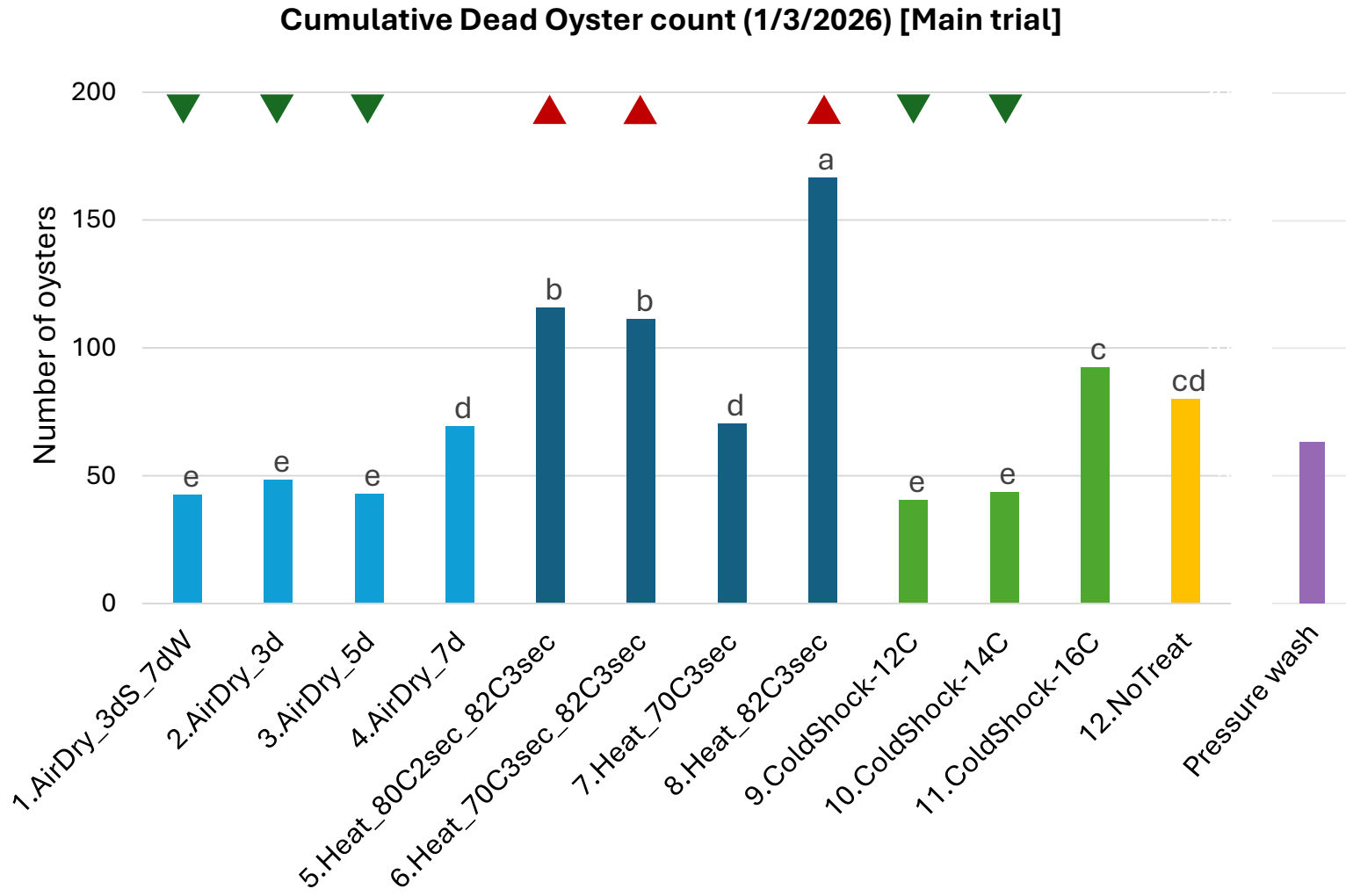
Floating bags (3)



No treatment (**CONTROL**)

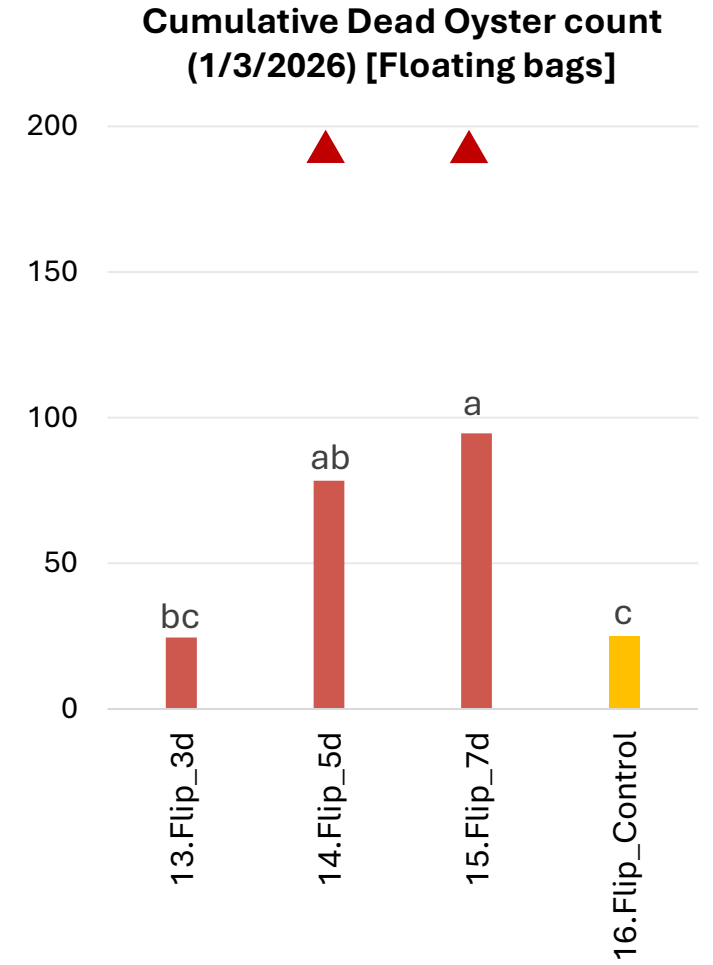
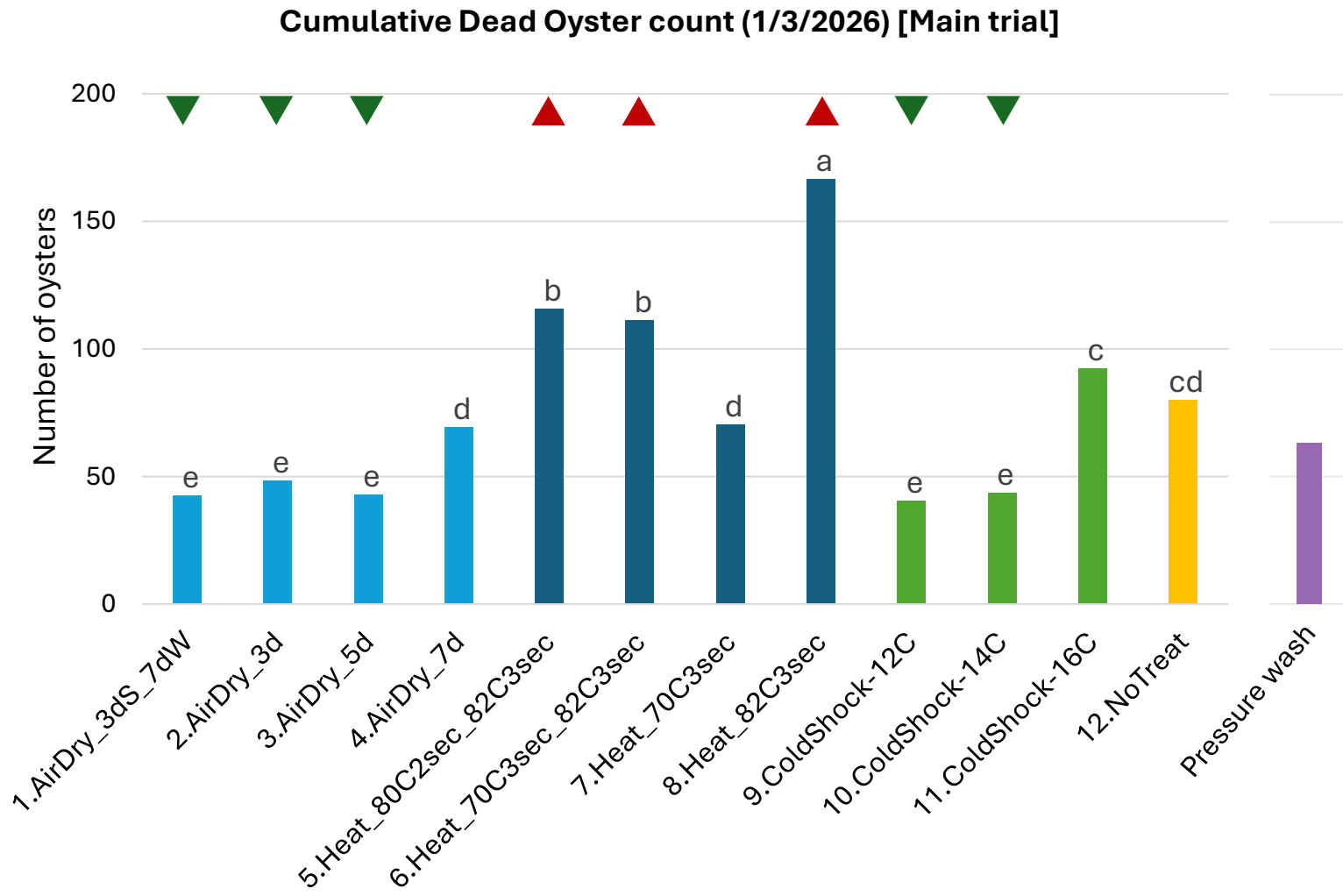
Non-identical sub-script letters show significant differences ($P < 0.05$)

Cumulative host mortality counts # (bag level)

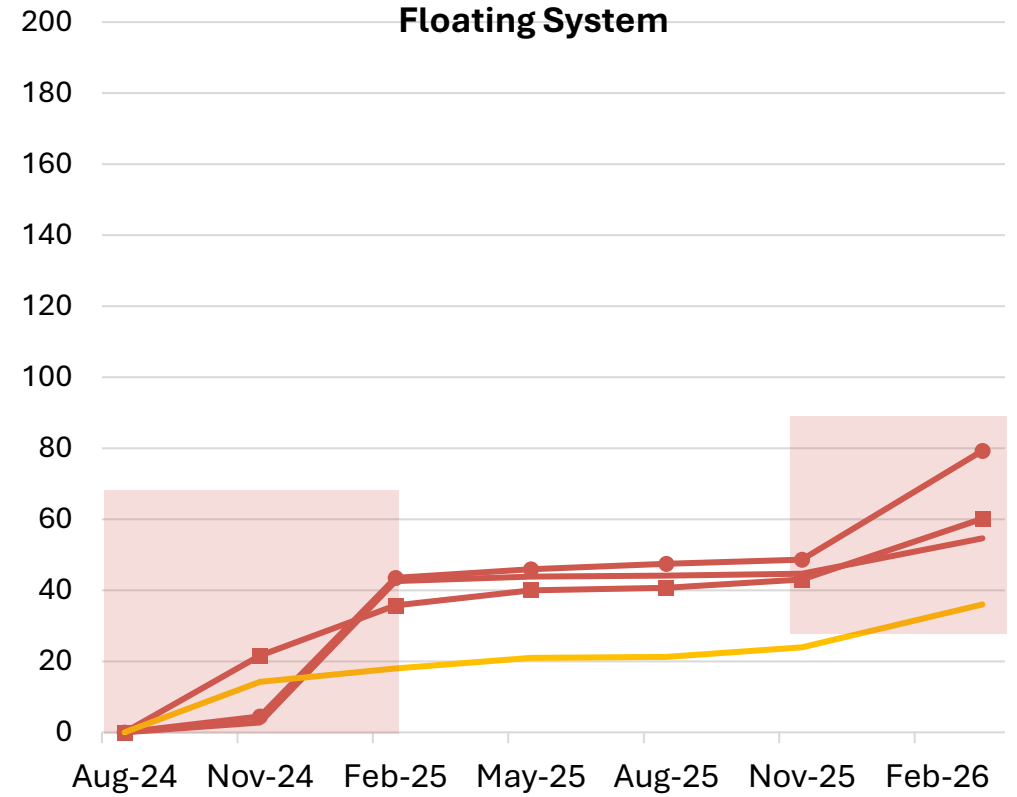
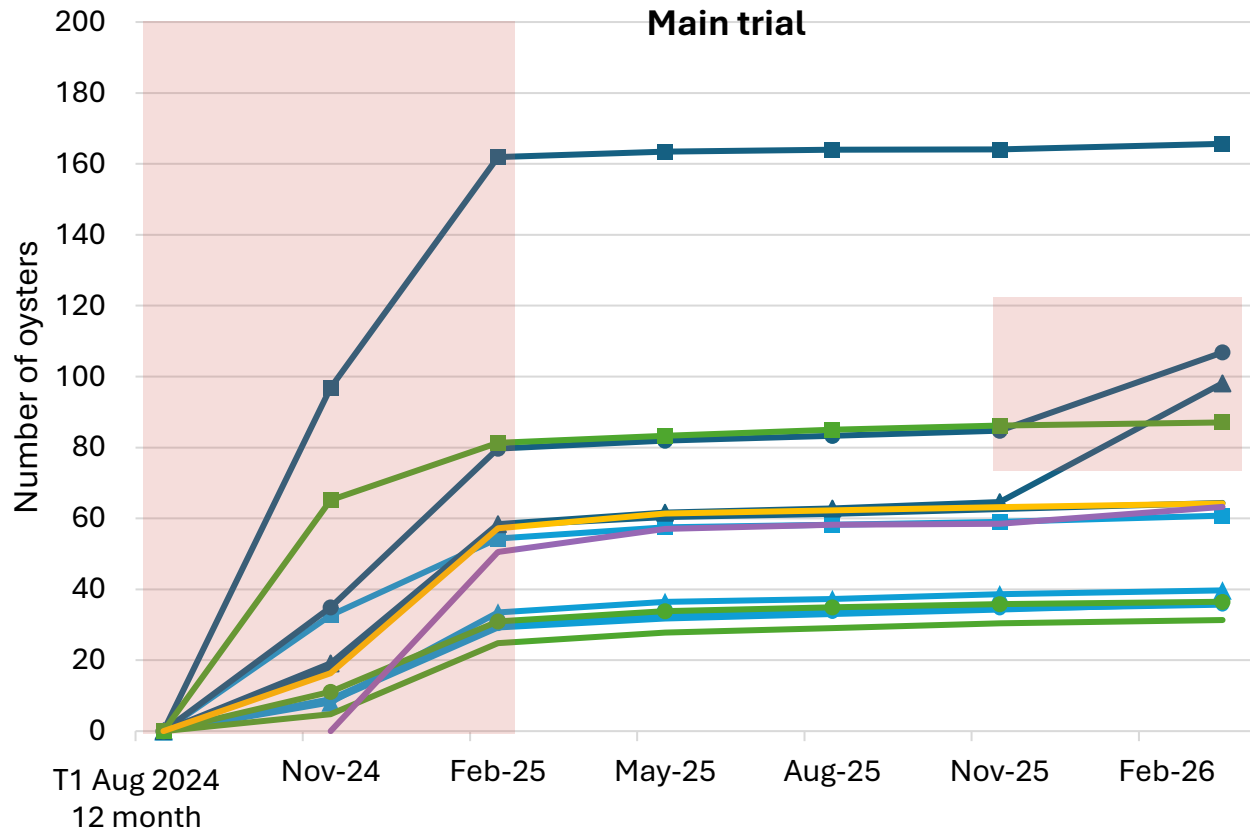


- Higher mortalities in all heat (except 70°C_3sec)
- Lower or comparable mortalities in other treatments

Cumulative host mortality counts # (bag level)



Host mortality counts # (bag level) – over time

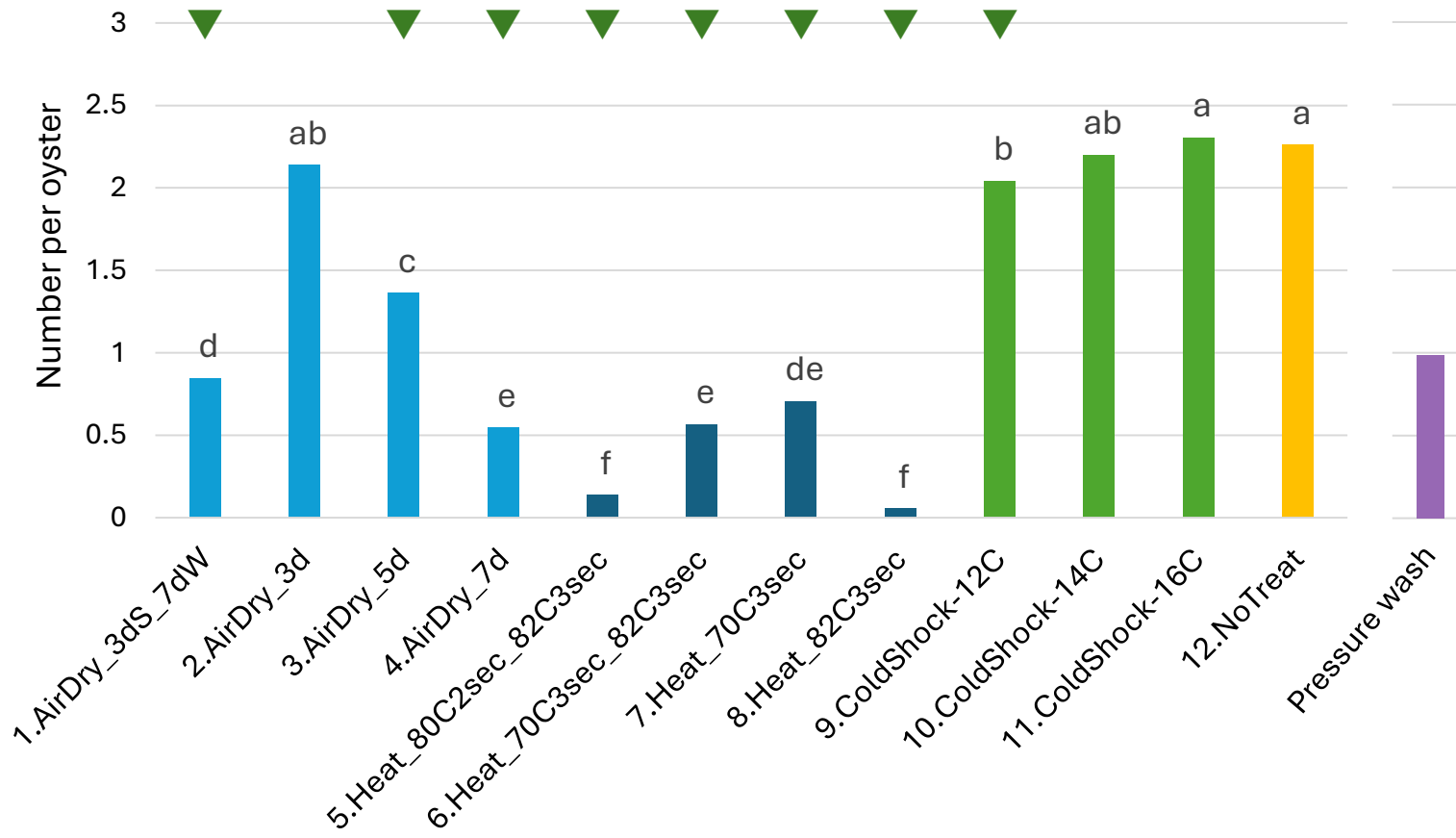


- AirDry_3dS_7dW
- ▲ AirDry_3d
- AirDry_5d
- AirDry_7d
- Heat_80C2sec_82C3sec
- ▲ Heat_70C3sec_82C3sec
- Heat_70C3sec
- Heat_82C3sec
- ColdShock-12C
- ColdShock-14C
- ColdShock-16C
- Control
- Pressure

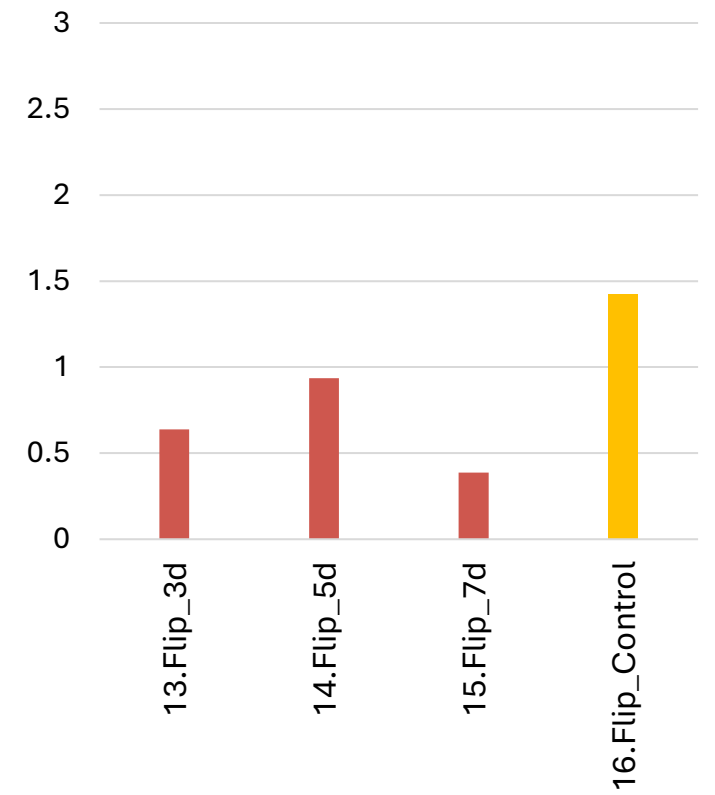
- Flip_3d
- Flip_5d
- Flip_7d
- Flip_Control

Average number of LIVE SPAT per oyster

Average number of spat per oyster – LIVE (1/3/2026) [Main trial]

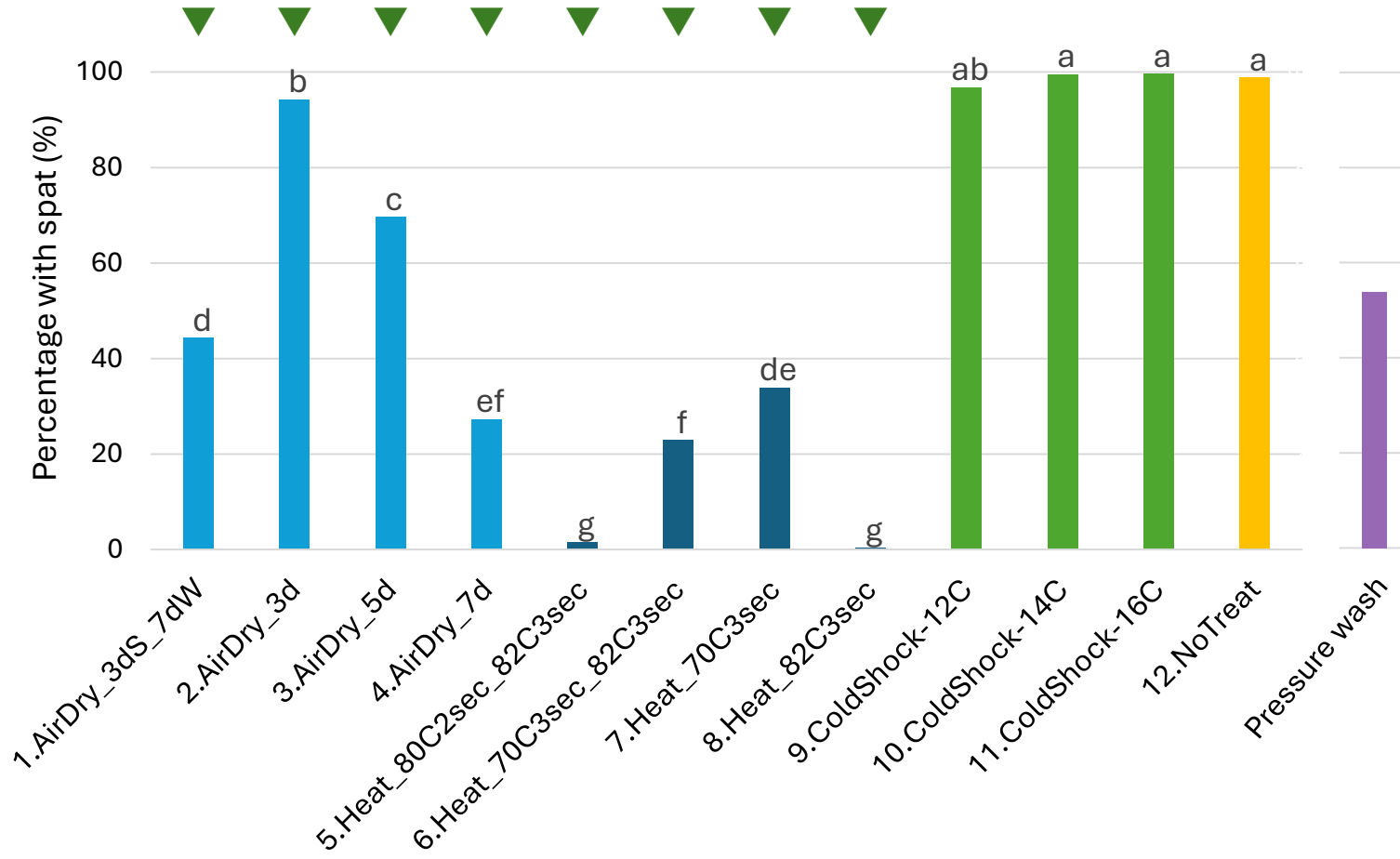


Average number of spat per oyster – LIVE (1/3/2026) [Floating bags]

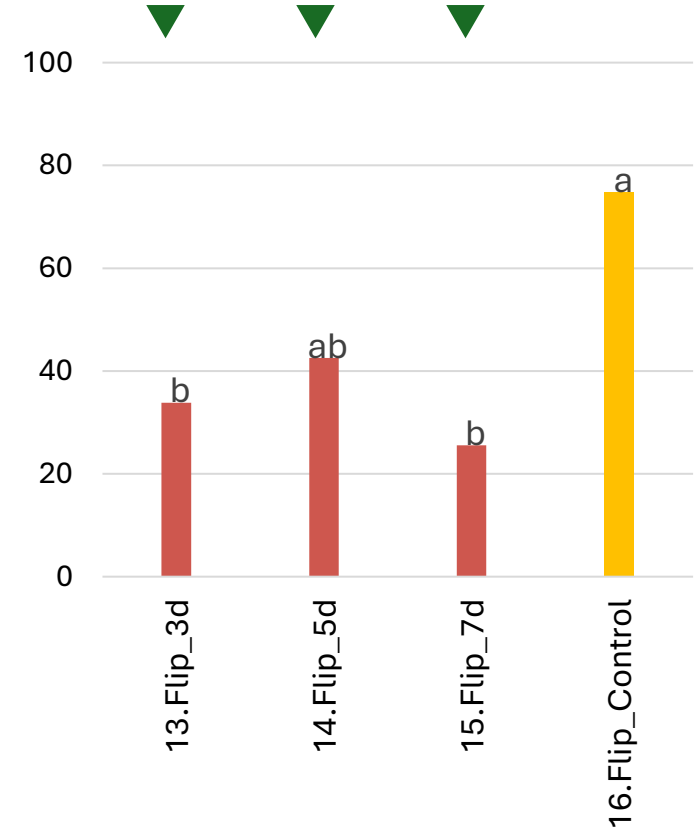


Percentage of oysters with LIVE SPAT

Percentage of oysters with spat – LIVE (1/3/2026) [Main trial]



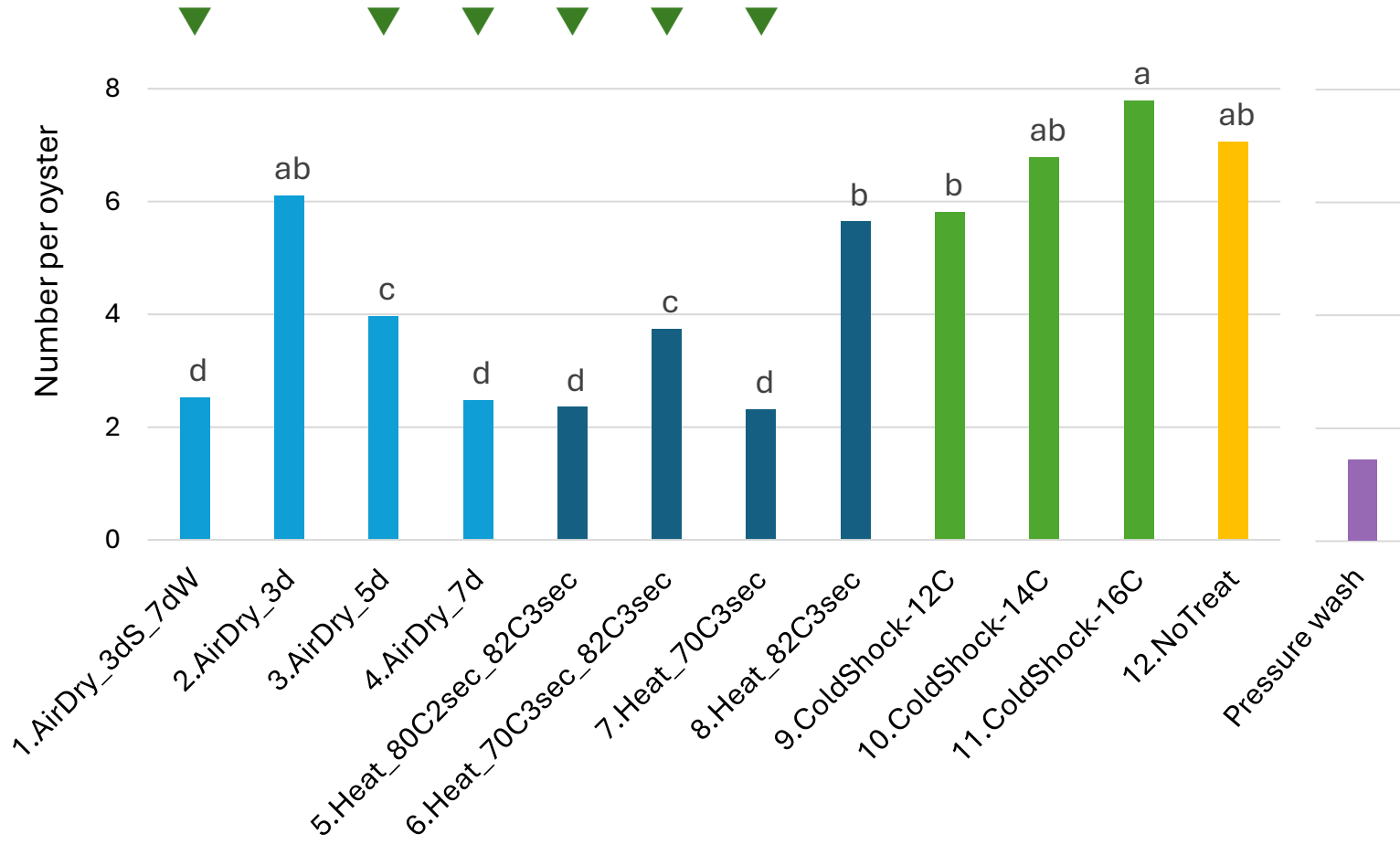
Percentage of oysters with spat – LIVE (1/3/2026) [Main trial]



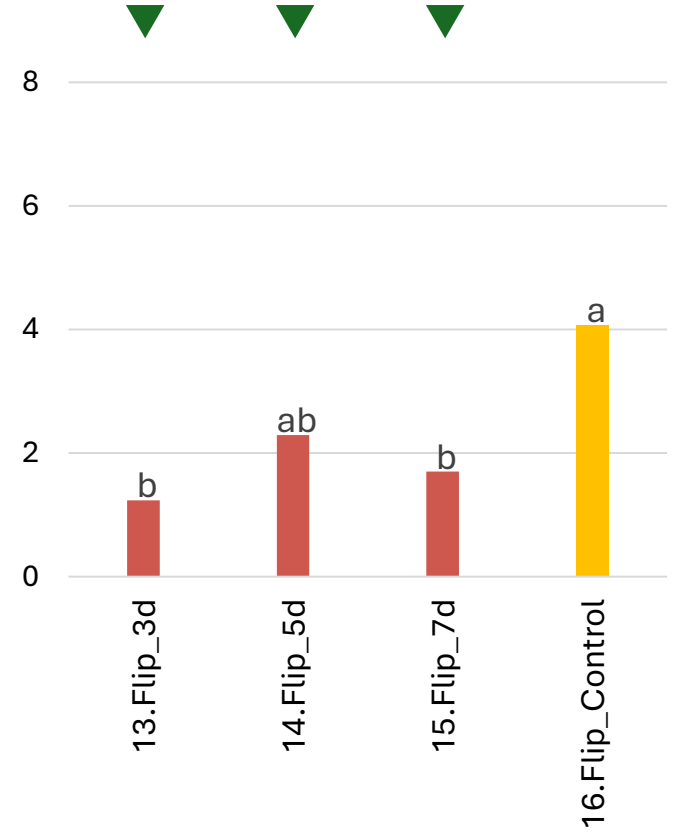
Average number of TOTAL FOULING per oyster



Average number of any fouling per oyster (1/3/2026) [Main Trial]



Av. number of any fouling per oyster (1/03/2026) [Floating System]



Growth rates: weight-based



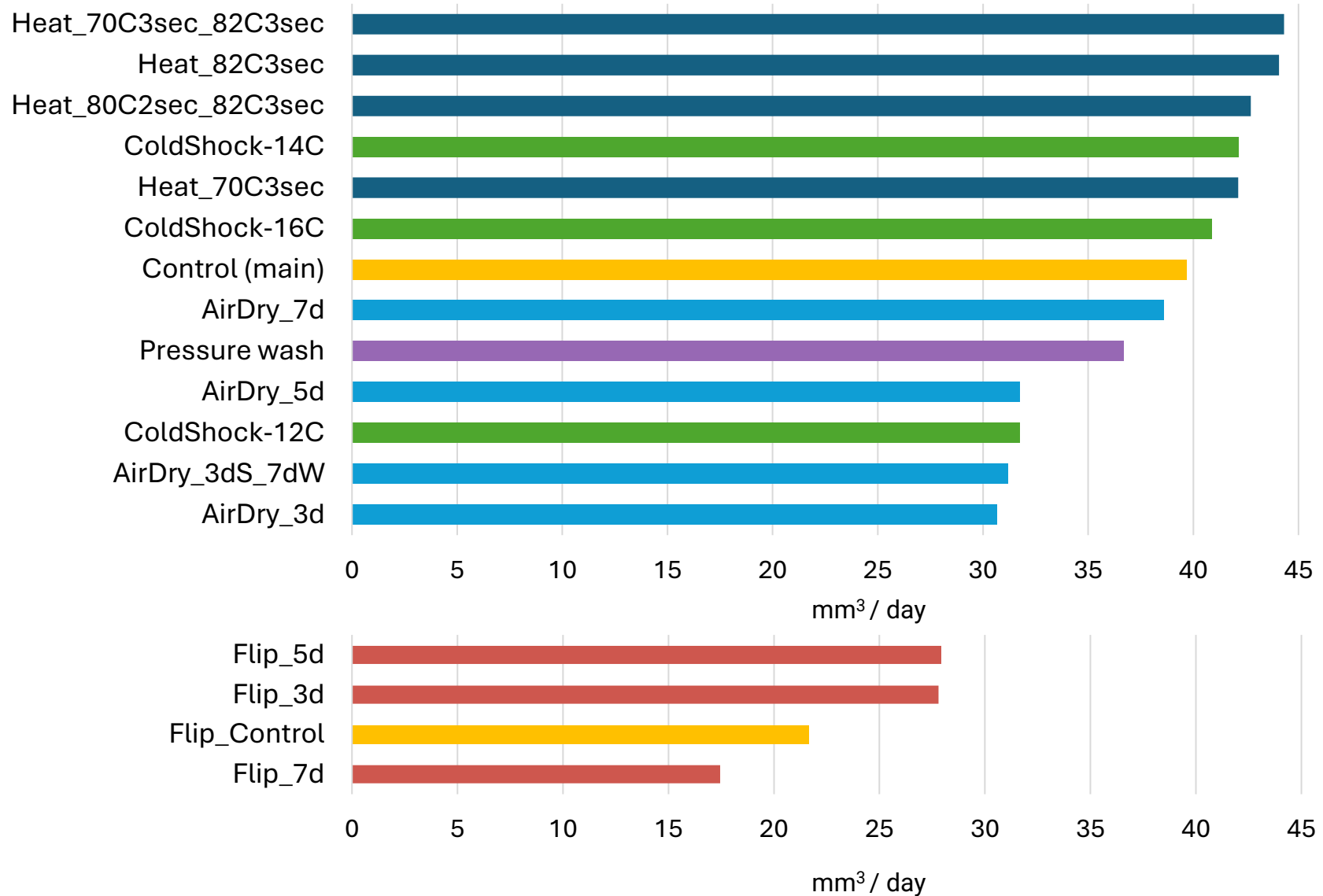
vs.



Individual weight very likely influenced by number and mass of fouling agents

Volumetric growth rate (VGR), mm³ / day

$$VGR = \frac{(L \times W \times D)_{t_2} - (L \times W \times D)_{t_1}}{\Delta t}$$



- Heat
- Air-dry
- Cold shock
- Pressure
- No treatment





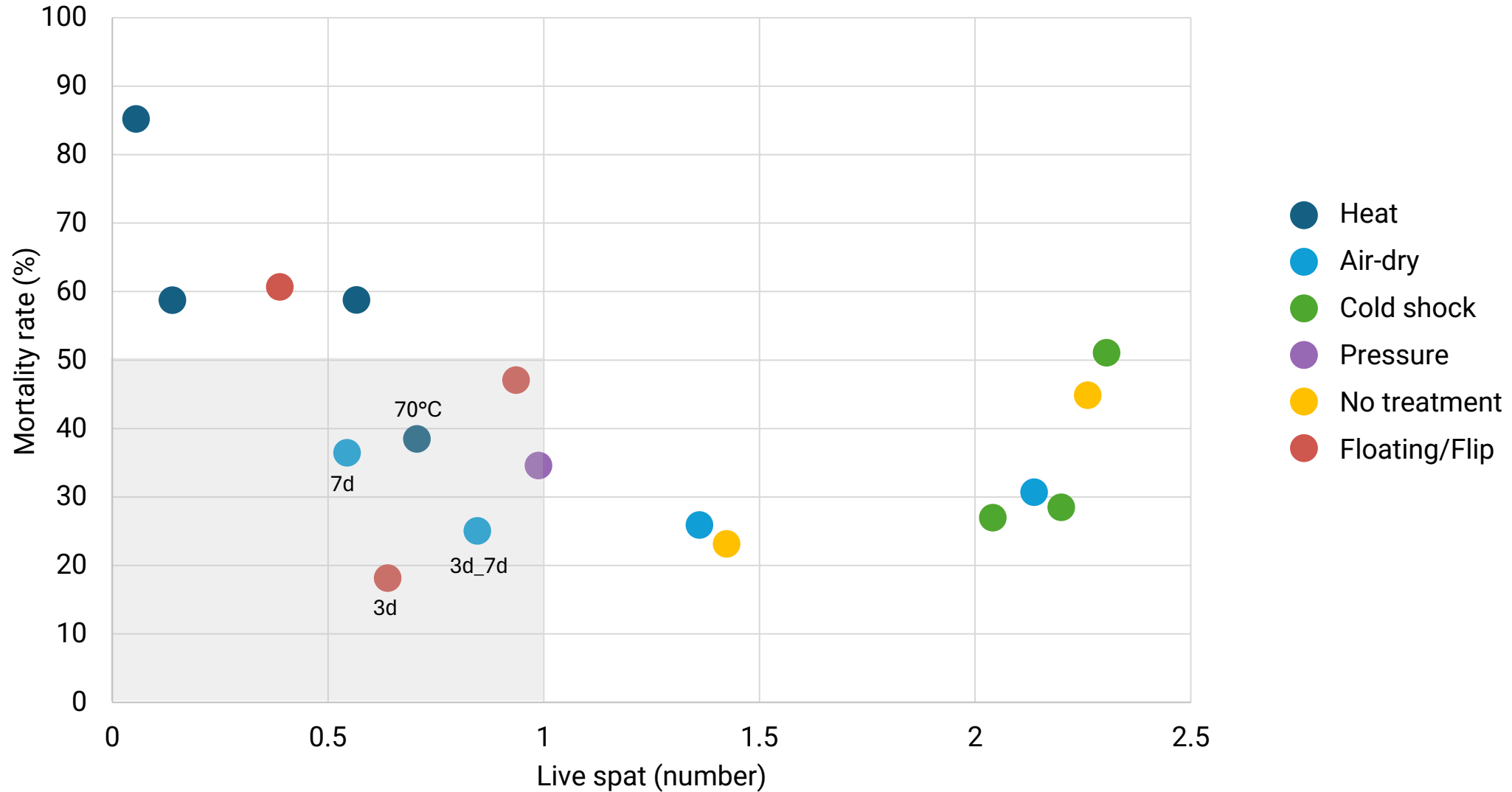
**Floating
bags**

**Main
trial**

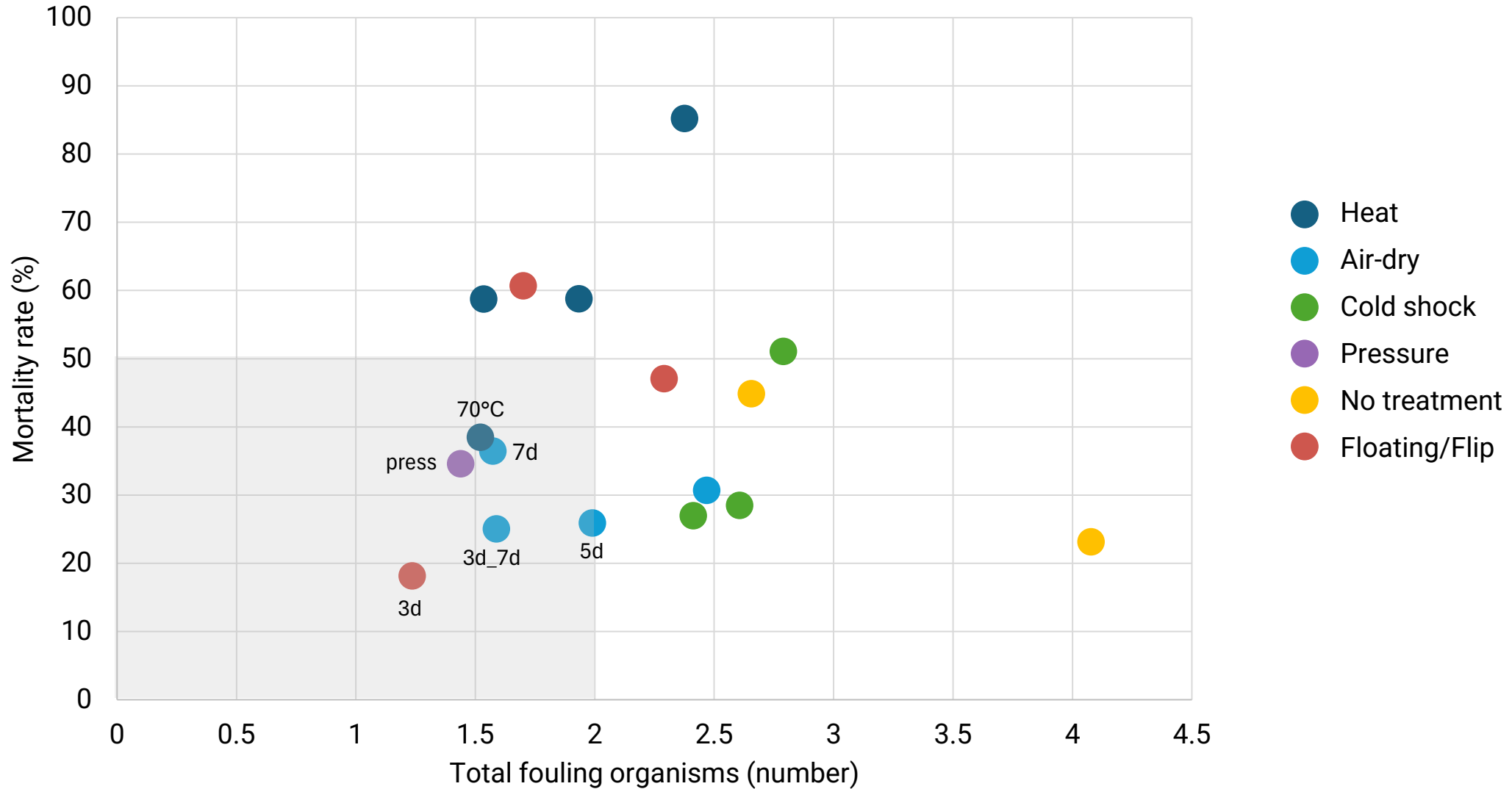


Trade-offs and practical balances

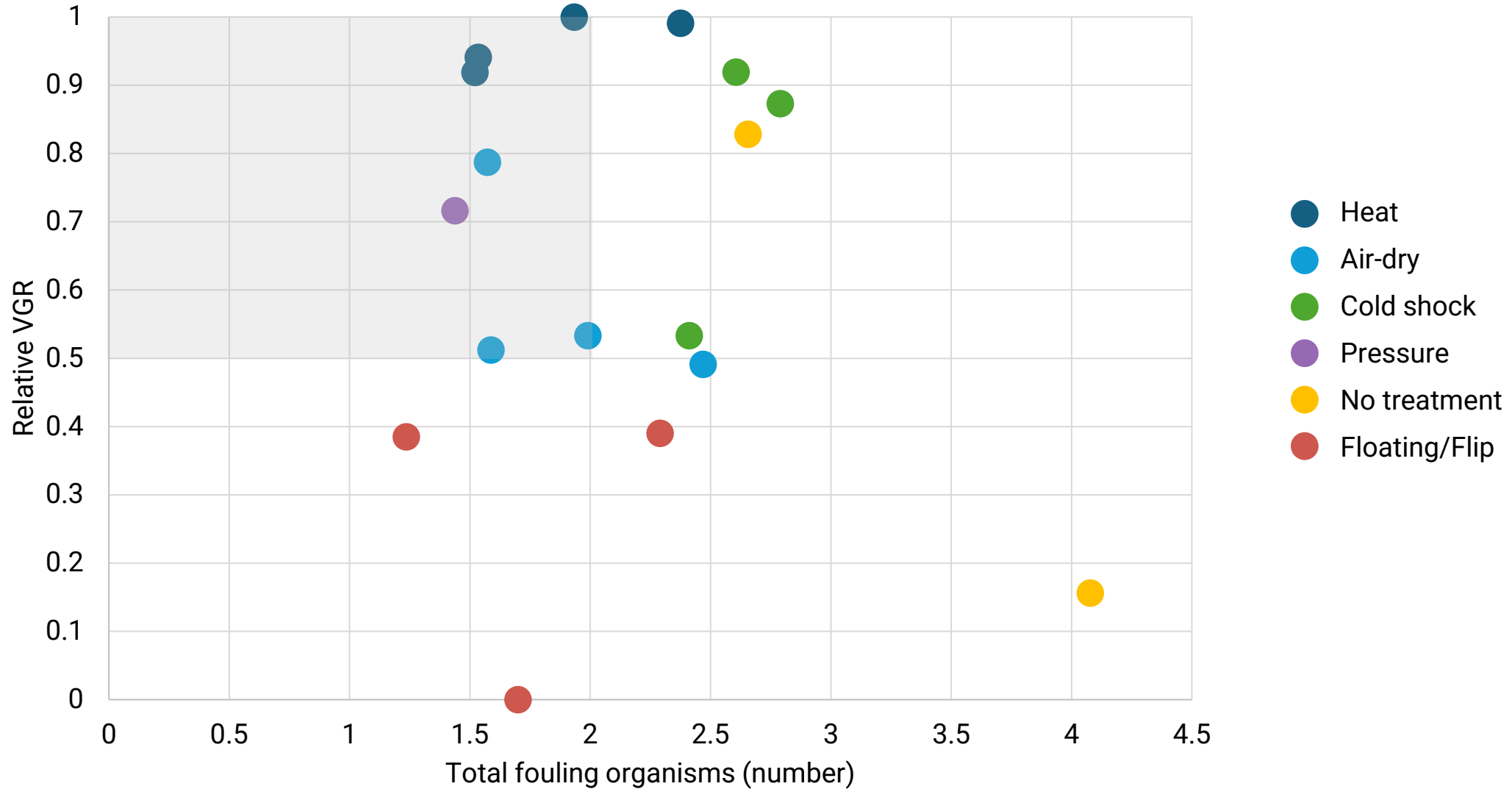
Trade-off plot, spat control vs mortality



Trade-off plot, total fouling control vs mortality



Trade-off plot, total fouling control vs VGR



Practical balance score

$$Score = \frac{\max - x}{\max - \min} \text{ OR } \frac{x - \min}{\max - \min}$$

No.	Treatment	Spat_score	Fouling_Score	Mortality_score	Rel_VGR_score
1	AirDry_3dS_7dW	0.65	0.88	0.91	0.51
2	AirDry_3d	0.07	0.57	0.88	0.49
3	AirDry_5d	0.42	0.73	0.91	0.53
4	AirDry_7d	0.78	0.88	0.77	0.79
5	Heat_80C2sec_82C3sec	0.96	0.90	0.51	0.94
6	Heat_70C3sec_82C3sec	0.77	0.75	0.52	1.00
7	Heat_70C3sec	0.71	0.89	0.76	0.91
8	Heat_82C3sec	1.00	0.60	0.30	0.99
9	ColdShock-12C	0.12	0.59	0.92	0.53
10	ColdShock-14C	0.05	0.52	0.91	0.92
11	ColdShock-16C	0.00	0.45	0.66	0.87
12	Control (main)	0.02	0.50	0.72	0.83
13	Flip_3d	0.74	1.00	0.91	0.39
14	Flip_5d	0.61	0.63	0.43	0.39
15	Flip_7d	0.85	0.84	0.49	0.00
16	Flip_Control	0.39	0.00	0.88	0.16
17	Pressure wash	0.59	0.93	0.77	0.72

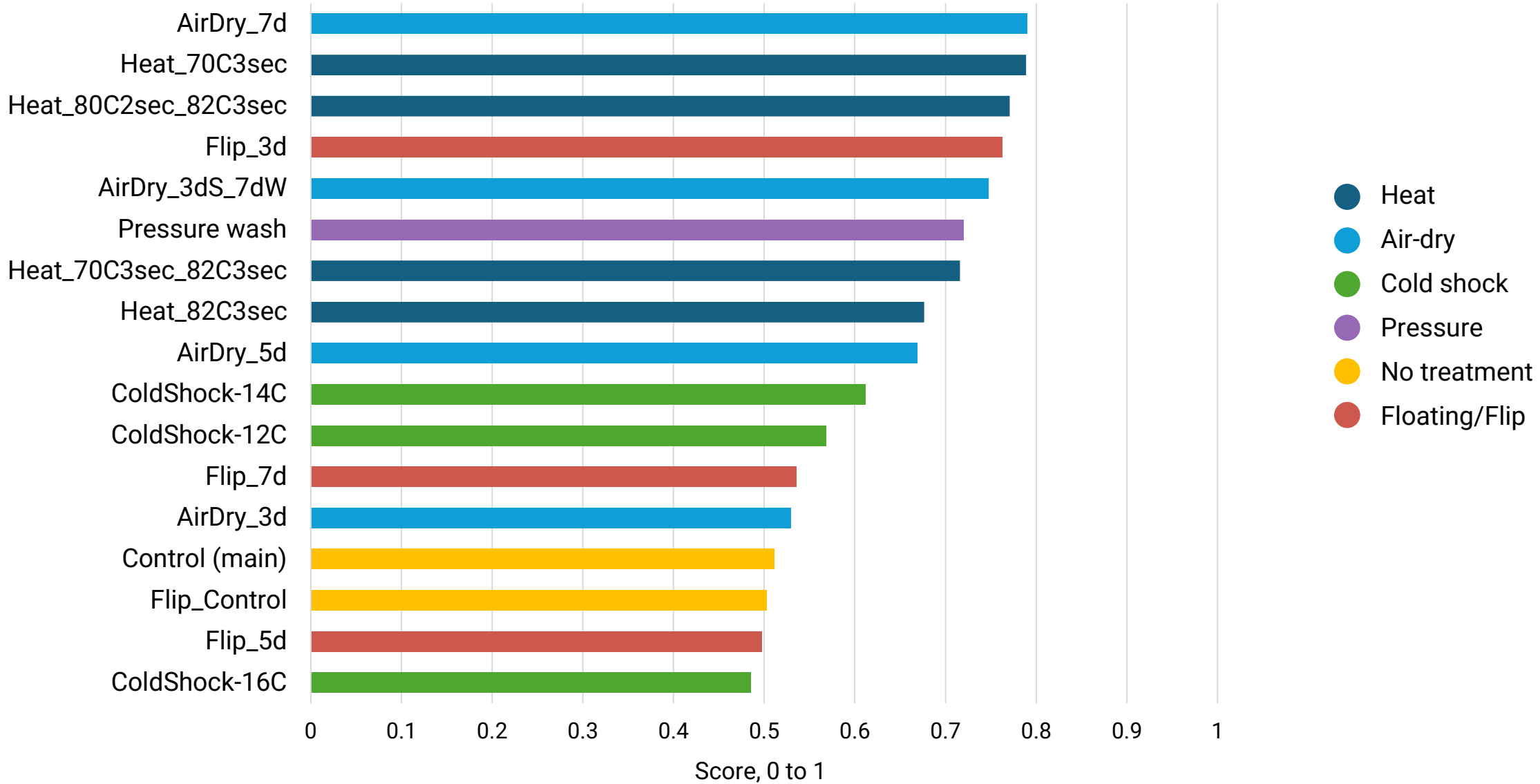
Practical balance score

$$\text{Practical balance score} = 0.3(\text{Spat}) + 0.1(\text{Fouling}) + 0.4(\text{Mortality}) + 0.2(\text{RelVGR})$$

No.	Treatment	Spat_score	Fouling_Score	Mortality_score	Rel_VGR_score	Practical balance score
1	AirDry_3dS_7dW	0.65	0.88	0.91	0.51	0.747
2	AirDry_3d	0.07	0.57	0.88	0.49	0.529
3	AirDry_5d	0.42	0.73	0.91	0.53	0.669
4	AirDry_7d	0.78	0.88	0.77	0.79	0.790
5	Heat_80C2sec_82C3sec	0.96	0.90	0.51	0.94	0.771
6	Heat_70C3sec_82C3sec	0.77	0.75	0.52	1.00	0.716
7	Heat_70C3sec	0.71	0.89	0.76	0.91	0.789
8	Heat_82C3sec	1.00	0.60	0.30	0.99	0.676
9	ColdShock-12C	0.12	0.59	0.92	0.53	0.569
10	ColdShock-14C	0.05	0.52	0.91	0.92	0.612
11	ColdShock-16C	0.00	0.45	0.66	0.87	0.485
12	Control (main)	0.02	0.50	0.72	0.83	0.511
13	Flip_3d	0.74	1.00	0.91	0.39	0.720
14	Flip_5d	0.61	0.63	0.43	0.39	0.762
15	Flip_7d	0.85	0.84	0.49	0.00	0.497
16	Flip_Control	0.39	0.00	0.88	0.16	0.535
17	Pressure wash	0.59	0.93	0.77	0.72	0.503

Practical balance score

$$\text{Practical balance score} = 0.3(\text{Spat}) + 0.1(\text{Fouling}) + 0.4(\text{Mortality}) + 0.2(\text{RelVGR})$$



Best performers



Air Dry_7d

1

Spat = 0.54, vs control = 2.3
(76% lower)

Fouling = 1.6, vs control = 2.7

Survival rate = 63.5%
(13% less mortalities vs control)

Relative VGR = 0.79
(5% lower than control)

Rank = 1

2nd place = Air Dry_3d_7d



Heat_70°C, 3sec

2

Spat = 0.71, vs control = 2.3
(69% lower)

Fouling = 1.5, vs control = 2.7

Survival rate = 61.5%
(12% less mortalities vs control)

Relative VGR = 0.92
(11% higher than control)

Rank = 2 (very close)

2nd place = Heat_80°C_82°C

Floating_Flip_3d

4

Spat = 0.64, vs control = 1.4
(55% lower)

Fouling = 1.2, vs control = 4.1

Survival rate = 81.9%
(2% less mortalities vs control)

Relative VGR = 0.39
(145% higher than control)

Rank = 4

2nd place = Floating_Flip_7d

Poorest performers

Cold shock, -16°C

17

Controls

15

14

Spat = 2.31 vs control = 2.26
(2% higher)

Fouling = 2.8, vs control = 2.7

Survival rate = 48.9%
(15% more mortalities vs control)

Relative VGR = 0.87
(5% higher than control)

Rank = 17

2nd place = All cold shock, bottom half

Conclusions



Air drying for longer durations = promising; minimal labour inputs



Heat-immersion at lower temps (70°C, 3sec) = good; labour and WHS concerns



Cold-shock = not performing well across variations trialled



Pressure washing = exploratory only; needs further investigation



Floating bags = likely a winner; with wave suppression

DELIVERING
FOR QUEENSLAND



Queensland
Government

Thank You

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