***Salmo salar*** 正體中文

**System:** Marine

| Kingdom | Phylum | Class | Order | Family |
|---|---|---|---|---|
| Animalia | Chordata | Actinopterygii | Salmoniformes | Salmonidae |

**Common name**

caplin-scull salmon (English), parr (English), hengst (Dutch), Atlanterhavslaks (Danish), outside salmon (English), lax (Icelandic), silver salmon (English), losos (Russian), schaanexw (Salish), Amerikanskiy atlanticheskiy losos' (Russian), slhop' schaanexw (Salish), spring salmon (English), laks (Danish), sãlmao-do-atlântico (Portuguese), skællaks (Danish), solomós (Greek), Atlantisk laks (Danish), las (German), nedfaldslaks (Danish), k'wolexw (Salish), semga (Russian), k'wit'thet (Salish), fiddler (English), Jacobzalm (Dutch), echter lachs (German), sk'wel'eng's schaanexw (Salish), common atlantic salmon (English), zalm (Dutch), breeder (English), grayling (English), ouinanish (English), grilse (English), tacon atlantique (French), Ijle zalm (Dutch), Atlantischer salmon (German), spring fish (English), sebago salmon (English), shamet skelex (Salish), sea salmon (English), grilt (English), saumon d'eau douce (French), ouananiche (English), salmó (Catalan), kelt (English), shmexwalsh (Salish), landlocked salmon (English), N. Atlantic salmon (English), losos atlantsky (Czech), slink (English), smolt (English), losos szlachetny a. atlantycki (Polish), salmon (English), saumon atlantique (French), lohi (Finnish), kutenut lohi (Finnish), sináech (Salish), hoplax (Icelandic), spak'ws schaanexw (Salish), lax (Swedish), kapisilik (English), winnish (English), salmon peel (English), st'thkway' (Salish), losos (Serbian), Atlantic salmon (English), kapisalirksoak (English), salmón del atlántico (Spanish), salmón (Spanish), salmâo (Portuguese), black salmon (English), bradan (English), vraklax (Swedish), alabalik atlantik (Turkish), lachs (German), Atlantic salmon (English), salmling (German), saama (English), lax (Norwegian), laks (Norwegian), laks atlantisk (Norwegian), salmo (Italian), sake masu-rui (Japanese), salmone del reno (Italian), salmone (Italian), salmone atlantico (Italian), losos (Polish), kumaliq (English), kebleriksorsoak (English), salmao (Portuguese), solomos (Greek), unaniche (English), somon de atlantic (English), braddan (English), saamarug (English), saamakutaak (English), sâma (English), gullspångslax (Swedish), losos obecný (Czech), salmâo-do-atlântico (Portuguese)

**Synonym**

*Trutta salar* , (Linnaeus, 1758)
*Salmo salar* , Linnaeus, 1758
*Salmo nobilis* , Olafsen, 1772
*Salmo goedenii* , Bloch, 1784
*Salmo salmulus* , Walbaum, 1792
*Salmo caerulescens* , Schmidt, 1795
*Salmo nobilis* , Pallas, 1814
*Salmo hamatus* , Cuvier, 1829
*Salmo ocla* , Nilsson, 1832
*Salmo salmo* , Valenciennes, 1848
*Salmo salar* , lacustris Hardin, 1862
*Trutta relicta* , Malmgren, 1863
*Salmo gracilis* , Couch, 1865
*Salmo brevipes* , Smitt, 1882
*Salmo renatus* , Lacepède, 1803
*Salmo rilla* , Lacepède, 1803
*Salmo salar brevipes* , Smitt, 1882
*Salmo salar biennis* , Berg, 1912
*Salmo salar brevipes relictus* , Berg, 1932
*Salmo salar saimensis* , Seppovaara, 1962
*Salmo salar europaeus* , Payne, Child & Forrest, 1971
*Salmo hardinii* , Günther, 1866

**Similar species**

**Summary**

Salmo salar ranks among the most popularly cultivated fish in the world. Commercial stocks have inflicted significant impacts of wild populations of wild salmon and other fish by way of competition, hybridization, and spread of disease. Great care should be taken to protect these wild fish populations while cultivating S. salar.

view this species on IUCN Red List

**Notes**

The ecological impacts of *Salmo salar* stem from cultivated populations which exert negative impacts on wild *S. salar* and other fish populations within native and introduced ranges. These farmed populations may be considered invasive even in native locations as it affects the long-term survival or genetic variation of native species, or the integrity or sustainability of natural communities (Chadderton, 2001).

**Lifecycle Stages**

The Alaskan Department of Fish and Game (2002) reports that, \"*Salmo salar* spawn in medium to large rivers from fall through spring. Juveniles can spend up to three years in streams and rivers before they migrate to the sea where they then spend up to three more years before returning to their birthplace to spawn and continue the cycle. Some *S. salar* may survive the spawning event (Pacific salmon do not) and return to the ocean to spawn again\".

**Uses**

*Salmo salar* is an extremely important food fish with over 1,000,000 tons cultivated annually. *S. salar* comprises over 90% of farmed salmon and over 50% of total salmon harvested. It is also a highly desirable sport fish by anglers (FAO, 2009).

**Habitat Description**

*Salmo salar* is an anadromous species which inhabits the benthopelgaic zone of freshwater watercourses and sea. Large, cool rivers with extensive, gravelly bottom headwaters are essential to early development. As they grow, older juveniles prefer deeper waters and faster currents. They spend 1-6 years in rivers before moving to sea in spring or summer when the sea surface temperature in coastal areas are above 8 °C. Although, some populations remain landlocked. While at sea, *S. salar* roam vast feeding ranges, preferring temperatures of 4-12 °C, for 1-5 years and grow quickly. They return to rivers in the autumn to spawn. Most were found to return to the same river in which they were spawned. *S. salar* may withstand depths of up to about 210 m and temperatures 0-28 °C for short periods of time (Renzi, 1999; Fiske, 2006; FishBase, 2009).

**Reproduction**

Renzi (1999) reports that, \"*S. salar* spawn in late fall/early winter. As spawning time nears, males undergo conspicuous changes in head shape: the head elongates and a pronounced hook, or kype, develops on the tip of the lower jaw. The nesting site is chosen by the female, usually a gravel-bottom riffle above a pool. The female digs the nest, called the \"redd,\" by flapping strongly with her caudal fin and peduncle while on her side; the redd is formed by her generated water currents. The female rests freely during redd preparation while the male continues to court her and drive away other males. When the redd is finished, the male aligns himself next to the female, the eggs and sperm are released, and the eggs are fertilized during the intermingling of the gametes. On average, a female deposits 700-800 eggs per pound of her body weight. The eggs are pale orange in colour, large and spherical, and somewhat adhesive for a short time. The female then covers the eggs with gravel, using the same method used to create the redd. The eggs are buried in gravel at a depth of about 12.7 to 25.4cm. The female rests after spawning and then repeats the operation, creating a new redd, depositing more eggs, and resting again until spawning is complete. The male continues to court and drive off intruders. Complete spawning by individuals may take a week or more, by which time the spawners are exhausted. Some Atlantic salmon die after spawning but many survive to spawn a second time; a very few salmon spawn three or more times. Spawning completed, the fish, now called \"kelts,\" may drop downriver to a pool and rest for a few weeks, or they may return at once to the ocean. Some may also remain in the river over winter and return to sea in the spring.\"

**Nutrition**

*Salmo salar* spend up to 4 years in deep-sea feeding grounds feeding on pelagic species such as herring, sprat and squid (FAO, 2009).

**General Impacts**
The negative ecological impacts associated with *Salmo salar* seem to be limited only to domestic fish farm stocks. Sea cages used are prone to tearing from storms, human error, predators or other causes, resulting in the mass escape of fish annually. For example a single storm in Norway resulted in the release of 490,000 farmed Atlantic salmonwhose total weight exceded the wild salmon harvest there for a whole year. Domesticate farm stocks of *S. salar* that escape can wreak havoc on wild populations by spreading disease and parasites to, competing with, and hybridizing with native salmon and other fish. Fish farming also fouls sea waters with varies toxicants associated with and produced by fish cultivation (Alaskan Department of Fish and Game, 2002; Thorstad *et al*, 2006; Volpe, undated; Hindar *et al*, 2006) .
Crowding fish in net pens increases stress, which makes them more susceptible to disease. Therefore, when outbreaks do occur they tend to spread rapidly through the captive population. Diseases that occur in captive populations, such as furunculosis and sea lice *Lepeophtheirus\nsalmonis* can spread to wild fish (Alaskan Department of Fish and Game, 2002; Amundrud & Murray, 2009; Naylor *et al*, 2005).
Escaped *S. salar* compete with wild populations and other native fishes for resources. Farmed salmon and hybrids (farm x wild) can be expected to interact and compete directly with wild fish for food, habitat, and territory. Farm juveniles are generally more aggressive and consume similar resources as wild fish. They grow faster than wild fish, which may give them a competitive advantage at some life stages (Thorstad *et al*, 2006).
Farm-raised *S. salar* also hybridize with wild stocks and other fishes, thereby reducing the wild stock's ability to survive in the wild by changing the level of genetic variability and frequency and types of alleles in the gene pools. The extremely high abundance of espaced salmon can completely dominate wild populations, comprising up to 80% of all breeders in smaller wild populations. Such an influx in these genetically divergent farmed Atlantic salmon can have dire consequences to wild populations and their genetics (Thorstad *et al*, 2006; Hindar *et al*, 2006).
The net 'walls' of sea cages or net pens allow virtually complete interaction between the farm and the surrounding environment. Therefore, clean, oxygenated water is free to pass into the net pen while uneaten food pellets, feces, antibiotics and toxic anti-foulants flow out. The exchange of clean water into the farm and dispersal of industrial wastes away from the farm means that the industry benefits from a subsidy from nature (Volpe, undated).
The likelihood of *S. salar* establishing reproducing populations in introduced habitats is extremely low. Over 130 attempts to introduce Atlantic salmon across 32 states in the United States, over 60 attempts in British Columbia, Canada, several attempts in Tasmania, and numerous attempts in Chile have all failed (Thorstad *et al*, 2006).

**Management Info**

Preventative measures: The use of potentially invasive alien species for aquaculture and their accidental release/or escape can have negative impacts on native biodiversity and ecosystems. Hewitt *et al*, (2006) Alien Species in Aquaculture: Considerations for responsible use aims to first provide decision makers and managers with information on the existing international and regional regulations that address the use of alien species in aquaculture, either directly or indirectly; and three examples of national responses to this issue (Australia, New Zealand and Chile). The publication also provides recommendations for a 'simple' set of guidelines and principles for developing countries that can be applied at a regional or domestic level for the responsible management of Alien Species use in aquaculture development. These guidelines focus primarily on marine systems, however may equally be applied to freshwater.
Copp *et al*, (2005) Risk identification and assessment of non-native freshwater fishes presents a conceptual risk assessment approach for freshwater fish species that addresses the first two elements (hazard identification, hazard assessment) of the UK environmental risk strategy. The paper presents a few worked examples of assessments on species to facilitate discussion. The electronic Decision-support tools- Invasive-species identification tool kits that includes a freshwater and marine fish invasives scoring kit are made available on the Cefas (Centre for Environment, Fisheries & Aquaculture Science) page for free download (subject to Crown Copyright (2007-2008)).
The impacts of farmed *Salmo salar* may be prevented by a number of strategies and technologies. Care should be taken in choosing farm sites as to prevent or reduce the spread of infections diseases and parasites suchs as sea lice (*Lepeophtheirus salmonis*) to wild fish populations (Thorstad *et al*, 2006; Amundrud & Murray, 2009). Sterilization of farm stocks by high pressure induction of triploidy in newly fertilized eggs would reduce the effects of hybridization of escaped *S. salar* with wild populations and other fishes. It may also reduce the competive effects of these escapees as well. This practice may reduce their survival and growth rate, increase the likelihood of deformities and susceptibility to disease, and induce negative market reactions. Culture of triploid *S. salar* was attmpted and abandoned in Fundy, Canada due to high susceptibility to the infectious salmon anemia virus. However, promising studies on this method continue (Thorstad *et al*, 2006).
Domestication of *S. salar* to the point that individuals can no longer breed or even survive in nature is another possible means of negating possible impacts of farmed stocks on wild populations. It would be a complicated and long term process to do so without comprimising characteristics necessary for a quality yeild (Thorstad *et al*, 2006).
Physical: The establishment of protected zones that prohibit the cultivation of *S. salar* is a means of retaining unaffected wild populations of Atalntic salmon. Norway, the top cultivator of *S. salar*, maintains 29 national salmon fjords and 52 national salmon rivers where new Atlantic salmon farming is prohibited. This protects 75% of wild salmon within the country. Large zones without existing salmon farms exhibited the inteded effect, but existing farms were allowed to remain. Establishing these zones before salmon farms are begun is essential to the effectiveness of this method. Recapture of escaped farmed salmon has been deemed ineffective (Thorstad *et al*, 2006).

**Pathway**

The commercial culture of *S. salar* in sea-cages in Tasmania has recently become a major part of the aquaculture industry (Kailola *et al.* 1993). *S. salar* are also farmed commercially in fish farms in mainland south eastern Australia, primarily in New South Wales and Victoria (Cadwallader, 1996).

**Principal source:** Alaskan Department of Fish and Game, 2002. Atlantic Salmon: White Paper - March 5 2002. Renzi, 1999. *Salmo salar* Atlantic salmon.

**Compiler:** IUCN/SSC Invasive Species Specialist Group (ISSG)

**Review:** Version 1: Dr John Volpe, Adjunct. University of Alberta Faculty of Biological Sciences Canada \ Dr John Volpe, Adjunct. University of Alberta Faculty of Biological Sciences Canada

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## ALIEN RANGE

**[1]** ARGENTINA
**[1]** ATLANTIC - WESTERN CENTRAL
**[7]** AUSTRALIA
**[1]** BRAZIL
**[7]** CANADA
**[1]** CHILE
**[1]** CHINA
**[1]** CYPRUS
**[1]** FALKLAND ISLANDS (MALVINAS)
**[2]** FRENCH SOUTHERN TERRITORIES
**[1]** GREECE
**[1]** ISRAEL
**[1]** KOREA, REPUBLIC OF
**[2]** NEW ZEALAND
**[1]** SINGAPORE
**[1]** SOUTH AFRICA
**[1]** TURKEY
**[37]** UNITED STATES

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**Summary:** The electronic tool kits made available on the Cefas page for free download are Crown Copyright (2007-2008). As such, these are freeware and may be freely distributed provided this notice is retained. No warranty, expressed or implied, is made and users should satisfy themselves as to the applicability of the results in any given circumstance. Toolkits available include 1) FISK- Freshwater Fish Invasiveness Scoring Kit (English and Spanish language version); 2) MFISK- Marine Fish Invasiveness Scoring Kit; 3) MI-ISK- Marine invertebrate Invasiveness Scoring Kit; 4) FI-ISK- Freshwater Invertebrate Invasiveness Scoring Kit and AmphISK- Amphibian Invasiveness Scoring Kit. These tool kits were developed by Cefas, with new VisualBasic and computational programming by Lorenzo Vilizzi, David Cooper, Andy South and Gordon H. Copp, based on VisualBasic code in the original Weed Risk Assessment (WRA) tool kit of P.C. Pheloung, P.A. Williams & S.R. Halloy (1999).
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**Summary:** This publication aims to first provide decision makers and managers with information on the existing international and regional regulations that address the use of alien species in aquaculture, either directly or indirectly; and three examples of national responses to this issue (New Zealand, Australia and Chile).
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**Summary:** In 1993, Canada, Mexico and the United States signed the North American Agreement on Environmental Cooperation (NAAEC) as a side agreement to the North American Free Trade Agreement (NAFTA). The NAAEC established the Commission for Environmental Cooperation (CEC) to help the Parties ensure that improved economic efficiency occurred simultaneously with trinational environmental cooperation. The NAAEC highlighted biodiversity as a key area for trinational cooperation. In 2001, the CEC adopted a resolution (Council Resolution 01-03), which created the Biodiversity Conservation Working Group (BCWG), a working group of high-level policy makers from Canada, Mexico and the United States. In 2003, the BCWG produced the �Strategic Plan for North American Cooperation in the Conservation of Biodiversity.� This strategy identified responding to threats, such as invasive species, as a priority action area. In 2004, the BCWG, recognizing the importance of prevention in addressing invasive species, agreed to work together to develop the draft CEC Risk Assessment Guidelines for Aquatic Alien Invasive Species (hereafter referred to as the Guidelines). These Guidelines will serve as a tool to North American resource managers who are evaluating whether or not to introduce a non-native species into a new ecosystem. Through this collaborative process, the BCWG has begun to implement its strategy as well as address an important trade and environment issue. With increased trade comes an increase in the potential for economic growth as well as biological invasion, by working to minimize the potential adverse impacts from trade, the CEC Parties are working to maximize the gains from trade while minimizing the environmental costs.
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