Influence of triploid status on salmon smoltification

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Abstract

Growth and survival in fresh water (FW), completion of smoltification, and subsequent growth in seawater (SW) of diploid (2n) and triploid (3n) Atlantic salmon were compared. 3n eggs were produced by thermal shock (10 min at 29°C) and verified by caryological examination of young embryos (86% survival) and, later on 9-month-old juveniles, by measurement of erythrocyte nuclear diameter 96% 3n). Parr were reared in four tanks (Le Conquet hatchery) under natural temperature and photoperiod (48°N). Survival from first-feeding (20 March) to smolting (mid-April of the next year) was 84.3% in the 2n and 81.4% in the 3n fish. At completion of smolting, the triploid salmon were significantly larger than diploid fish (171 ± 2 vs 163 ± 2 mm; $P < 0.01$) but both groups exhibited the same condition factor (1.04 ± 0.03). Gill microsomal Na^+, K^+-ATPase activity showed similar patterns in both groups, increasing from mid-February, both peaking on 21 April at 30.1 ± 2.2 μmol $PO_4 \cdot$mg prot$^{-1} \cdot$h^{-1}. In contrast, 2n and 3n fish exhibited significant differences in plasma thyroid hormones (T_3 and T_4) and growth hormone (GH) levels. T_3 increased in 2n fish at the end of March, reaching 12.5 ± 1 ng·ml^{-1}, but in 3n fish remained low and varied little after the beginning of March (1.5 ng·ml^{-1}). T_4 surged in 2n salmon on 28 March (19.5 ± 1.5 ng·ml^{-1}), but peaked later in 2n fish (15 April) and at a lower level (10.2 ± 1.2 ng·ml^{-1}, $P < 0.01$). GH levels increased in 2n fish in late March, reaching 12.2 ± 1 ng·ml^{-1} on 4 April, significantly ($P < 0.01$) higher than the 3n salmon (8.0 ± 0.5 ng·ml^{-1}).

Both 2n and 3n groups were transferred directly to 35‰ SW on 18 April. Both groups showed good hypo-osmoregulatory ability. Plasma osmolality and chloride after 48 h in SW were 362 ± 2 mOsm·l^{-1} and 148 ± 2 mM·l^{-1} in 2n and 360 ± 2 and 149 ± 4 in 3n smolts. Mortality after 21 days in SW was 3% (2n) and 4% (3n).

Long-term results in net pens showed better performance in 2n than in 3n salmon in SW. In June, after 14 months in SW, survival of 2n salmon was 70% and only 45% for 3n fish. At this time, 2n and 3n salmon weighed 1.568 and 1.420 kg, respectively. Although triploid Atlantic salmon are used in Scotland, Canada and Tasmania, the seawater rearing of 3n salmon in France may not be practicable because of local environmental conditions. Triploids appeared able to adapt to SW but their growth and survival were inferior to those of 2n fish. The endocrinological differences between 2n and 3n fish may be responsible for relatively poor performance of 3n salmon in SW.

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