

The Atlantic Salmon *Salmo salar* in Australia

L. C. Llewellyn

Curlew Biological Services, PO Box 67, Pacific Palms, NSW 2428

Email: leighton@activ8.net.au

ABSTRACT

The multimillion dollar Tasmanian Atlantic Salmon aquaculture industry grew from a shaky beginning with just 36 ripe females in the 1970's. The early unsuccessful attempts to introduce Atlantic Salmon (*Salmo salar*) to Australia which started in 1841 are summarised. By 1960 no known populations of Atlantic Salmon existed in Australia so Dr D.D. Francois arranged the import of Atlantic Salmon ova in 1963, 1964 and 1965. By 1972 when I took over management of Atlantic Salmon in N.S.W., the remaining stocks had become very low, only 36 ripe females remaining, and the importation of new stocks were prohibited. By 1979 1,000,000 ova were laid down for that year although mortalities were high. In the 1980's several shipments of these Atlantic Salmon ova were supplied to Tasmania, and from these, the multimillion dollar Tasmanian Salmon aquaculture industry has developed. Lake Jindabyne is still stocked annually with Atlantic Salmon and reasonable angler returns result, but no breeding in the wild has been reported.

Key words: Atlantic Salmon *Salmo salar* in N.S.W. Introductions. Tasmanian Salmon Aquaculture industry.

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Introduction

The Australian Atlantic Salmon Aquaculture industry is now particularly successful in Tasmanian waters, but was based on the fortunate survival of just a few fish in a New South Wales salmonid hatchery around 40 years ago. The early history of the introduction of Atlantic Salmon *Salmo salar* into Australia was summarised by Brinsley (2011), Francois (1963, 1965), Roughley (1951). The first attempts to introduce Atlantic Salmon to Australia were in 1841, 1852, 1860 and 1862 by personnel such as Sir William Denison, Gottlieb Boeicus, Alexander Black, C. Moscrop, Robert Ramsbottom and Frank Bucksland (Brinsley 2011). These were all unsuccessful. In 1863 Lake Wenham Ice Company, Boston, Mass. determined that a continual stream of water and light was not necessary, and partial deprivation of air was not fatal for the maintenance of ova. It is believed that using these criteria a Mr James Ardell Youl was able to delay the hatching of ova, and he attempted a further introduction of Atlantic Salmon in 1864 aboard the sailing vessel *Norfolk*, which was partly successful. One hundred thousand ova were packed in 200 boxes, in moss with 32 tons of ice, for the 80 day trip. Only a third of the eggs survived the trip. Some were retained in Melbourne where 120 survived and these young fish were stocked into Badger Creek near Healesville, 60 km ENE of Melbourne. The rest of the ova were sent to Tasmania where 500 young fish eventually were released into the Derwent River, Hobart. Authors do not agree on the exact numbers of salmonids that survived on this shipment but the overall importation details are not disputed.

Many unsuccessful attempts were made to establish sea run Atlantic Salmon in New Zealand, Tasmania and Victoria. A total of around 730,000 were distributed among these localities between 1860 and 1880. Nearly 5,000,000 ova had been imported into New Zealand by 1922 without any real success. Following more recent introductions in New Zealand, a small population survived, now confined,

as a land-locked form, in the upper Waiau catchment, where it is now considered to be nearly extinct. Their decline in this catchment is thought to have been due to the introduction of Rainbow Trout into the catchment, as has also been found to be the case in some North American populations (Francois 1963, 1965). Stocks are however maintained in a number of New Zealand hatcheries (Anon 2013). Other attempts to introduce Atlantic Salmon into Tasmania, in 1909 and 1936, were also unsuccessful (Lynch 1972). However, the most recent introductions, in 1963, have given rise to the significant Atlantic Salmon aquaculture industry now established in Tasmania. This paper outlines the precarious start to this lucrative industry.

Introduction of Atlantic Salmon to N.S.W. in the 1960's

Dr Donald D. Francois, the Senior Biologist at NSW Fisheries between 1962 and 1966, and later Director of Fisheries from 1966-1986, made an attempt in 1963 to introduce Atlantic Salmon with the hope of getting them established in NSW waters (Brinsley 2011, Francois 1963, 1965, Arentz 1966). No Atlantic Salmon were known to still exist in Australia, at the time of this 1963 introduction. In my view Francois was one of the last fish "acclimatisationists"; those people who introduce exotic species with an intention of establishing them in the wild. He was at the time a keen trout fisherman and this no doubt influenced him in this pursuit, as Atlantic Salmon were renowned for their fighting, sporting and table qualities. Introduction of fish species into Australia at that time was not easy because of the fear of introducing disease together with the fish. However, he sourced disease free Atlantic Salmon eggs from Nova Scotia and imported them and conducted trials at the Gaden Trout Hatchery,

near Jindabyne in the Snowy Mountains area of N.S.W. Ocean waters off N.S.W. were too warm to establish a sea run population, which was their normal habit, so attempts were made to establish a lake run population from the progeny of these fish by releasing them into lakes created by the Snowy Mountain Hydroelectric Scheme. Lake run populations of this species had been previously established elsewhere in North America (Francois 1963).

One hundred thousand eyed ova donated by the Canadian Government from the Fall run of Atlantic Salmon at the Cobequid Fish Culture Station, Philip River, Cumberland County, Nova Scotia, arrived in Sydney on 27th February 1963 by air after a 6 day trip. They were transferred to Sawpit Creek in Mt Kosciusko National Park, where the most suitable water temperature (around 50°F (10°C)) was available for their development. Later, 65,000 of the remaining Atlantic Salmon fry were transferred to Gaden Hatchery near Jindabyne following losses of 13,000 ova at Sawpit Creek and a further 22,000 alevins during transfer to Gaden. Nine thousand fry were eventually released into Micalong Creek which flows into Burrinjuck Dam, but only 17,500 of the remaining fry survived the winter (Brinsley 2011, Francois 1965, Anon. 1964), of which some were released and the rest were retained for future brood stock at Gaden Hatchery. The Canadian Government agreed to supply a further 100,000 eggs per year for the next 3 years. The next batch of eggs received in March 1964, was transferred to a site close to the Dutton Hatchery, near Ebor in north-eastern N.S.W., and 60,000 of these ova hatched. Of these, 25,000 1.5-2.5 inch (38-63mm) fish were released in October 1964, and 2,500 were supplied to Gaden Trout Hatchery for growth into brood stock. Thirteen thousand were released into Micalong Creek and 11,500 into the Goodradigbee River (both Burrinjuck Dam feeder streams) (Anon 1964-65). The third batch, received in 1965, was also reared at the Dutton Hatchery site, and from this batch 7000 fingerlings were put into Micalong Creek, 2000 went to Gaden Hatchery, and 7000 were kept as brood stock at Dutton; there is some dispute about the exact numbers produced from this batch. The fourth consignment was cancelled because of poor weather conditions in Australia.

There was early evidence of success in establishment of a wild population. Numerous reports were received of Atlantic Salmon being angled in Burrinjuck Dam following these releases (Anon 1965, Anon 1966). A 4.5lbs (2.04kg) fish was caught in 1966 that was full of roe (Anon 1965-66). In addition, brood stock raised from the introduction in 1963 matured and started to produce ova in 1966, when they were 3+ years old, although only a portion of the females matured at this age in their first breeding season and their ova production was low, generally producing less than 700 ova per mature fish. Numbers of ova produced annually at the hatchery nevertheless increased significantly in following years.

Although no Atlantic Salmon were released into Lake Jindabyne directly up to 1970, some escapees found their way there from Gaden Trout Hatchery, which is situated on the Thredbo River which runs into Lake Jindabyne. Some fish, including one of 1lb 6oz (0.62kg), were

caught in the lake in May 1970 (Anon. 1970). The intention of these stockings was to establish a land-locked self supporting population, but there was never any confirmation of any natural breeding in the wild anywhere in New South Wales.

My involvement in Atlantic Salmon management

In 1972 I was transferred from the Narrandera Inland Fisheries Research Station to Sydney to manage all salmonid stocks in NSW. One of my tasks was to look after the Atlantic Salmon stocks at Gaden Trout Hatchery, Jindabyne, and Dutton Trout Hatchery, Ebor. By 1972 the stocks were running very low at Gaden Trout Hatchery and in 1974-75 close examination of the stocks at Dutton Trout Hatchery indicated some doubt as to their authenticity. Consequently I took 3 samples of large brood stock fish from Dutton Trout Hatchery back to Sydney, together with two Brown Trout *Salmo trutta*, and asked the other Trout Biologist, Richard Tilzey, what species he thought they were without letting on where they had come from (See Fig. 1). He assured me that they were all Brown Trout. I immediately summoned Dr Francois to inspect these fish, and he agreed that they were all Brown Trout, after which I told him they were the so called "Atlantic Salmon" brood stock from Dutton Hatchery. He was not impressed, and I was told I must give top priority to caring for the very limited Atlantic Salmon stock remaining at Gaden Hatchery, Jindabyne, OR ELSE! The so called Atlantic Salmon brood stock at Dutton Hatchery were then all released, not to be seen again.

This appeared to be the last chance to maintain Atlantic Salmon stocks in Australia, because further imports from overseas were about to be banned. At the September 1970 Australian Fisheries Council meeting, the question of regulating to prevent the entry of frozen flesh, live fish and eggs of any members of the salmon and trout family was raised (Anon. 1970-71). This was to eliminate the chance of introducing diseases such as infectious pancreatic necrosis, viral haemorrhagic septicaemia and whirling disease, which could be devastating to existing Australian trout stocks. Hence, in around 1973, the import of such salmonid products into Australia was eventually banned (except for tinned products). This meant that the small number of Atlantic Salmon surviving at Gaden Trout Hatchery, Jindabyne, constituted the only basis for a potential future Atlantic Salmon aquacultural industry in Australia, and no stock could now be replenished from overseas.

The stocks at Gaden Hatchery had run down to less than 180 3+ year old fish by the 1972 season. Of these, only 36 females had matured and produced 12,000 ova, of which only 1,200 hatched. In an attempt to ensure that these ova were provided with the optimum conditions, I set up an apparatus which provided a stable optimum temperature and a guaranteed water supply. Although the apparatus worked successfully, survival was still limited, probably due to the brood stock being first time breeders and the food that had been provided to them

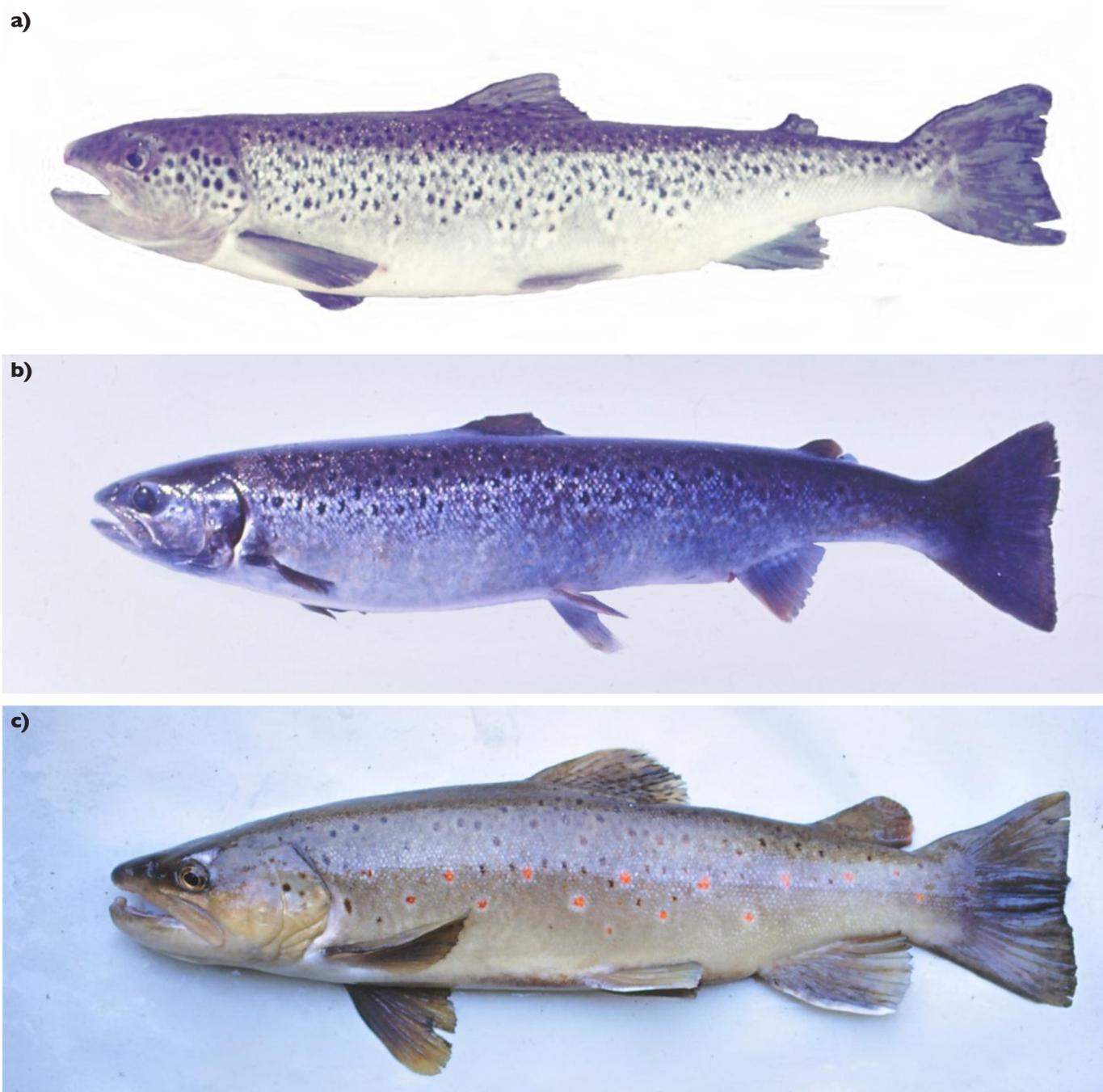


Figure 1. a) and b) Atlantic Salmon (*Salmo salar*) from the Gaden Trout Hatchery stock; c) the so called "Atlantic Salmon" from Dutton Hatchery, which were Brown Trout (*Salmo trutta*).

did not meet their full nutritional requirements. It was therefore touch and go as to whether these Atlantic Salmon stocks would survive.

The following year 158 now 4+ fish remained and they produced 43,000 ova, of which 20,500 hatched. Each subsequent year a proportion of each year class was retained to develop as future brood stock. The intention was to hold, for future breeding, around 1000 of each year class from 0+ - 5+, as breeding usually commenced in some 3+ fish. By 1979 we had adequate numbers of each year class and we successfully laid down in excess of 1,000,000 ova, although mortalities were sometimes as high as 75%. In 1976 some Atlantic

Salmon fingerlings were transferred from Gaden to Dutton Trout Hatchery to re-establish new brood stock there. This was to be an insurance policy in case of a severe disease outbreak and high mortalities at the Gaden Hatchery, as had happened in the past. Dutton Hatchery produced 160,000 ova in 1979 but severe weather conditions later in the season returned their total stock to nil. The geographic location of Dutton Hatchery in northern New South Wales meant that on occasions it experienced very hot weather and very low river flows, which were not conducive to survival of such cold water species. No permanent stocks of Atlantic Salmon have been maintained at Dutton Hatchery since 1979.

Since 1975 a majority of the Atlantic Salmon raised (100,000's) were released into Lake Jindabyne with the aim of establishing a self supporting population, thus enabling brood stock to be taken from the lake and river rather than keeping them at the Hatchery. This was unsuccessful, with only a few unripe fish being trapped in the Thredbo River. In the early 1980's Atlantic Salmon were stocked into Fitzroy Falls Dam, Oberon Dam and Blowering Dam in N.S.W., but angler return from these stockings were negligible. In July 1982 I transferred from N.S.W. Fisheries to the National Parks and Wildlife Service thus terminating any responsibilities for salmonid management.

The Tasmanian Atlantic Salmon aquaculture industry and current stocks in N.S.W.

In the early 1980's, Tasmanian Fisheries authorities asked whether NSW Fisheries would be prepared to supply them with ova to attempt an introduction into Tasmanian waters. This was eventually approved after rigorous screening for potential disease, and Tasmania was supplied with ova in 1984 (Anon 2007a). The ova were placed in a dedicated government quarantine hatchery and eventually 36,000 fish were transferred to sea cages as the founding stock of Tasmania's new Atlantic Salmon farming industry. Two more batches of eggs providing another two year classes were imported from NSW to Tasmania in 1985 and 1986, by which time the industry had set up its own world class Atlantic Salmon hatchery. They were able to build up their entire stock from these ova.

In the late 1990's there was a movement to stop the production of Atlantic Salmon at the NSW Hatcheries but the decision was made to continue keeping them as a backup for the Tasmanian stock in case there was a major disaster there, because of the prohibition on importation

of any new salmonid stock to Australia. Between 1989 and 1998 Gaden Hatchery laid down nearly 6,915,000 Atlantic Salmon ova and by 2005 this number had reached 10,000,000 with a hatching success of around 65% (Brinsley 2011). Lake Jindabyne was being stocked with between 100,000 and 200,000 and Khancoban Dam 50,000 of these annually. In 1998-99 stocking into Lake Jindabyne resulted in 3.0% of the total salmonid catch being Atlantic Salmon, although growth rates had been poor. The Atlantic Salmon caught in Lake Jindabyne averaged around 25cm in length and 160 gm in weight.

At present six year classes (15 5+ , 20 ♂ 30♀ 4+, 40♂ 60♀ 3+, 200 2+, 400 1+ and 10,000 0+ fry) have been retained at Gaden Trout Hatchery as potential brood stock, which can produce up to 200,000 ova per annum. In 2001 the Snowy Mountains Lake Working Group recommended that Lake Jindabyne should be stocked annually with 200,000 Atlantic Salmon fry and excess brood stock when available virtually supporting the current stocking regime. There is however still no evidence that successful natural breeding has occurred in streams feeding Lake Jindabyne, although there have been unconfirmed suggestions that there may have been some successful natural breeding in Burrinjuck Dam. In 2003 an Environmental Impact Statement on Freshwater Fish Stocking in NSW identified numerous restrictions that should be placed on stocking particularly in areas where threatened species occur. This could impact on future Atlantic Salmon stocking regimes.

However, the multimillion dollar Tasmanian Salmon aquaculture industry (now valued at \$350 million per annum, and still growing (Anon. 2009)) has developed from the ova which originated from the successful breeding of the 36 ripe female brood fish at Gaden Trout Hatchery in 1972, which I was given an ultimatum to care for. The Tasmanian aquaculture harvest is currently approximately 1.5% of the total world production of farmed Atlantic Salmon (Anon. 2007b).

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