

# Salmon Ranching in Chile

## The Private Sector\*



Fine spring chinook returning to the Domsea hatchery.

**JON M. LINDBERGH**  
and

**RICHARD E. NOBLE**

Domsea Farms, Inc.  
4398 West Old Belfair Hwy.  
Bremerton, WA 98312, U.S.A.

**KENNETH M. BLACKBURN**

Domsea Pesquera Chile Ltda.  
Garcia de Torres  
Vitacura, Santiago, Chile

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In a salmon ocean-ranching venture, young salmon are reared in hatcheries, where they are protected from most natural hazards. Once they reach a size where predation and juvenile mortality are much reduced, the fish are released to forage and fatten at sea. The adults return home, according to their homing instinct, but they do not face the risks of rapids, floods and hungry bears. Instead, they swim back to a fish trap placed close to a selected river mouth. Broodstock for the next generation of salmon are isolated

from the population and the rest, still in prime condition, are sold in the marketplace.

Good-quality fresh water of the right temperature is needed to hatch salmon eggs and rear juveniles. A location with tidal influence must be found where smolts (juveniles ready to migrate to salt water) are released and adults recaptured. Political, economic, and social, as well as biological and oceanographic conditions have to be favorable. It is advantageous not to have an established salmon catch fishery nearby which may take a high percentage of the fish before they can return to the collection facility.

Of all the factors involved, proper oceanographic conditions and a good source of feed at sea are probably the most important. If salmon have a rich ocean pasture, they stay healthy, grow fast, survive in higher numbers, come back larger, and bring a better price. If they do not have good forage, they return at less desirable sizes or do not come back at all.

A salmon pasture with extraordinary promise lies in the Southern Ocean. Strong upwelling creates ocean waters

rich in nutrients all the way around the Antarctic Continent. Biological productivity in terms of potential salmon feed is enormous.

Domsea Pesquera Chile, Ltda., now operated by Fundacion Chile of Santiago, picked the island of Chiloe for our first effort to introduce Pacific salmon in the southern hemisphere. Chiloe, at 42°S, is somewhat more northerly than we would have wished, and we were uncertain about the effects of ocean-current patterns offshore. However, Chiloe is accessible by road and close to commercial ship and air services. Locations farther south involve significantly more transportation and logistical problems. The objective of the project is to establish an economically profitable salmon run, and logistical considerations are key to good economics.

### Ranching strategy

Domsea's strategy in salmon ocean ranching has been to release the minimum viable numbers of migratory-size fish of as many species and strains as possible. When return percentages of one or more salmon runs are good enough to demonstrate future commercial success, those runs are expanded to full-scale. Domsea has also put more emphasis on test releases rather than site-specific environmental studies.

### Coho salmon

Our first plan in Chiloe was to transport eyed coho salmon eggs from Washington State to a small stream draining into Lago Popetan, a lake 2 km long and 1 km wide. Environmental parameters appeared to be suitable.

We purchased 700,000 coho eggs of Skagit stock from the State of Washington in December 1976. Under normal circumstances, these eggs would have eyed out in January 1977, and been shipped to Chiloe shortly thereafter. Seasons are, however, reversed between the northern and southern hemispheres. We were quite concerned about the survival of the eggs in southern summer water temperatures above 20°C. To avoid this threat, we incubated the eggs at our facilities in the United States using artificially cooled water at approximately 2°C during most of the incubation period to delay egg development until April, when 500,000 eyed eggs were shipped.

An unusually late spell of hot weather occurred shortly after the transfer, and

water temperatures increased to 23°C. Mortality exceeded 90%. Our remaining 200,000 eggs in the United States were immediately shipped. We spread them out among the most protected stream waters available and hoped for the best. Fate was kind, the eggs hatched, and the fry were transferred to floating pens in Lago Popetan. Fish grew at expected rates and mortalities were low.

Fish food in the pens in Lago Popetan and in subsequent rearing enclosures was primarily imported dry pellet. Chopped saltwater fish, beef and sheep liver, and other fresh products were acquired locally and fed to the fish periodically as a supplement to the dry diet.

#### Curaco de Velez release site

In mid-1977, a promising hatchery site was located and developed on a stream at Curaco de Velez on the island of Quinchao near Chiloe. All coho from Lago Popetan were transferred there for release in order to have them return to the new facility.

#### Coho returns

In July 1978, two coho jacks (juveniles) returned to Curaco. These jacks were the first confirmed returns of Pacific salmon in Chile and were considered a very positive sign. In succeeding months, we were advised that "fish unknown in the region" were occasionally being caught by fishermen in waters around Chiloe. A reward was posted for coho and a number were turned in.

The first adult coho returned in April 1979, and the run continued

### Releases and Returns—Curaco de Velez, Chile

Species	Release date	Number released	Number returned through July 1981	Percentage returned
Coho (Skagit)	Late 1977	90,000	30—Early 1979	.03%
Spring Chinook	Mid- to late 1978	120,000	334—Late 1979 817*—Late 1980 to early 1981	.17% .79% (Total)
Coho (Skagit)	Late 1978	30,000	6—Early 1980	.02%
Spring Chinook	Mid- to late 1979	190,000	817*—Late 1980 to early 1981	.11%
Coho (Skykomish)	Late 1979	210,000	20—Mid-1981	.01%

\*Spring chinook returns to date for late '78 and late '79 releases combined due to difficulty in separate identification.

into June. The total number of adults was 30, or 0.03% of the release, a disappointing result. In the three subsequent years, further groups of coho were released. Returns continued to be poor (see Table). Coho have been a technical success for Domsea; they have been the first returns of Pacific salmon in Chile. But they have definitely not been a commercial success.

#### Chinook salmon

At Curaco, 120,000 yearling spring chinook smolts were released in late 1978. Jacks began to return in May 1979, a

total of 332 by the end of 1980.

Adult spring chinook returns commenced in September 1980, and continued to May 1981. A total of 817 chinook returned from the 1978 release and a subsequent 1979 release of 190,000 (smaller smolts).

We held 425 adults as broodstock. Survival to full maturity was 94%, surprisingly good for spring chinook.

Over one million eggs were taken in March-May 1981 as females ripened. Survival through to fry has been very good.

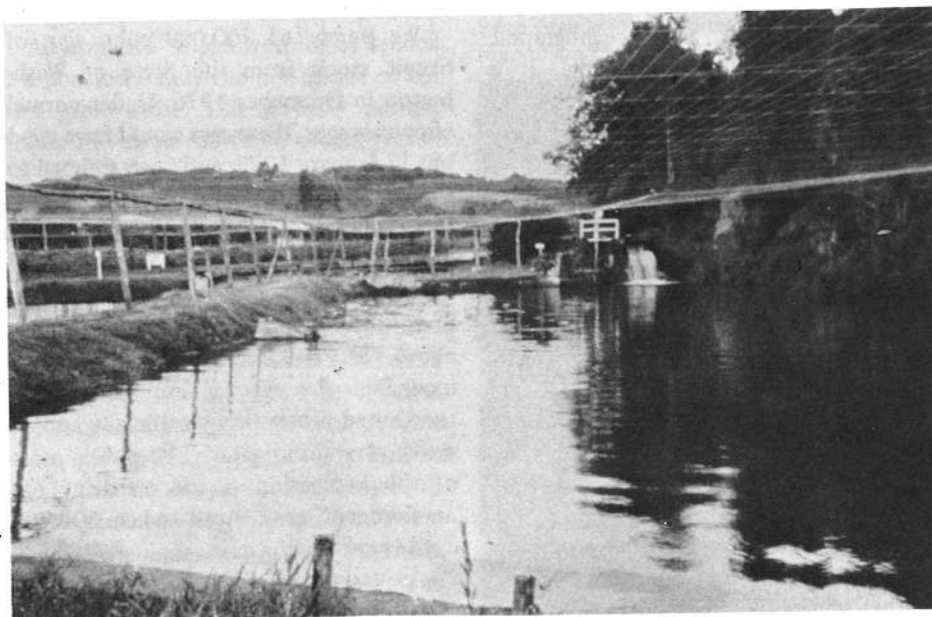
#### Comparisons

Why did spring chinook do better than coho? Our evaluation at the beginning of the project was that coho are easier to raise and will be more likely to return. On the other hand, successful transplants of chinook to New Zealand demonstrated that the species is versatile for transplants.

Ocean-current patterns off the Chilean continental shelf are different from currents in the north Pacific and may be adverse to salmon survival. If the three species released to date in significant numbers in Chile are compared (see Table), a trend emerges. Chinook are generally a shelf-hugging species, coho somewhat more wide-ranging, while chum migrate thousands of kilometers to central ocean areas. Results show good returns for chinook, marginal returns for coho and no returns for chum.

Do chinook stay safely within the shelter of the coast while the other species venture further and become hopelessly lost in the Southern Ocean? Are coho and chum being released in the wrong places? Or are other factors such as feed or predators involved? Future work will provide the answers.

Part of the facilities of Domsea: The idea is to tap the salmon pasture which lies in the Southern Ocean. Experts now acknowledge a high probability of success of this private enterprise of salmon transplantation.



Photos by Jon Lindbergh.