Effects of fishery related fight time and air exposure on pre-spawn survival and reproductive success of adult hatchery steelhead.

2015-2017

What's the big deal?

Physiological Effects of Brief Air Exposure in Exhaustively Exercised Rainbow Trout (Oncorhynchus mykiss): Implications for "Catch and Release" Fisheries

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Ferguson, R. A., and B. L. Tufts. 1992. Physiological effects of brief air exposure in exhaustively exercised rainbow trout (Oncorhynchus mykiss): implications for "catch and release" fisheries. Can. J. Fish. Aquat. Sci. 49: 1157–1162.

Rainbow trout (Oncorhynchus mykiss) which were air exposed for 60 s after exhaustive exercise initially had a much larger extracellular acidosis than trout which were only exercised. In both groups, however, plasma pH returned to normal by 4 h. Blood lactate concentrations were also greater in the air-exposed fish and confinued to increase throughout the experiment. During air exposure, there was retention of carbon dioxide in the blood, and oxygen tension (Po.) and hemoglobin:oxygen carriage (Hb:O₃) both fell by over 80%. After 30 min of recovery, however, blood gases resembled those in fish which were only exercised. Finally, survival after 12 h was 10% in control fish and 88% in the exercised fish but fell to 62 and 28% in fish which were solved for 30 and 60 s, respectively, after exercise. These results indicate that the brief period of air exposure which occurs in many "catch and release" fisheries is a significant additional stress which may ultimately influence whether a released fish survives.

Des truites arc-en-ciel (Oncorhynchus mykiss) exposées à l'air pendant 60 s après une activité physique épuisante ont présenté, tout d'abord, une acidose extracellulaire beaucoup plus élevée que celles qui n'avaient pas été exposées à l'air. Dans les deux groupes, toutefois, le pH plasmatique est revenu à la normale dans les quatre heures suivantes. La concentration de lactate sanguin était également plus élevée chez les poissons exposés à l'air, et elle a continué à augmente tout au long de l'expérience. Pendant l'exposition à l'air, on a enregistré une rétention de dioxyde de carbone dans le sang, la tension en oxygène (Po₂) et le transport de la molécule d'hémoglobine oxygénée (Hb:O₂) diminuant tous deux de plus de 80%. Cependant, après 30 min de repos, les gas sanguins se situaient à des niveaux comparables à ceux des poissons n'ayant pas été exposés à l'air. Finalement, le taux de survie après 1 2 h était de 100%, chez les témoins et de 88% chez les poissons ayant été soumis des exercices épuisants, mais il a chutté à 62 et à 28% chez ceux qui ont été exposés à l'air. Endadat ot et 60 s l'eau des prises, la courte période pendant laquelle les truites sont exposées à l'air prefisente un stress supplémentaire important, qui peut en fin de compte, avoir une incidence sur la survie des poissons relachés.

Received July 9, 1991 Accepted December 16, 1991 (JB118) Reçu le 9 juillet 1991 Accepté le 16 décembre 1991

n integral component of the management strategy in commercial and recreational fisheries is the release of a significant portion of the catch. In commercial fisheries, this may include species caught out of season or individuals which do not meet size restrictions. In recreational fisheries, "catch and release" policies have also been implemented to offset the impact of increased angling pressure on limited fish stocks. For example, recreational fishermen on Canada's east coast must now release all multi-sea-winter salmon (i.e. over 63 cm in length) and all smaller salmon over and above the daily or seasonal limit. Smilar legislative restrictions apply to a diversity of species throughout North America (Barnhart 1989). Furthermore, in a number of sport fisheries, individuals as well as tournament organizers are promoting the live release of fish even in the absence of legislation.

Fish caught either by commercial or recreational methods often struggle to the point of complete exhaustion. Black (1957a, 1957b, 1957c, 1958) has shown that a significant percentage of these fish may die from the ordeal. Death does not occur immediately, but often well into the recovery period. While other investigators have documented similar mortalities in exhaustively exercised fish (Bouck and Ball 1966; Beggs et al. 1980; Graham et al. 1982; Wood et al 1983), some studies indicate that exhaustive exercise is not associated with significant mortality (Wydoski et al. 1976; Tufts et al. 1991). It is clear nonetheless that the period of exhaustive exercise associated with angling or struggling in commercial fishing gear results in a significant physiological disturbance in a fish (Wood and Perry 1985). Furthermore, complete recovery is not guaranteed simply because the exhausted fish is eventually released.

In both commercial and recreational fisheries, exhaustive exercise is often followed by a brief period of air exposure prior to release. During this time, the gill's delicate lamellae will collapse and gas exchange may be largely inhibited. The importance of this additional stress on the disturbance associated with exhaustive exercise and on the process of recovery has not previously been investigated. The purpose of the present study was unerfore to examine the additive effect of brief air exposure on the physiological disturbance associated with exhaustive exercise in the rainbow trout (Oncorhynchus mykiss). In view

MOLECULAR ECOLOGY

Molecular Ecology (2013) 22, 187-200

doi: 10.1111/mec.12102

Does catch and release affect the mating system and individual reproductive success of wild Atlantic salmon (*Salmo salar* L.)?

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Abstract

In this study, we documented the breeding system of a wild population of Atlantic salmon (Salmo salar L) by genetically sampling every returning adult and assessed the determinants of individual fitness. We then quantified the impacts of catch and release (C&R) on mating and reproductive success. Both sexes showed high variance in individual reproductive success, and the estimated standardized variance was higher for males (2.86) than for females (0.73). We found a weak positive relationship between body size and fitness and observed that fitness was positively correlated with the number of mates, especially in males. Mature male parr sired 44% of the analysed offspring. The impact of C&R on the number of offspring was size dependent, as the reproductive success of larger fish was more impaired than smaller ones. Also, there was an interactive negative effect of water temperature and air exposure time on reproductive success of C&R salmon. This study improves our understanding of the complex reproductive biology of the Atlantic salmon and is the first to investigate the impact of C&R on reproductive success. Our study expands the management toolbox of appropriate C&R practices that promote conservation of salmon populations and limit negative impacts on mating and reproductive success.

Keywords: alternative reproductive tactics, catch and release, fitness, reproductive success, Sabno salar, salmon

Received 18 June 2012; revision received 14 September 2012; accepted 24 September 2012

Introduction

Studies of breeding systems enable us to understand the processes underlying the different reproductive strategies adopted by both sexes of a species. In particular, variance in reproductive success is thought to be higher among males than among females, which may result from the strong correlation in males between the number of mates and fertility (Bateman 1948; but see Gowaty *et al.* 2012). Intrasexual selection drives the evolution of alternative reproductive tactics (ARTs) (Oliveira *et al.* 2008), which are particularly frequent in fish (Taborsky 2008). Species of the salmonid family are

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well known for their great diversity of breeding systems and the morphological differences associated with males adopting different ARTs (Fleming 1998). In Atlantic salmon (Salmo salar L.), males may either mature as parr, which are young, nonmigratory individuals, or after one (known as grilse) or two winters at sea (large salmon), whereas females normally mature after two winters at sea (Klemetsen et al. 2003). Early parentage genetic analysis on the species breeding system revealed an unexpected high level of polygamy for both sexes (Garant et al. 2001; Taggart et al. 2001) and, in apparent disagreement with sexual selection theory (Andersson 1994), an equally high variance in reproductive success for both sexes (Fleming et al. 1997; Garant et al. 2001). Other studies have found differences in reproductive success (RS) realized by males adopting

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Physiological Effects of Brief Air Exposure in Exhaustively Exercised Rainbow Trout (Oncorhynchus mykiss): Implications for Does catch and release affect the mating system and "Catch and Release" Fisheries individual reproductive success of wild Atlantic salmon (Salmo salar L.)? R. A. Ferguson and B. L. Tufts¹ Department of Biology, Queen's University, Kingston, Ont. K7L 3N6, Canada ANTOINE RICHARD,* MÉLANIE DIONNE,† JINLIANG WANG‡ and LOUIS BERNATCHEZ* 4 Leaend 100 0 s 88 control 35 80 exer 62 % Survival exer + 30s air 60 30 Number of infered fry exer + 60s air 40 28 25 20 20 0 Treatment 2 FIG. 5. Survival of rainbow trout 12 h following control conditions, exhaustive exercise, exhaustive exercise plus 30 s of air exposure, and exhaustive exercise plus 60 s of air exposure. 5 63 cm in length) and all smaller salmon over and above the and Perry 1985). Furthermore, complete recovery is not guardaily or seasonal limit. Similar legislative restrictions apply to anteed simply because the exhausted fish is eventually released. a diversity of species throughout North America (Barnhart In both commercial and recreational fisheries, exhaustive 12 10 14 16 18 20 1989). Furthermore, in a number of sport fisheries, individuals exercise is often followed by a brief period of air exposure prior as well as tournament organizers are promoting the live release

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Can. J. Fish. Aquat. Sci., Vol. 49, 1992

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Water temperature (°C)

doi: 10.1111/mec.12102

1157

Objectives



Fight Time



Angler Air Exposure



Brood Collection



Transport Air Exposure

Unique Mark



Adult Holding

With T. P. P. P. P. M. Dr. W.

PHILE GLEPPI



FUF



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Spawn Crossing



Pre-spawn adult and progeny survival



Results

Three year pre-spawn survival

- 97% for the 1,148 angler caught broodstock
- 92% for the 3,325 swim-in broodstock

Fight time

- Fight time (n=162) averaged 164 seconds
 - Higher than observed in trout fisheries, similar to steelhead fisheries (Lamasky and Meyer 2016; Chiaramonte et al. 2018; Roth et al. 2018)

Air exposure

- Angler air exposure (n=180) averaged 23 seconds
- Transport air exposure (n=635) averaged 28 seconds
 - Both angler and transport air similar to trout and steelhead fisheries (Lamasky and Meyer 2016; Chiaramonte et al. 2018; Roth et al. 2018)

Results continued

Table 1. Sample size, mean with standard error (SE), and range of times measured in seconds (s)

or days for fight time, longest single interval of angler air exposure, transport air exposures, and days held at the hatchery for adult hatchery steelhead caught by anglers for broodstock in the South Fork Clearwater River, 2015-2017.

Measure	Sex	n	Mean	Range
Fight time (s)	Female	82	173.2 (SE = 15.5)	16-554
	Male	80	153.8 (SE = 16.9)	2-668
Angler air exposure (s)	Female	100	20.3 (SE = 1.9)	2-123
	Male	80	25.8 (SE = 3.0)	3-178
Transport air exposure (s)	Female	346	25.7 (SE = 0.8)	7-131
	Male	289	30.8 (SE = 1.0)	8-91
Days held	Female	348	11.9 (SE = 0.4)	1-38
	Male	306	11.4 (SE = 0.4)	1-31

Fight Time Results



Air Exposure Results





Spawn readiness



The caveats



The caveats



The caveats



The take home message

- The results of this and the majority of other studies conducted addressing fight and air exposure times relative to actual anglers, show no negative population level effect and support IDFG's current fisheries management regulations.
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Why not?



Why not?



