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Fishing for Atlantic salmon following a major escape event: inferences about dispersal, survival and ecological impact

J.M. Lyle

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Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 49,
Hobart TAS 7001

Enquires should be directed to:
Assoc. Prof. Jeremy Lyle
Institute for Marine and Antarctic Studies
University of Tasmania
Private Bag 49, Hobart, Tasmania 7001, Australia
Jeremy.Lyle@utas.edu.au
Ph. (03) 6226 8255
Fax (03) 6227 8035

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Executive summary

A major storm event in southern Tasmania during May 2018 resulted in substantial damage to salmonid farming infrastructure located off the east coast of Bruny Island and the escape of an estimated 120,000 Atlantic salmon. The escape attracted significant interest from recreational fishers as well as raising concerns about the potential ecological impacts of such a large loss of fish.

In order to better understand the dynamics of dispersal, survival and impacts of the escaped Atlantic salmon, an on-line survey of recreational fishers was implemented. Over 120 fishers participated in the survey. Dispersal from the farm site was rapid but appeared to be largely restricted to south-eastern Tasmania and within the general Storm Bay region, including associated embayments and tributaries. During the first 4-6 weeks there were a number of reports of escapees being schooled up in various locations throughout the region, often associated with areas of freshwater or tidal inflows or within rivers and creeks. In such situations they were readily captured by gillnet and line fishing methods.

Based on capture dates, and assuming that most if not all were from the May escape event, at least some Atlantic salmon had survived at liberty for almost four months. This does not necessarily mean that these fish were thriving, in fact there was only limited evidence to suggest active feeding on native fauna.

Most recreational fishers fishing for the escapees did so to take advantage of a windfall opportunity and/or to capture a premium table fish. A proportion of fishers did, however, express concerns about the ecological impacts of escapees and were motivated to contribute to the removal or fish down of the introduced species.

Introduction

Commercial farming of salmonids commenced in Tasmania in the mid-1980 and is centred on Atlantic salmon (*Salmo salar*) and to a lesser extent rainbow trout (*Oncorhynchus mykiss*). Atlantic salmon are native to the North Atlantic and were introduced to Australia in the late 1800s as sportfish for recreational anglers. Today Tasmania produces over 60000 tonnes of salmonids per annum, with Atlantic salmon accounting for the bulk of the production. The industry has significant economic benefits, with current annual production valued at over AUD$800M.

A consequence of the worldwide expansion of aquaculture based on salmonids has been the accidental escape of large numbers of farmed fish into the environment. Escapes occur as large pulses or through small leakages, a consequence of human error and natural causes, such as predator or storm damage to cages (Gausen and Moen 1991, McKinnell *et al.* 1997). Within their natural distribution range, the impact of Atlantic salmon escapees can be genetic, through hybridisation and genetic introgression, and ecological through competition for food and space, disturbance of spawning beds and transfer of diseases or parasites into wild salmonid populations, sometimes with disastrous effects for wild stocks (Heggberget *et al.* 1996; Gross 1998). The development of marine aquaculture for salmonids in the southern hemisphere, in particular Chile and Australia, has given rise to concerns surrounding the potential impacts of farm escapees on native fauna through predation and competition for food, disease and pathogen transfer and the establishment of self-sustaining populations in the wild (Soto *et al.* 2001; Abrantes *et al.* 2011; Sepulveda *et al*. 2013).

A major storm event during May 2018 caused significant property damage in southern Tasmania (Blackwood 2018), including to salmonid infrastructure located off the east coast of Bruny Island. Damage to two stocked pens occurred when internal feed bins broke through the bottom of the netting and allowed the escape of an estimated 120,000 Atlantic salmon (Compton 2018). This large escape of fish attracted significant interest from recreational fishers who sought to take advantage of this ‘windfall’ and there were many reports of large catches and concentrations of escapees in the weeks following the escape event (Beniuk 2018, Denholm 2018, Luttrell 2018, Ogilvie and Dunlevie 2018). The large number of escaped Atlantic salmon also raised concerns about potential ecological impacts, including feeding on native fauna and possible biosecurity risks through the transference of disease and even establishment of self-sustaining populations. In order to better understand the dynamics of dispersal, survival and potential ecological impacts of such an escape event an opportunistic survey of recreational fishers’ experiences fishing for the escapees was implemented.

Methods

Survey design and implementation

Given the opportunistic nature of the survey and issues related to reporting biases, especially recall bias, a modified panel survey approach was adopted. This involved an initial questionnaire-based survey (Wave 1) that was promoted using a variety of media platforms (Appendix 1) and implemented within six weeks of the storm event. This initial survey was designed to collect information from respondents about their fishing for escapees and identify those with an intention to continue fishing for the escapees and willingness to be re-contacted. This latter group was contacted again (Wave 2) about six weeks later and asked about any fishing they had done for escapees since completing the initial survey. Those respondents who indicated an intention to continue fishing for escapees were contacted again about six weeks later (Wave 3) and asked about any fishing they had done since completing the Wave 2 survey. This resulted in the coverage of more than four months of relevant fishing activity, generally with recall periods of no more than 6-8 weeks. Although the fishing information was self-reported, issues related to recall bias are likely to be minor, giving confidence in the quality of the data provided.

The Wave 1 questionnaire was developed using the on-line platform 'Survey Monkey' (Appendix 2). The questionnaire was designed to collect profiling information from each respondent (age, previous fishing experience, and postcode), fishing activity for escapees since the storm event (number of days fished, methods used and catch numbers). In order to inform on the spatial and temporal pattern of dispersal, respondents were asked to identify the earliest date and location that they captured an Atlantic salmon following the escape event. Respondents who had fished on multiple occasions were also asked to identify the most recent date and location that they had caught an Atlantic salmon escapee. Information on the size, condition and any observations on the stomach contents of the catch was canvassed. Recognising that the quality of such reports was likely to be variable, respondents were asked whether their observations were based on direct measurements or estimates for some or all their catch.

In order to understand motivations around fishing for escapees, respondents were asked to rate the level of importance (from "very important" to "not at all important") that they attributed to a number of statements relevant to fishing. The final section of the survey established whether respondents were likely to do any more fishing for escapees in the near future and, if so, whether they would consent to be recontacted (for Wave 2).

The Wave 1 questionnaire was made accessible to the public between late June and early August 2018[1]. The survey was promoted through social media, including IMAS and DPIPWE Fisheries Facebook pages, via local radio and print media. The survey was also promoted using an extensive email list of subscribers (over 20,000) to the DPIPWE *Fishing News* network and was shared by various Facebook groups with interests in fishing in Tasmania. The survey distribution thus involved strategic targeting and self-selection (non-probabilistic) sampling which introduces a number of inherent limitations that prevent making generalisations about the number of persons who fished for the escapees, their collective effort and total catch. Rather, the survey has value in identifying patterns in the dispersal and availability (survival) of the escaped Atlantic salmon through time and general observations about fisher behaviour and motivations in relation to fishing for escapees.

[1] Potential respondents were able to request a mail version of the questionnaire. However, all Wave 1 survey responses were based on the on-line version.

Wave 2 and Wave 3 follow-up surveys were conducted by email or telephone depending on respondent preference and were focussed on fishing activity and observations on the size, condition and evidence of feeding by the Atlantic salmon caught since last contact with the respondent.

This study was approved by the Tasmanian Social Sciences Human Research Ethics Committee (Ethics reference H0017407).

Results and Discussion

Survey response and respondent characteristics

The on-line survey (Wave 1) was open from 20th June until 10th August 2018. A total of 152 responses were received, 26 of these were incomplete and only provided demographic information and a further two were considered out of scope, only reporting fishing activities in Macquarie Harbour (western Tasmania). This resulted in an effective initial sample of 124 respondents, of whom 117 reported fishing for escapees with 111 catching at least one Atlantic salmon within the reporting period, for a total catch of 1689 Atlantic salmon (Table 1).

All age groups were represented in the sample of respondents (Fig. 1), with a mode in the 40-49 age group. Males (n = 121) accounted for 98% of the total sample. In terms of reported years of fishing experience (average 32.6 years, standard deviation (SD) 17.6) and number of days fished in saltwater in the previous 12 months (average 42.4 days, SD 41.5), respondents tended to be highly experienced and avid fishers.

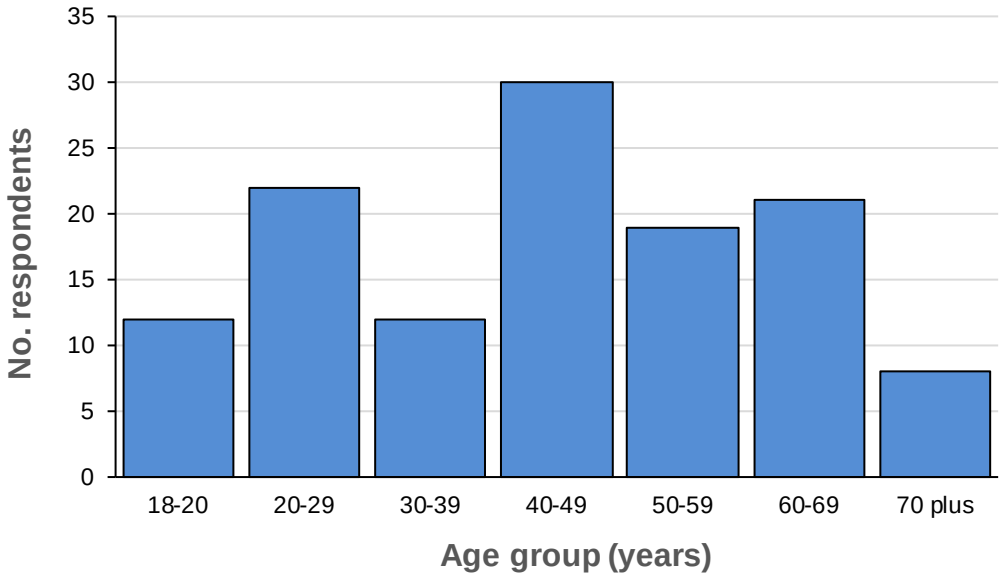

Fig. 1. Age distribution of Wave 1 respondents (n =124).

Forty-six responses were obtained in the first follow-up of intending fishers (Wave 2), with 13 (62%) out of 21 respondents who reported fishing since completing the initial survey having caught at least one additional Atlantic salmon (Table 1). The second follow-up of intending fishers (Wave 3) resulted in 18 responses, of whom 11 had fished for escapees but only three (27%) reported catching at least one Atlantic salmon.

Table 1. Summary of fishing information reported by sample wave.

	Response dates		No. respondents			Salmon catch	Reported fishing dates	
Wave	Earliest	Latest	Total	Fished	Caught fish	No.	Earliest	Latest
1	20/06/2018	10/08/2018	124	117	111	1689	13/05/2018	19/07/2018
2	25/07/2018	20/08/2018	46	21	13	68		18/08/2018
3	11/09/2018	24/09/2018	18	11	3	6		2/09/2018

Fish 'survival'

Based on the earliest and latest reported capture dates and an assumption that all reported Atlantic salmon were escapees from the May storm event, the data indicate the earliest catches were taken within two days of the storm event and that catches, although diminishing in number, were taken until at least early September (Table 1). These observations imply that at least some escapees had survived at liberty for more than 114 days (over 16 weeks). This compares with the confirmed survival of 99 days for an acoustically tagged Atlantic salmon released in Macquarie Harbour (Bell *et al*. 2016). Survival of Atlantic salmon for this length of time does not in itself imply that the individuals were thriving. In order to properly address this question it would be necessary to monitor changing fish condition through time, ideally using a range of biochemical and physical condition indicators (e.g. Abrantes *et al.* 2011).

Fish dispersal

Respondents provided information about the location and date of their earliest capture of an escapee and subsequent locations from which Atlantic salmon were captured. This provided information that could be used to map the dispersal of escapees from the farm site through time. Within the first 14 days catches were taken off the eastern shore of Bruny Island (adjacent to the farm site), the northern part of the D'Entrecastreaux Channel and at various locations within Frederick Henry Bay (Fig. 2). Over the following weeks catches were reported throughout Norfolk Bay, Pittwater, the Derwent Estuary, Huon River and eastern shore of Storm Bay (Fig. 3). Relatively large schools of fish were reported in several areas associated with water inflows, including the Coal River, Carlton River, McGees Bridge and Sorell Causeway and in a number of smaller freshwater streams. Fish were observed to move actively upstream in some of these tributaries, with several locations attracting considerable fishing effort as the fish became concentrated and relatively easy to capture.

Significantly, no catches were reported from the east coast of Tasmania, including southern Tasman Peninsula, the southern D'Entrecasteaux Channel and western shore of Storm Bay south of Bruny Island. While the presence of escapees in these areas cannot be discounted our data suggest that that most fish dispersed in a northly and north-easterly direction and remained contained within the Storm Bay, D'Entrecasteaux Channel, Derwent and Norfolk-Frederick Henry Bay region.

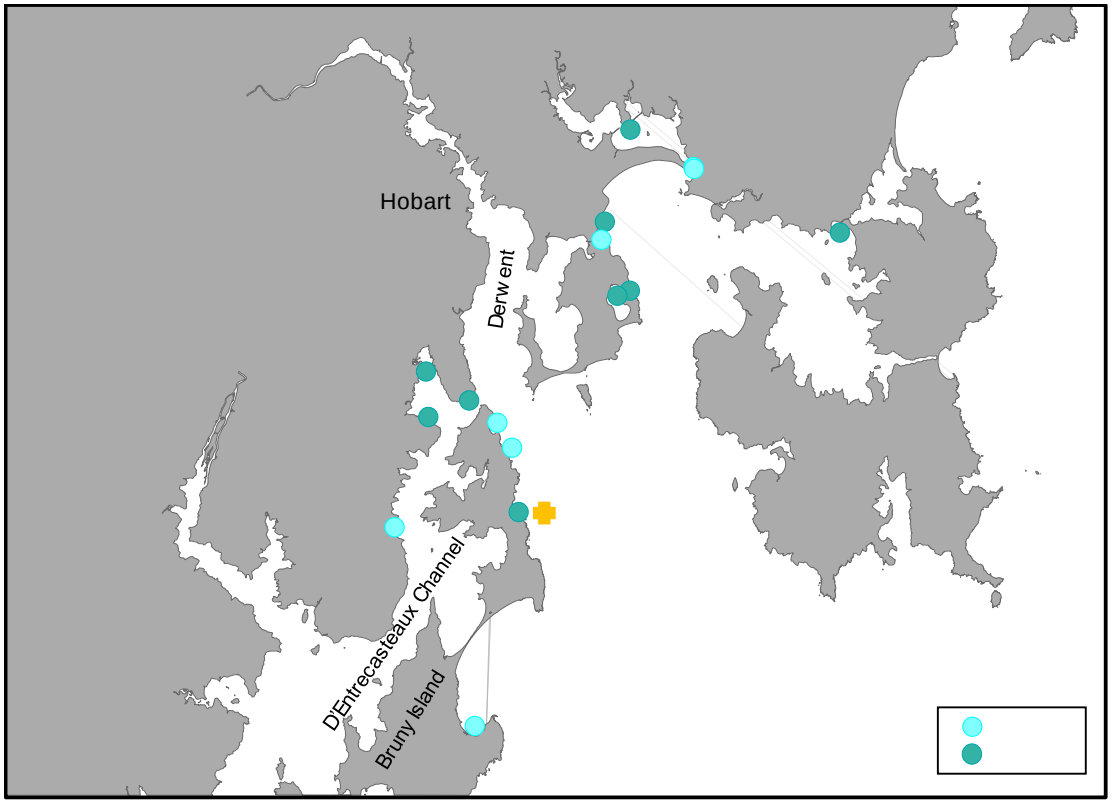

Fig 2. Map of south-eastern Tasmania showing the location of reported Atlantic salmon captures within the seven days (Week 0) and fourteen days (Week 1) following 11th May 2018. The orange cross marks the approximate location of the aquaculture lease site.

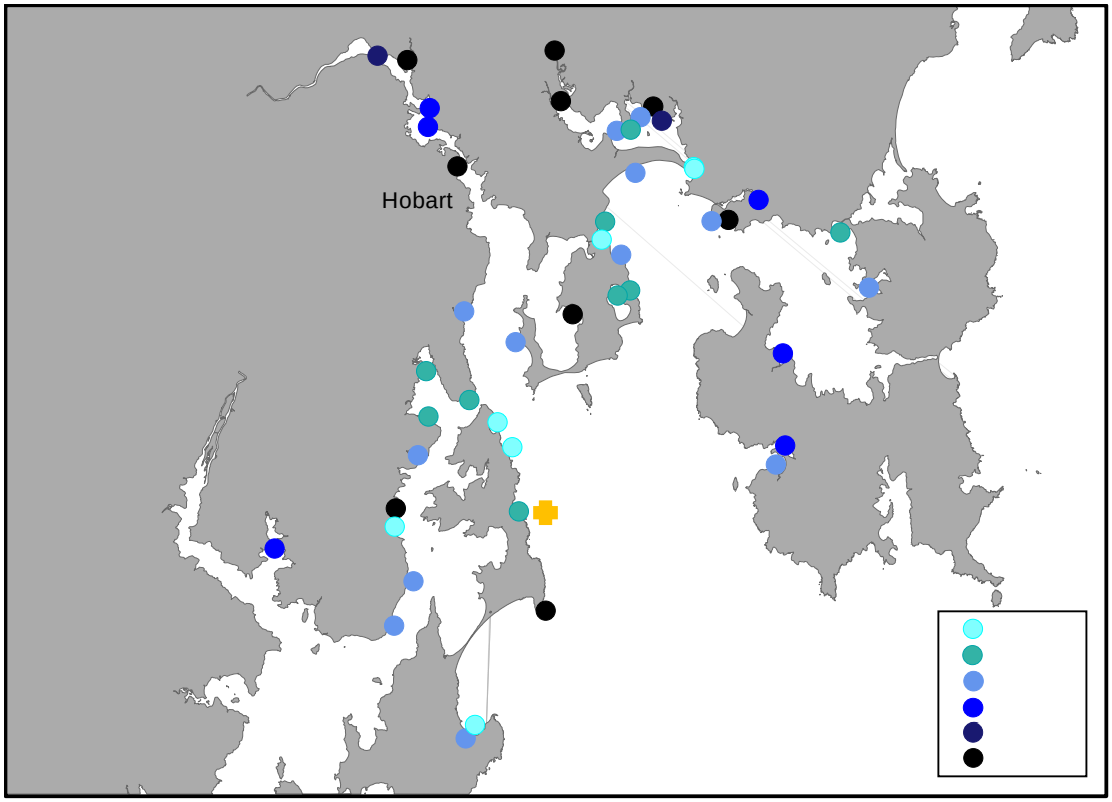

Fig 3. Map of south-eastern Tasmania showing the location, based on the earliest reported date of capture, following 11th May 2018 escape of Atlantic salmon. All data for Weeks 5 and later have been combined. The orange cross marks the approximate location of the aquaculture lease site.

Fishing methods

Traditionally, gillnets have been the primary method used by recreational fishers in Tasmania to target escapees (Lyle and Tracey 2016). However, in the present study respondents reported a range of fishing methods, including line fishing (angling), primarily with lures (soft plastics, silver slices and hard body lures) but also bait (including pellets), as well as gillnets (graballs) and even the opportunistic use of spears (associated with night fishing for flounder). Most Wave 1 respondents (73%) reported line fishing while 36% used graballs to target escapees (11 respondents line fished as well as using gillnets) (Table 2). In terms of effort (days fished), line fishing accounted for 59% of the total effort but only 32% of the total catch numbers. Average daily catch rates for gillnet fishers (4.6-5.1 fish per day) were about three times higher than for line fishers (1.6 per day).

Although the relative importance of the various fishing methods cannot be inferred from the survey data due to the non-probabilistic sampling approach, it is apparent that line fishing may represent a viable option especially in situations where Atlantic salmon become concentrated and targeted fishing is feasible.

Respondents indicated that most of the fish were in the 50-70 cm size range, weighing between 1.5-5 kg.

Table 2. Wave 1 responses based on reported fishing method(s), catch (number of Atlantic salmon), effort (days fished) and average catch rate (number per day). "Graball plus" refers to respondents who reported using graballs in addition to other (including line fishing) methods.

	No. respondents			Atlantic salmon catch	
Method	Fished	Caught salmon	Days fished	No.	No. per day
Graball	30	30	119	611	5.1
Graball plus	12	12	115	529	4.6
Line fishing	75	69	340	549	1.6
Total	117	111	574	1689	2.9

Feeding

Respondents were asked whether they had checked the stomachs of the Atlantic salmon they had caught, and if so whether they had food items in their stomachs. Seventy Wave 1 respondents indicated that they had checked the stomachs of the fish they had caught, 37 respondents (53%) reported that all were empty (representing a total of 486 Atlantic salmon) (Table 3). Thirty-three respondents (47%) noted that they had "checked stomachs, some food items present". While it was not possible to quantify the proportion of individuals with food items, 21 respondents indicated the presence of fish prey, 11 reported crustaceans (nine respondents noted crabs and four identified shrimp), and six reported a range of other items (including weed, "soft coral" and unidentified matter). The most frequently identified fish groups were "small baitfish" (12 reports), followed by whitebait/pretty fish (three reports), juvenile mullet (three reports), flounder (two reports), toadfish (two reports) and anchovy (two reports). Ten of the 33 respondents who reported that some food items were present provided enough detail to determine numbers with and without food present. Out of 51 Atlantic salmon

within this group, 14 (27%) had at least one prey item in their stomach, the remainder had empty stomachs.

Interestingly, although there were limited reports of Atlantic salmon being caught in late August/early September, respondents noted that some of the fish had "gained condition", were "healthy looking" and in "fairly good condition", and that all but one of six fish had prey items (fish or crabs) in their stomachs.

Table 3. Wave 1 responses to questions relating to observations of the stomach contents of captured Atlantic salmon.

Response	No. respondents	Total salmon caught
Checked stomach contents but all were empty (excluding sticks, stones or bait items)	37	486
Checked stomachs, some food items present	33	689
Unsure, did not check stomach contents	36	422
Total	106	1597

Fisher motivation

Respondents were asked to rate the importance of a number of statements relevant to fishing for Atlantic salmon. The majority (>75%) of respondents indicated that the opportunity to catch a quality fish species and to take full advantage of a "windfall" situation were quite or very important motives for fishing for escapees (Fig. 4). Just over half indicated that the challenge of catching an Atlantic salmon was an important motivation whereas to remove an introduced species from the environment and because they are easy to catch in good numbers were important motivations for slightly less than half of the respondents. Of least importance to fishers was the opportunity to avoid having to buy Atlantic salmon, only a third of respondents indicated that this was an important motivation.

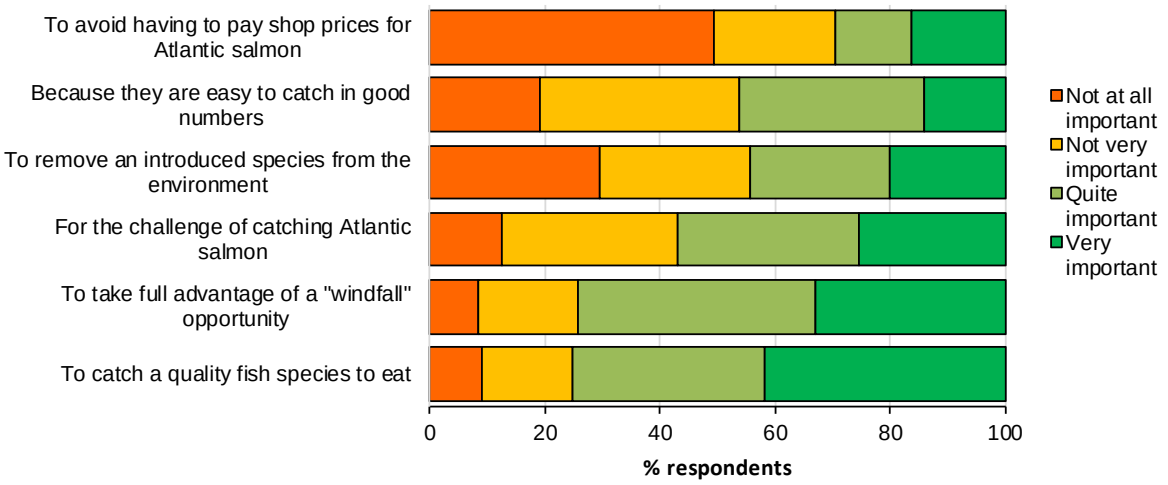

Fig. 4. Statements about possible motivations to fish for escapee Atlantic salmon and the importance to respondents (n = 119-122 depending on question).

Management and general comments

Respondents were reminded of the marine fishing regulations relevant to Atlantic salmon which include a daily bag limit of 12, a possession limit of 24 fish per person and that size limits do not apply. In addition, it was noted that gillnets as well as line fishing methods are recognised as effective fishing methods.

Respondents were then asked whether they wished to share any comments regarding the management of this fishery or general comments about fishing for escapees. More than a quarter of those who responded indicated that since Atlantic salmon is an introduced species bag (and possession) limits should not apply; the priority should be to remove them from the environment as quickly and efficiently as possible (Table 4). By contrast, a similar proportion of respondents were of the opinion that escape events represented a windfall or bonus for recreational fishers, with some even suggesting that marine farms should purposively release fish to support a marine recreational fishery for the species. Coincidentally, it has been common practice in Tasmania for excess Atlantic salmon brood stock to be released in freshwater lakes for recreational fishers to catch. There was a mixed response to the recreational use of gillnets to capture escapees, for some respondents the increased gillnet effort associated with targeting escapees was considered undesirable (due to impacts on non-target species) whereas others noted that gillnets represented an effective and legitimate way to reduce escapee numbers. Several respondents expressed general concerns over the ecological and environmental impacts of large-scale salmonid aquaculture in Tasmania, including the potential impact of escapees feeding on native fauna.

Table 4. General themes about management and issues surrounding escapees raised by survey respondents.

Themes	No.	%
Bag limits should not apply to escapees	17	27.0
Escape events represent a windfall fishing opportunity	17	27.0
Concerned about impact of escapees on native fauna	7	11.1
Concerned about the increase in gillnetting associated with escape events	5	7.9
Opposed or concerned about general impacts of marine farming	5	7.9
Supportive of current management arrangements	3	4.8
Supportive of using gillnets to catch escapees	2	3.2
Escapees should be exempt of rules that apply to trout	1	1.6
Other	10	15.9
Respondents	63	

Conclusions

Key findings

This survey has provided important insights into the dispersal, survival and potential impacts on native fauna of Atlantic salmon escapees. Dispersal was rapid but appeared to be largely restricted to south-eastern Tasmania, within the general Storm Bay region, including associated embayments and tributaries. During the first 4-6 weeks following the escape event there were reports of escapees schooled up in various locations throughout the region, often associated with areas of tidal and freshwater inflows as well as within some rivers and creeks. In such situations they were often readily captured by gillnet (where permitted) and/or line fishing methods.

Based on reported dates of capture, and assuming that most if not all of the reported Atlantic salmon had derived from the May 2018 escape event, some individuals appeared to have survived at liberty for almost four months. This does not necessary mean that these fish were thriving, in fact there was only limited evidence to suggest active feeding on native fauna. To adequately address this issue and better understand potential ecological impacts it would be necessary to collect information on body condition (e.g. muscle lipid content and body weight/length indices) and apply biochemical tests such as stable isotope and fatty acid analyses in addition to examining stomach contents.

Most recreational fishers targeting the escapees did so to take advantage of a windfall opportunity to capture what is considered a premium table fish. On the other hand, a proportion of respondents expressed concerns about the potential ecological impacts of escapees and were motivated to contribute to the removal or fish down of the introduced species.

Response to future escape events

As a condition of their environmental licence, marine farm operators in Tasmania are required to report escapes of 500 or more fish to the regulator (these reports are confidential). While there are no requirements for industry to implement measures to recover the escapees, provision has been made to allow for targeted fishing for escaped fish in the past. For instance, the early 2000s a commercial fisher was engaged by industry to fish down escapees following large escape events in Macquarie Harbour (Steer and Lyle 2003). Consistent with experiences from the northern hemisphere gillnets proved to be an effective fishing method (e.g. Skilbrei and Jorgensen 2010, Chittenden *et al.* 2011). However, the dispersal of the fish meant that catch rates declined rapidly through time, indicating that timing was critical if this strategy was to be effective.

In practice, large salmonid escapes tend to attract considerable interest from recreational and commercial fishers who have been shown to have significant and relatively immediate impacts on the number of escapees surviving (Skilbrei and Wennevik 2006, Skilbrei and Jorgensen 2010, Chittenden *et al.* 2011). This is certainly the case in Tasmania and, as evident in the current case, even though fishing effort was spatially widespread reflecting the dispersed distribution of the escapees, there were hotspots where catches were concentrated. These observations suggest that if a more proactive stance in relation to the fish down of escapees

was to be considered, targeted fishing of such locations with gillnets by contractors, rather than adjacent to farm sites, could represent an effective strategy.

Given the fact that large-scale escape events are rare and unpredictable developing a research response to address the ecological implications of these events is problematic and challenging. Nonetheless, engagement of recreational fishers has proven effective in delivering basic information about the behaviour and possible impacts of escapees. There were, however, limitations in the present study. Firstly, due to reporting confidentiality our understanding of the numbers of fish involved in the escape was unclear. This meant that from the outset there was uncertainty as to whether it would even be worthwhile implementing a fisher survey. Secondly, delays necessitated by the time taken to scope out and design a survey, to obtain appropriate ethics approvals and implement and promote the survey all meant that compromises were necessary. For example, the reliance on respondent self-selection and recalled information, limited detail about individual fishing events (contrast the detail achieved with the phone-diary approach, e.g. Lyle *et al*. 2014), and a limited ability to follow up respondents were issues. Thirdly, the lack of biological sampling limited inferences about the ecological impacts of the escapees. If fish sampling were to be undertaken by researchers, prior animal ethics approval is required (a process that typically takes 6-8 weeks) along with budget support for field collections and sample processing. Alternatively, while fishers could be encouraged to provide samples this would still take time to organise and implement (including necessary human ethics and government permit approvals), such that key events could be missed. In order to move forward and begin to more formally address the potential ecological implications of salmonid escapes in Tasmania, the ability to respond rapidly to future large-scale escape events will be paramount. The recent experiences provide a solid basis to develop such a contingency.

Acknowledgements

The support and interest of the recreational fishers who participated in the survey is greatly appreciated.

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Appendix 1. *Survey invitation*

Been fishing for escapee Atlantic salmon recently? – if so IMAS is interested in hearing from you.

Escapee Atlantic salmon fishing survey

In early May storm damage to a marine farm located to the east of Bruny Island resulted in the escape of a significant number of Atlantic salmon. While representing a bonanza for recreational fishers, relatively little is known about the impacts of such escape events. There are several important questions that arise, these include how widely and how quickly do escapees disperse, how long do they survive in the wild, and are they able to adapt to feeding on natural prey items.

Using this recent escape event as a case study we are inviting recreational fishers to share their experiences in catching escapees. By mapping the area over which the Atlantic salmon have been caught we can better understand patterns of dispersal and, by tracking catch rates through time, we hope to make inferences about survival rates. Finally, any observations about the presence or absence of food items in the stomachs will help understand whether the escaped fish feed on natural prey.

If you would like to find out more either go to:

https://www.surveymonkey.com/r/EscapeeSalmon

or, if you would prefer to receive information by mail, please contact Graeme Ewing (IMAS) on 03 6226 8228 or Graeme.Ewing@utas.edu.au so we can post you a copy.

Appendix 2. *Fishing survey (Wave 1)*

Escapee Atlantic salmon fishing survey

Information for Participants

Thank you for considering to take part in this survey. Please note, respondents should be 18 years or older and have been fishing for escapee Atlantic salmon.

In early May 2018 a major storm event resulted in the escape of a large number of Atlantic salmon from a fish farm located off the east coast of Bruny Island. In response, there have been numerous reports of recreational fishers targeting escapees using a range of fishing methods. While these fish may represent a bonanza for fishers there are a number of outstanding questions surrounding the implications of such a large loss of fish; specifically how far and quickly do they disperse, how long do they survive in the wild and do they consume native fauna?

By harnessing your experiences and observations we hope to be able to better understand these questions. This survey is being conducted by the Institute for Marine and Antarctic Studies (IMAS), participation is voluntary and expected to take 10-15 minutes to complete. There are four sections and each section has an explanation of what is involved to answer the survey.

By submitting your survey response you are providing your consent to participate in this study. Please be assured, any personal identifying information will be treated in the strictest confidence and will be removed from the databases at the completion of the study. Other information will be held for five years and then destroyed. Any reports will involve combined information and thus any comments or responses will not be individually identifiable. When available, reports from this study will be promoted by through various IMAS media platforms.

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number H0017407.

If you have any questions about the study feel free to contact Sean Tracey on (03) 6226 8286 or by email at Sean.Tracey@utas.edu.au.

In anticipation, we thank you for your co-operation and look forward to your contribution to this important study.

Yours sincerely,

Dr Jeremy Lyle

Project Leader

Questionnaire

Part A: Information about you

First we have some questions about you and your general fishing experience.

Q1: How many years have you been actively involved in recreational fishing? ☐

Q2: During the past 12 months many days did you to spend **saltwater fishing** in Tasmania, whether you caught anything or not?

☐

Q3: During the past 12 months many days did you to spend **freshwater fishing** in Tasmania, whether you caught anything or not?

☐

Q4: Are you the holder of a current Graball or Mullet net licence? Yes ☐ No ☐

Q5: Your age? (Please note respondents should be 18 years or older)

18-20 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ 70 plus ☐

Q6: Your gender? Male ☐ Female ☐ Other ☐

Q7: Your postcode? ☐☐☐☐

Part B: Your fishing for escapees

In this section, we what you to think about all of the fishing for Atlantic salmon you have done since the major escape event on 11th May this year, in particular when and where you went fishing and how many escapees you captured. Your information will be combined with that reported by other fishers to describe how far and over what timeframe the salmon dispersed from the farm site. Trends in catch rates will help understand the rate of fish-down of the escapees, noting that predation by seals, sharks and other marine predators as well as starvation are also expected to reduce numbers.

Q8: Since the 11th May 2018 have you done any fishing for netting or escapee Atlantic salmon, or incidentally caught any escapee Atlantic salmon?

Yes ☐ GO TO Q9
No ☐ GO TO PART C

Q9: On how many separate days have you fished for Atlantic salmon since the escape event in early May? ☐

Q10: Since the escape event, how many Atlantic salmon have you personally caught? ☐

IF NO ESCAPEES CAPTURED SKIP TO PART C

Q11: Which of the following methods have you used successfully to catch Atlantic salmon from this recent escape event? (tick as many as are relevant to you)

Graball ☐

Lure ☐

Fly ☐

Bait ☐

Other (specify ☐

Q12: What was the earliest date (*DD/MM*) following the recent escape event that you **caught** an Atlantic salmon escapee? ☐ / ☐

Q13: Where was this? ☐

Q14: If you have caught escapes since then, when was your **most recent successful fishing** trip for the escapees? ☐ / ☐

Q15: Where was this (if a different location to above)? ☐

Q16: Are there any other locations you have also caught Atlantic salmon since the early May escape event?

☐

Q17: Are you aware of any other locations that other fishers have caught Atlantic salmon since the early May escape event?

☐

Q18: What was the size range of the escapees you caught?

(indicate whether weight and length) ☐

Q19: Are sizes estimates or measured?

Estimates ☐

Measured ☐

Combination ☐

Q20: Escapees are generally considered to be poorly adapted to feeding on natural prey, have you observed any evidence that any of Atlantic salmon from the recent escape event had successfully fed on natural prey items. (Tick which best represents your observations).

Unsure, did not check stomach contents ☐

Checked stomachs but all were empty (excluding sticks, stones or bait items) ☐

Checked stomachs, some food items present ☐

Please specify

PART C: General comments

Q21: Motivations:

Below are some statements about motivations for fishing for Atlantic salmon escapees, please indicate how important each statement is to you and your decision to go fishing for escapees.

	Very important	Quite important	Not very important	Not at all important
To catch a quality fish species to eat	☐	☐	☐	☐
For the challenge of catching Atlantic salmon	☐	☐	☐	☐
To remove an introduced species from the environment	☐	☐	☐	☐
To take full advantage of a “windfall” opportunity	☐	☐	☐	☐
Because they are easy to catch in good numbers	☐	☐	☐	☐
To avoid having to pay shop prices for Atlantic salmon	☐	☐	☐	☐

Q22: Management

The fishery for Atlantic salmon in marine waters is based exclusively on escapees from marine farms. Fishing regulations for Atlantic salmon include a daily bag limit of 12 and a possession limit of 24 per person. There are no size limits. Gillnets as well as line fishing methods are recognised as effective fishing methods.

Do you have any comments regarding the management of this fishery or general comments about fishing for escapees that you would like to share?

PART D: Future fishing plans

Q23: How likely is it that you will go fishing again for escapees over the next couple of months?

Quite Likely ☐

Not very likely ☐

Not sure ☐

Q24: Would you be willing to contacted again about any future fishing, noting that the main reasons for this are to determine the timeframe over which escapees continue to be captured (that is how long they survive in the wild), and whether they move further away from the release site?

Yes ☐

No ☐

Q25: If you answered YES to the previous question, what is your preferred method of contact?

Phone ☐

Email ☐

Q26: What are your contact details?

Your name: ……..

Phone number: …….. Best times to call: ……..

Your email. ……..

We will endeavour to be in touch again within the next 4-6 weeks.

Thank you for your participation

Appendix 3. Follow-up surveys (Waves 2 & 3).

Escapee Atlantic salmon fishing survey – Follow-up (Email version)

Dear …….

This is a follow-up to the survey about Atlantic salmon escapees you recently answered for the Institute for Marine and Antarctic Studies. In that survey you indicated you were likely to do some more fishing for Atlantic salmon and would be willing to be contacted again.

You will recall that in early May 2018 a major storm event resulted in the escape of a large number of Atlantic salmon from a fish farm located off the east coast of Bruny Island. The aim of this follow-up survey is to extend the time period over which we have information about the escape event. We are hoping to understand how long escapees survive and how far they disperse. The experiences and observations of recreational fishers will help us better understand the environmental implications of such a large loss of fish.

This survey has two sections and is intended to add to the previous information you provided. By submitting your survey response you are providing your consent to participate in this study. Please be assured, any personal identifying information will be treated in the strictest confidence and will be removed from the databases at the completion of the study. Other information will be held for five years and then destroyed. Any reports will involve combined information and thus any comments or responses will not be individually identifiable.

I invite you to complete the following questions, noting that the survey is voluntary and has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on +61 3 6226 6254 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number H0017407.

PART A: Recent fishing activity	
The last day on which you reported fishing for escapees was:	DD/MM/2018
Q 1: Have you done any fishing for escapees since that date?	Yes/No
IF NO GO TO PART B	

Q2: IF YES …. can you please provide details of you most recent fishing trip for escapees?

Date (dd/mm)	Location	Method(s) used	Catch (no. of escapees)

Have you caught escapees in any **other locations** since DD/MM (please list)	

Q3: What was the size range of the escapees you've caught recently (indicate whether size is estimated/measured/ combination?)	Size range	Estimated?
Q4: Have you observed any changes in the body condition of the escapees? If so, in what ways?		
Q5: Have you observed any evidence that any of Atlantic salmon had successfully fed on natural prey items. If yes, provide details.		

PART B: Future fishing plans	
Are you likely to go fishing again for escapees over the next couple of months?	Yes/No
Would you be willing for us to contacted again about your fishing, noting that the main reasons for this are to determine the timeframe over which escapees continue to be captured (that is how long they survive in the wild), and how far they have dispersed from the release site?	Yes/No
Is this the best way for us to contact you again (if an alternative method is preferred please specify below):	

Thank you again for your participation.