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RÍO GRANDE STUDIES

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Spawning male sea trout

Since 2010, the Río Grande's sea-run brown trout fishery has been the subject of a major review of its traditional exploitation model. The goal is to maintain the quality and health of the fishery and to build a scientific-based program for fishery management. The current model is based on mortality control through different regulations, such as catch and release and restricted rod capacity across most of the system on Argentine side of the river. This area is the base for private concessionaires and non-commercial users who can use the river without pay. In this context, the government together with the private operators of fishing lodges and other resource users are working together to establish actions to conserve and/or improve the resource. These scientific studies are essential to establishing several fisheries optimization programs, some sponsored jointly by private concessionaries and the Tierra del Fuego government.

Scientific studies on anadromous salmonids in Tierra del Fuego can be separated

into three stages or phases. The first with exclusively government financing, the second with almost exclusively private financing and a third, as seen here, where government, NGO's and private operators all contribute by providing funds and working together to conserve the resource and the environment:

1. The First Phase

The first serious study on anadromous salmonid fisheries was held in 2001 at the Ewan River by local fisheries biologist Miguel Casalinuovo and his partners. As a result of this first phase, funded by the Tierra del Fuego Government (at a cost of USD $68,000 for the 1.5-year study), it was possible to collect basic information on the biology and ecology of brown trout, such as mortality, growth, sex ratio, size and age structure, reproductive maturity, etc.

Juvenile search by electrofishing

2. The Second Phase

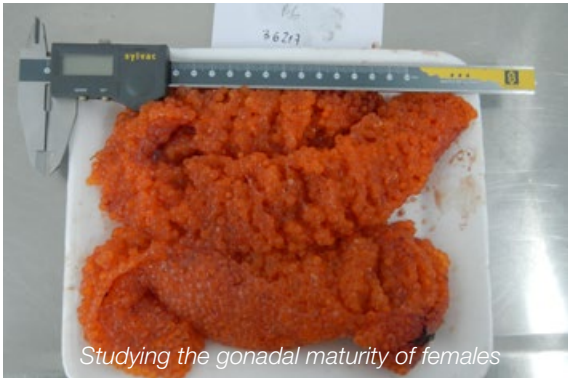
This phase started in 2006, when a group of private operators, commissioned Dr. Jack Stanford and his team of University of Montana biologists to provide scientific data on: a) the evolution of the fishery; b) the size and health of the fish population; c) the potential risks to the population; d) to provide management advice and best practices to optimize the resource; and e) to suggest a sustainable river carrying capacity. Together, the U of M study and a thesis completed by their lead scientist answered questions that lent credibility and added empirical verification to several claims. A by-product of that fact gathering mission (at a cost approaching USD

$200,000 in just 3 years, funded mainly by lodges) is some fascinating information regarding the health of the run, the exact population number of the fish in the river, how many are caught “over and over”, juvenile ecology, as well as an answer to whether or not there’s a significant fluctuation in the number of sea trout that return annually to the Rio Grande. Notable results obtained from data collected from more than 9,000 fish caught and released during the study were:

- The average brown trout in the Rio Grande weighs more than nine pounds.
- One trout in five is over fifteen pounds and one in fifty will be a fish that would tip honest scales between twenty and twenty-five pounds.
- The recapture rate is low in the same season.
- In three seasons there has been normal fluctuation in the number of returning fish, (55,000-75,000), some of which are up to 12 years old.

Following the work of Dr. Stanford, in 2009, another local government scientist, Carlos Luizón, focused his attention on the historical catch records of commercial operations in the Rio Grande, carrying out studies similar to those on the Ewan River. This last study is a real “manual” for those scientists who want to work in fisheries biology on the Rio Grande, as it presents and compares, in an incisive manner, detailed information obtained up to that date from Tierra del Fuego’s three major rivers: Ewan, Menéndez and Grande. Meanwhile, U of M studies helped generate the underlying ecological hypothesis used in the third phase with respect to juvenile sea-run brown trout habitats.

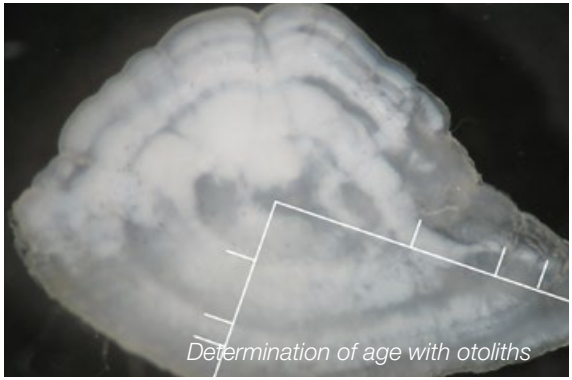
Sea trout stomach content



Studying the gonadal maturity of females

3. The Third (actual) Phase

This actual river study phase started in December 2010, when an important workshop was held in Rio Grande City as part of the fishery review process. It included all stakeholders and primary river users. The meetings encouraged discussion on the development and benefits of an integrated management plan for recreational fishing in the Rio Grande by the Study Group on Anadromous Salmonids (GESA, CENPAT-CONICET). Dr. Miguel Pascual led the workshop at the request of the Tierra del Fuego government, and a platform was developed to analyze fishery management options, to simulate the evolution of the fishery at different levels of fishing pressure, and to study the implications of new fisheries regulations. It was based on an individual growth model that explores the evolution of the sea trout population and the quality of fishing when subjected to a specific fishing pressure (level of fishing mortality and size regulations). The biological components that were used to construct this platform were based on size and age structures, as well as the analysis of individual fish growth. Capture scenarios were based on the current use of the fishery as a starting point to analyze management alternatives. The current state of the fishery refers specifically to the total number of fish caught per season in the system and the number of fish killed as a result of fishing activity, whether for direct kill (legal fishing or poaching) or post-release mortality associated with catch and release (C&R). In the same workshop, sources of uncertainty stemming from limited existing information were also discussed.



Determination of age with otoliths

Insertion of radio transmitter

This type of proposed fisheries management is new in the country, and there is a lack of robust data for some of the variables that feed the models. Thus, these uncertainties must be considered as one of several benchmarks to improve the predictive model. Three major sources of uncertainty that affected the resulting analysis of Rio Grande brown trout were: a) The real size of the run; b) Mortality associated with catch in the entire system (coastal nets, poaching, public zone, Chilean part, etc.); and c) Mortality associated with C&R practices. As a result, since 2012, Miguel Casalinuovo and his team have conducted complementary studies (jointly financed by the government, NGO's and private operators) to more accurately estimate the parameters needed to feed the general model. That work includes:

a) Catch and Release Mortality (2012). The study consisted of placing cages in the river that were used to monitor fly-caught trout and study their potential mortality rates. In addition, data sets were recorded: water temperature, salinity, acidity, etc, for comparison between the river and the site of the traps. For each fish caught the team measured different variables associated with the mortality of fish, some of which were: the total time of struggle (from the hook-up until it was put in the net), the time it was out of water (for photos, weighing, etc.), the degree of bleeding, the state of the fish at the time of release (vigorous or lethargic), etc. C&R was performed according to standard practices of guides and anglers, with the difference being that at the time a specimen should be released, it was instead placed in a floating tub and transferred to the observation cages (2.5 m3, maximum number of individuals confined to a cage at the same time: four fish). There, the fish were tagged for identification and held under observation for 48 hours, after which they were released in the case of being alive. This time was chosen because the literature mentioned that 90 percent of post-release deaths occurred within that time frame. To separate the mortality caused by anglers and mortality generated by the cage, another stock of fish was captured with a tangle net in order to obtain an experimental control.

Pots-release mortality studies

**A total of 65 fish were held in cages without mortality. These results showed that the adequate management of the catches carried out by the guides minimized the impact of the practice on fish stock.*

b) Run Size (2012). This study was based on a new analysis of the data obtained by the guides between 2006 and 2008 (Second Phase), because the method used to calculate the population size was based on some methodological assumptions that don't play out on the Rio Grande. The method used (catch-mark-recapture of fish) assumes closed populations, without mortality, and where each fish has the same probability of capture before and after marking. This is not true in the Rio Grande and could lead to incorrect estimates of run size. Therefore, alternative methods were used that take into account the migratory behavior of the fish and their rate of disappearance in the system (mortality + migration).

Water quality equipment

The results did not vary in relation to those reported by the University of Montana (2007: 53,000, 2008: 85,000), however their accuracy (statistical confidence intervals) was much higher. Properly estimated run size is necessary to calculate the fisheries' rate of capture and other variables of importance for management.

c) Gillnets by Catch (2012). Current regulations in Tierra del Fuego restrict gillnets from within a radius of 500 meters from the mouths of rivers. This measure has not been scientifically determined. For this reason, experiments were performed with gillnets at 0, 500 and 1,000 meters from the mouth of an experimental river every 15 days during two fishing seasons (December-April).

Results showed (contrary to what was expected) that the catches of sea trout were similar in the three distances considered. The variables that explained the catches were the high tides and the months of the year, not the mouth distance. This means that if you want to protect fish it's not enough to increase the distance of gillnets from the river the mouth. Additional restrictions should be established, especially at high tides, where fish enter from the estuary to the river.

d) Fish Movements (2013). Chilean/Argentine studies on the movement of fish using hydroacoustics demonstrated that the use of the river is not homogeneous. A Didson type echo-sounder was used at three sites: the first near the estuary (28 km from the mouth to the sea), the second on the Chilean-Argentine border (88 km from the mouth to the sea), and the third located at the confluence of the Grande and Blanco rivers (146 km from the mouth to the sea), in Chile. The study revealed that 22 percent of the fish reached the border and only 16 percent reached the confluence of the two rivers. These differences became more pronounced for trophy-sized fish (over 650 mm). Complementarily, the aerial monitoring of 50 individuals with an implanted VHF transmitter was performed during a full year with the purpose of describing the movements of the fish, to detect the mass spawning sites, the use of tributaries, the time of permanence in freshwater and its mortality. The fish were caught in the estuary at three different times to study the behavior of early-entry fish (November-December), mid-entry fish (January-February) and late-entry fish (March). Each fish received an external transmitter before being immediately released. Later they were tracked by plane, registering their position with a GPS every 15 days across the entire basin, on both the Argentine and Chilean sides.

Results showed that most of radio marked sea-run brown trout settled in the first kilometres of the river, with a strong tendency to settle in only one place for their

Searching fry

Temperature datalogers downloading

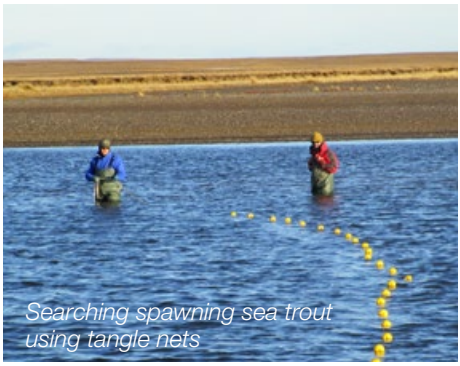
entire stay in freshwater. The same study showed that fish entering the river early established throughout the system, whereas those entering later were located closer to the estuary.

In addition to the studies mentioned above, a Permanent Fishery Information System (SIP) has been established in the Rio Grande since 2012, which involves regular data collection from two different sources: a) catch records of commercial operations and b) classical biological sampling. The SIP has 6 years of data (2012-2016). Additionally it is working intensively on juvenile recruitment studies, characterization of habitat and competition between species since Didymo and Chinook salmon are new species in the basin.

During the 5-year study (at a cost of approaching USD $90,000), and with the cooperation of new researchers from other parts of Argentina and Chile, encompassed in the Ecofluvial Network for the Conservation of the Aquatic Environments of Patagonia (REDECO), new and more accurate information has been obtained:

Ready for work

Trout measuring



Searching spawning sea trout using tangle nets

• C&R mortality with appropriate care is extremely low (0-6%).
• The run size varies between 53,000 (2007) and 85,000 (2008).
• The run is structured by age, with younger fish entering from the ocean at the end of the season.
• The main run enters from the sea usually during high tides.
• The juveniles spent between 1 to 4 years in river before smolting.
• The non-natural mortality in the entire system is low, as a result of adequate management in Argentina.
• The catch per unit effort is around 0.55 fishes per angler each fishing hour.
• The average size of fish is 640 mm, and the typical fish caught is about 700 mm. The biggest fish recorded reached a size of 1,080 mm.
• The female:male ratio was about 2.3:1.
• Most spawning sites are downstream of the Menéndez River mouth. Most of radio-marked fish settled in the first kilometers of the river, with a strong tendency to settle in only one place for their entire stay in fresh water.
• Fish entering the river early (January and February) are established throughout the system while the later (April) are located closest to the estuary.
• Fish that enter from the sea (for spawning or overwinter) start to leave the system in late spring. In December all radio-marked fish were again in the sea.
• In the first years of life, juveniles appear to prefer environments that offer food and shelter, and they concentrate their efforts in side-channels before migrating into the mainstem when they increase in age and size.
• Didymo and Chinook salmon have moved into the basin. Juvenile salmon were caught across the whole basin, found in the same environments as juvenile brown and rainbow trout.
• Chinook salmon have become abundant in the electro-fishing surveys of juvenile species, even displacing rainbow trout in 2015.
• The juvenile Chinook probably are stream type.

Selecting the sampling sites

• Catches of adult Chinook salmon in Argentine section of the river have increased since 2013. There is no evidence of spawning grounds of the specie in the Argentine basin.

• Brown trout spawn in June/July and free-swimming fry appear in the river around mid-November.

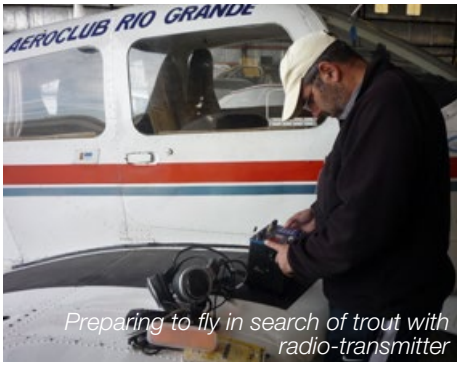
Sea trout recaptured with a radio-transmitter

What's Next?

Studies have shown the importance of resource management, including improving regulations and presenting better alternatives for the construction of high-impact engineering projects. For these reasons we believe that more research is warranted. For the near future, our in-river studies will continue, while we add the estuarial and marine environments to the equation, where no information is currently available. Above all, the estuary presents several threats, such as pollution from the City of Rio Grande, that could strongly impact the fishery.

More info?

http://seatroutresearch.blogspot.com.ar



Preparing to fly in search of trout with radio-transmitter

Sea trout nests

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