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FORECASTING FISHERIES

Prediction and the planned economy in the Interwar Soviet Union

Planning was central to the Bolshevik project and not even fish in the sea were to be an exception. In 1931 the country's main fisheries trade journal *Rybnoe khoziaistvo* urged its readers to

> fight against the prejudices that at sea nothing can be organized according to a plan, that there chaos reigns, that catching fish is like a card game and depends entirely on happenstance [...] The socialist economy cannot operate any other way except by plan![1]

However, as anyone who has ever fished for a living knows, catches of fish from year to year in fisheries everywhere have always been subject to seemingly random, unpredictable fluctuations. To plan the fishing industry, the Bolshevik state turned to scientists to help maximize, maintain and, most importantly, predict fisheries yields in order to make fishing a reliable part of an all-encompassing economic plan. As another 1931 article in the same journal proclaimed:

> the infant science of fisheries will be a true child of the Soviet Union [...] The teacher of this science will be life—production—which is our incredible reality, planned and shaped by human will.[2]

Consequently, wrote the same author, the new fisheries science would be a modern, quantitative, Marxist science of experiment based on industrial needs—an "electric

1. P. Bolotin, "Podgotovimsia po-bolshevistki k putine [Preparing for the fishing season the Bolshevik way]," *Rybnoe khoziaistvo*, 2 (February 1931): 1.

2. V.D. Volkhovitianov, "O rybokhoziaistvennoi nauke [On fisheries science]," *Rybnoe khoziaistvo*, 2 (February 1931): 33.

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motor of physiology" rather than the "steam of morphology"[3] that was the old tsarist, natural-historical ichthyology.

Such declarations in the early 1930s mesh well with most accounts of Russian and Soviet science. Scholars have long shown that the Bolshevik regime initially left imperial scientific institutions and practices intact, though Nikolai Krementsov has argued that, along with early control of the education system, the Bolshevik state used the 1920s to create a Communist scientific apparatus that operated in parallel to the existing system but according to a vastly different institutional and cultural model.[4] In this telling, 1928 and subsequent transformation of Soviet science into a highly centralized and hierarchical complex of institutions along with state organs to supervise and control it was a decade in the making. Similarly, James Andrews has highlighted how control over journals of popular science only changed after 1928 when radical Communists seized control of journals and, in many cases, changed their content and focus to applied technology with Stalinist emphasis on control over nature and extraction of resources to build socialism.[5] In philosophy of science and epistemology, a lively debate in the 1920s suggested a number of divergent possibilities on the basis of Marxist-Leninism. Only in 1928 was dialectical materialism stabilized and turned into institutional dogma.[6] The "Great Break" or Cultural Revolution, or some combination thereof, are deemed by these accounts the critical juncture in the history of science in the Soviet Union.[7]

Environmental historians of the Soviet Union, too, have located a juncture at this time involving both cultural and political changes and the beginning of breakneck industrialization and the first five-year plan. Much of the recent literature places Soviet environmental history within a larger global pattern of industrialization and rapacious use of living and non-living things subject only to rationalizing economic logics of growth. The uniqueness of the Soviet experience in this bigger story might

3. Ibid, 35.

4. Nikolai Kremenstov, *Stalinist Science* (Princeton, N.J.: Princeton University Press, 1997), 13-26. On scientific institutions before and after the revolution, see Loren Graham, *The Soviet Academy of Sciences and the Communist Party, 1927-1932* (Princeton, N.J.: Princeton University Press, 1967), ch. 1 and L. Graham, *Science in Russia and the Soviet Union: A Short History* (Cambridge: Cambridge University Press, 1994), ch. 2.

5. James Andrews, *Science for the Masses: The Bolshevik State, Public Science, and the Popular Imagination in Soviet Russia, 1917-1934* (College Station, TX: Texas A&M University Press, 2003), 3, 121-134. On the controversy over science pedagogy in the 1920s and victory of the radical Bolsheviks demanding totally subjugated to demands of production, see Douglas Weiner, "Struggle over the Soviet Future: Science Education versus Vocationalism during the 1920s," *The Russian Review*, 65, 1 (2006): 72-97.

6. David Joravsky, *Soviet Marxism and Natural Science, 1917-1932* (New York: Columbia University Press, 1961), 312.

7. On the Cultural Revolution as an event, see Sheila Fitzpatrick, "Cultural Revolution in Russia 1928-32," *Journal of Contemporary History*, 9, 1 (1974): 33-52 and Sheila Fitzpatrick, ed., *Cultural Revolution in Russia, 1928-1931* (Bloomington: Indiana University Press, 1978). For appraisal several decades thereafter, see Michael David-Fox, "What is Cultural Revolution," *The Russian Review*, 58, 2 (1999): 181-201 and Sheila Fitzpatrick, "Cultural Revolution Revisited," *The Russian Review*, 58, 2 (1999): 202-209.

only be in the zeal and extent to which the Soviet Union pushed this utilitarian logic, ending up with an "exaggerated version of modernity."[8] In environmental sciences, too, Stephen Brain's recent work has argued that 1929 proved to be a fundamental break—where 1917 was not—in Soviet forestry, "destroying intellectual old growth from the tsarist era" and "changing the possibilities for regrowth in the future."[9] In geology others have argued mentalities changed in the early Soviet period around the goal of "colonizing" and dominating nature rather than just exploiting natural resources, just as in much of the economic development ideology of the day.[10]

This essay, focusing on fisheries science in the Caspian Sea region from 1917 through the first five-year plan, takes 1928-1929 as a pivotal moment in scientific practice and resource management but frames it under a somewhat different gloss. Although the rhetoric shifted towards Bolshevik vocabulary and explicit Marxist-Leninist emphasis on practical science, it had already long been an emphatically applied science, close to and oriented toward industry. Practices did, however, shift. Prediction became the preeminent goal of scientific activity driven by the concrete needs of a planned economy. The Soviet incorporation of free-swimming fish into its all-encompassing economic plan required a new type of scientific knowledge of nature and new scientific practices for attaining it. As one scholar of economic forecasting has noted, "prognoses are impossible and unavoidable" in the modern day.[11]

8. Paul Josephson et al., *An Environmental History of Russia* (Cambridge: Cambridge University Press, 2013). For comparative perspectives, see too P. Josephson, *Industrialized Nature: Brute Force Technology and the Transformation of the Natural World* (Washington, D.C.: Island Press, 2002) and Kate Brown, "Gridded Lives: Why Kazakhstan and Montana are Nearly the Same Place," *The American Historical Review*, 106, 1 (2001): 17-48. Andy Bruno has noted the general concurrence among scholars on this point, though he downplayed it slightly, writing that "the Soviet relationship to the natural world more greatly reflects the common experience of modernizing states than the allegedly aberrant behavior of communist regimes." Andy Bruno, *The Nature of Soviet Power* (Cambridge: Cambridge University Press, 2016), 15-16. For recent states-of-the-field, see Stephen Brain, "The Environmental History of the Soviet Union," in J.R. McNeill and Erin Stewart Maudlin, eds., *A Companion to Global Environmental History* (Malden, MA: Wiley-Blackwell, 2012), A. Bruno, "Russian Environmental History: Directions and Potentials," *Kritika*, 8, 3 (2007): 635-650, Brian Bonhomme, "Writing the Environmental History of the World's Largest State: Four Decades of Scholarship on Russia and the USSR," *Global Environment*, 12 (2013): 12-37, and Randall Dills, "Forest and Grassland: Recent Trends in Russian Environmental History," *Global Environment*, 12 (2013): 38-61. On incorporating the environment into histories of Communist-bloc, see Zsuzsa Gille, "From Nature as Proxy to Nature as Actor," *Slavic Review*, 68, 1 (2009): 1-9. Indeed, the literature is growing fitfully.

9. Brain, *Song of the Forest,* 104 and *passim.*

10. Julia Obertreis, "Der 'Angriff auf die Wüste' in Zentralasien: Zur Umweltgeschichte der Sowjetunion," *Osteuropa*, 58, 4-5 (2008): 39-40 and Alla Bolotova, "Colonisation of Nature in the Soviet Union: State Ideology, Public Discourse, and the Experience of Geologists," *Historical Social Research*, 29, 3 (2004): 104-123. On alternating Soviet development ideologies of conquering nature and harmonizing industry with nature throughout the Soviet period, see Bruno, *The Nature of Soviet Power*.

11. Kurt Rothschild, "Prognosen, Prognosen: Eine kleine Prognosendiagnose," *Wirtschaft und Gesellschaft*, 31, 1 (2005): 125.

Yet they were not always so.[12] This shift in scientific priorities had consequences for the conduct of fisheries science and fish as scientific objects. The task of predicting fish dynamics and yields, as in any case of forecasting future outcomes of complex systems, was one riddled with complexity, nonlinearity, and uncertainty. Furthermore, as many scholars have shown, prediction was and still is in such cases a social process as much as a technical one.[13] This development was not limited to the Soviet Union; similar changes occurred in the aims and methods of fisheries science in North America and Europe as well, though not nearly so abruptly. This area of Soviet science was very much part of the global interwar conjuncture of modernizing states.[14]

The analysis of the break in the late 1920s brings not just industrialization to the fore, but those who made industrialization happen—Bolshevik planners and engineers who adapted "an even more aggressive attitude" toward manipulation of nature in the Soviet Union than in other states.[15] Soviet engineers and planners are in many conceptions the epitome of "high modernism" with radical Promethean designs on people and nature, willful self-assuredness, and unwillingness to accommodate or even see local detail and realities.[16] This article explores how new

12. On debates over forecasting in nineteenth-century meteorology and early twentieth-century economics, see respectively Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago: University of Chicago Press, 2005) and Walter Friedman, *Fortune Tellers: the Story of America's First Economic Forecasters* (Princeton: Princeton University Press, 2013).

13. Jens Beckert, *Imagined Futures: Fictional Expectations and Capitalist Dynamics* (Cambridge, MA: Harvard University Press, 2016), 233. See also Phaedra Daipha, *Masters of Uncertainty: Weather Forecasters and the Quest for Ground Truth* (Chicago: University of Chicago Press, 2015).

14. Stephen Kotkin, "Modern Times: The Soviet Union and the Interwar Conjuncture," *Kritika*, 2, 1 (2001): 111-164. On the "modernizing" school of Soviet history vis-a-vis the "neo-traditionalists," see Michael David-Fox, "Multiple Modernities vs. Neo-Traditionalism: On Recent Debates in Russian and Soviet History," *Jahrbücher für Geschichte Osteuropas*, 54, 4 (2006): 535-555 and Peter Holquist, "New Terrains and New Chronologies: The Interwar Period through the Lens of Population Politics," *Kritika*, 4, 1 (2003): 163-175, and for a brief summary that looks at avenues for future research that do not hew to, or even necessarily reference, these terms of debate. Lewis Siegelbaum, "Wither Soviet History?: Some Reflections on Recent Anglophone Historiography," *Region*, 1, 2 (2012): 213-230.

15. Josephson et al., *An Environmental History of Russia*, 74. As Kendall Bailes has argued, the role of the engineer and idea of "technocracy," society ruled by engineers in its "widest sense," was a uniquely sensitive issue in the Soviet state. Kendall Bailes, "The Politics of Technology: Stalin and Technocratic Thinking among Soviet Engineers," *The American Historical Review*, 79, 2 (1974): 445-469 and, more broadly, K. Bailes, *Technology and Society under Lenin and Stalin: Origins of the Soviet Technical Intelligentsia, 1917-1941* (Princeton: Princeton University Press, 1978).

16. James Scott, *Seeing like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1999). On Promethean Soviet engineering designs on nature, see Klaus Gestwa, *Die Stalinschen Großbauten des Kommunismus: Sowjetische Technik- und Umweltgeschichte, 1948-1967* (München: Olbenbourg Verlag, 2010). Douglas Weiner has chronicled some attempts within the scientific community to stand up to this mindset, in *A Little Corner of Freedom* (Berkeley: University of California Press, 1999), 3 and *Models of Nature: Ecology, Conservation, and the Cultural Revolution in Soviet Russia* (Bloomington: Indiana University Press, 1988).

tools—especially those developed to enable prediction—led to biologists increasingly conceiving of and studying fish in relation to humans, bringing something of an engineering mindset to fisheries.

Changes in scientific practice—ways of knowing—also had important implications for the conceptualization of material nature and the objects of knowledge or, more prosaically here, fish. This is, then, fruitful territory for considering, as Kristin Asdal has suggested, "a more radical version of history than implied by [current] environmental history—a version in which both nature and the sciences have a history."[17] Asdal highlighted how both Donna Haraway and Bruno Latour have urged scholars and citizens more broadly to see nature not as a unitary thing that can be accessed by any one method, theory, or scientific discipline but something that occurs "in a discursive process in which material and semiotic resources go together" (Haraway) and where "humans do not stand *above* nature, as implied by contrasting humanity and the biosphere, but in relation *with* nature" (Latour).[18] On the one hand, Asdal's challenge is one that has been duly accepted by environmental historians who have chronicled and underlined how nature has been a factor and actor, sometimes a decisive one, in history at all times and all places. But what *is* this nature? This is the deeper challenge of Asdal, and by extension Haraway and Latour.[19] The shift to forecasting changed not only what it meant to know something about fish in the interwar Soviet Caspian, but fish as a scientific object itself.[20] Fish were changed as they were written into Soviet economic plans not, of course, in Ian Hacking's sense of "making-up people"—fish could not be cognizant nor change their behavior in reaction to how scientists or others represented them.[21] But nature, as Asdal argued, is under-determined and spoken for with different voices.

17. Kristin Asdal, "The Problematic Nature of Nature: The Post-Constructivist Challenge to Environmental History," *History and Theory*, 42, 4 (Dec., 2003): 73. See, too, Libby Robin and Jane Carruthers, "Introduction: Environmental History and the History of Biology," *Journal of the History of Biology*, 44, 1 (2011): 1-14 and the rest of the special issue on environmental history.

18. Asdal, "The Problematic Nature of Nature…," 69 and 71, respectively.

19. Perhaps nowhere so masterfully have environment, society, and science been simultaneously historicized as in Carolyn Merchant's, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (San Francisco: Harper & Row, 1980). See, too, Gregg Mitman, "Where Ecology, Nature and Politics Meet: Reclaiming the *Death of Nature*," *ISIS*, 97, 3 (2006): 496-504. In this vein, on the issue of fisheries see the excellent works of Arthur McEvoy, *The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980* (New York: Cambridge University Press, 1986) and Dean Bavington, *Managed Annihilation: An Unnatural History of the Newfoundland Cod Collapse* (Vancouver: University of British Columbia Press, 2010).

20. The literature in history and philosophy of science on ontologies or "biographies" of the subjects of scientific study undergirds this approach. See Lorraine Daston, ed., *Biographies of Scientific Objects* (Chicago: University of Chicago Press, 2000) and Ian Hacking, *Historical Ontology* (Cambridge, MA: Harvard University Press, 2004).

21. Ian Hacking, "Making Up People," in Thomas Heller, Morton Sosna, David Wellbery, eds., *Reconstructing Individualism: Autonomy, Individuality, and the Self in Western Thought* (Stanford: Stanford University Press, 1986), 222-236. The debate of whether or not to give "agency" to things and animals is a recurring and well-rehearsed topic in environmental history.

Thus, rather than engage in the perennial debate about giving "agency" to animals and things, this article departs from the observation that nature has an existence separate and independent of people, but is known to humans through processes, experiences, and categories that are fundamentally social.[22] Populations of fish became a different sort of "natural" object when the knowledge regime under which they were studied shifted to one that valued and prioritized prediction.

The fishing sector made up a significant part of the imperial Russian economy and was a large employer in the Caspian region. According to contemporary statistics, in 1913, the last full year of peace before a world war and two revolutions upended the Empire, the Caspian Sea accounted for some 63% of Russia's total haul of fish, 9% of the world total.[23] In the world economy, the 73 million poods[24] of fish caught by Russia were second only to the 76 million poods harvested by Great Britain, while in terms of market value the take was some 140 million rubles, putting it just behind Japan and the United States. This was equal to some 0.7% of Russia's net national income.[25] In the Astrakhan guberniia, according to I.I. Panin, 60% of the working population was employed in the fishing industry prior to the civil war, while in Azerbaijan some 40,000 people worked in fishing in 1917.[26] The biggest employers were private investors who rented Caspian fishing rights.[27] The Caspian fisheries were a major site of industrialization in the last decades of the tsarist regime. Spurred on by the opening of the Baku oil fields, which provided fuel for the development of faster and cheaper river transport, and the 1881 cancellation of a tax on salt used in processing and preserving fish, factories were built near Astrakhan to refrigerate and process fish for shipment.[28] Moreover, the Caspian acquired increased significance—later mythologized—as a major source of protein for the

22. For classic statements on the social nature of cognition see Ludwik Fleck, *The Genesis and Development of a Scientific Fact* (Chicago: University of Chicago Press, 1979 [1935]) and David Bloor, *Knowledge and Social Imagery* (Chicago: University of Chicago Press, 1991 [1976]).

23. V.M. Shaparlinskii, *The Fishing Industry of the USSR* (Israel Program for Scientific Translations, Jerusalem: 1964), 6.

24. A pood was roughly 36 pounds.

25. Fisheries statistics from I.N. Arnold, *Rybnaia promyshlennost´* [The fishing industry] (M.: Gosudarstvennoe Izdatel´stvo, 1926), 3. The net national income number, which excludes Poland and Finland, was calculated by Andrei Markevich and Mark Harrison, "Great War, Civil War, and Recovery: Russia's National Income, 1913 to 1928," *Maddison-Project Working Paper*, WP-2 (January 2011): 25.

26. For comparison, 58,000 were employed at the Baku oil fields. I.I. Panin, *Istoriia Astrakhanskogo kraia: 1900-1940 gg*. [History of the province of Astrakhan: 1900-1940] (Astrakhan´: Volga, 1997), 10, 108; M.A. Ismailov, *Sotsial´no-ekonomicheskaia struktura Azerbaidzhana v epokhu imperializma* [The socio-economic structure of Azerbaijan in the imperial period] (Baku: Elm, 1982), 25, 40, 57.

27. Ismailov, *Sotsial´no-ekonomicheskaia struktura Azerbaidzhana,* 25, 40, 57.

28. A.F. Videtskii, ed., *Promyshlennaia Astrakhan´* [Industrial Astrakhan] (Astrakhan´: Izdatel´stvo Gazety "Volga," 1959), 21-24.

country during the civil war when the Red Army was cut off from its other major sources of fish in the North and Black Seas and in the Far East.

The revolutions of 1917 and ensuing civil war caused widespread damage to the fishing industry on the Caspian. While Astrakhan was never occupied by White armies, by 1919 Soviet sources suggest only 10% of the fishing industry was still operating. A large majority of fishing boats and equipment were destroyed and much of the working population was engaged at the front. The fishing industry was formally nationalized by the revolutionary government at the outset of the war, but much of the industry was left in the hands of the industrialists as was the case in other sectors of the economy.[29] A critical reading of the Soviet sources suggests that the state retained monopoly power to buy and seize fish at fixed prices in an analogous manner to the infamous *prodrazverstka* in agriculture, by which both tsarist and Bolshevik governments confiscated products for nominal prices during WWI and the Russian civil war. In 1920, according to official statistics, fishing output was less than a quarter of its 1913 levels.[30] Following the Tenth Bolshevik Congress in 1921 and the establishment of the New Economic Policy (NEP), the state monopoly on fishing zones was canceled in most areas of the Caspian and the fishing yields grew throughout the 1920s in combination with some repair and construction of fishing boats and equipment.[31]

As early as the 1840s the imperial Russian state, worried by apparent declines in fishery yields, had organized and funded scientific study of key fisheries of the empire.[32] Permanent research facilities were established at the turn of the century in Astrakhan, and a decade later in Baku.[33] The two ichthyology laboratories were retained under the Bolshevik government and absorbed by the Main Directorate of Fishing and Fisheries Industry (*Glavryba)* and in 1923 transferred to the People's Commissariat for Food Supplies. Year-end reports lament that this transfer was not

29. Panin, *Istoriia Astrakhanskogo kraia*, 77.

30. N.P. Sysoev, *Ekonomika rybnoi promyshlennosti SSSR* [The economy of the USSR fishing industry] (M.: Pishchevaia Promyshlennost′, 1977), 37. Simultaneous with overall decreases in fishing activity, wartime conditions could have led to increased and harmful levels of certain types of fishing, particularly in rivers and shallow, easily-accessible waters in a context of decreased state enforcement of fishing regulations. See Josephson et al, *An Environmental History of Russia*, 63.

31. An economic survey conducted by the Astrakhan laboratory in 1926 found that fishing equipment levels had rebounded following the war, but had not reached pre-war levels. K.A. Kisilevich, "Povtornoi issledovanie (perepis′) lovetskykh khoziaistv Astrakhanskoi gubernii [Repeat study (census) of the fishing economy of Astrakhan province]" in *Trudy Astrakhanskoi ikhtiologicheskoi laboratorii* [Proceedings of the Astrakhan Ichthyology Laboratory] 1928, t. VI, vyp. 1 (1924): xi.

32. P.G. Borisov, *Fisheries Research in Russia: A Historical* Survey (Israel Program for Scientific Translations: Jerusalem, 1964), ch. 1 and M. Solov′ev, *Ber na Kaspii* [Baer on the Caspian] (M.: Izdatel′stvo Akademii Nauk, 1941). For an early history of Russian naturalists and expeditions, see Ryan Tucker Jones, *Empire of Extinction: Russians and the North Pacific's Strange Beasts of the Sea, 1741-1867* (Oxford: Oxford University Press, 2014).

33. Borisov, *Fisheries Research in Russia*, 45.

accompanied by any improvements in material support for the laboratory.[34] The Astrakhan and Baku laboratories continued in much the same vein as before 1917 with increased emphasis on *large-scale* industrial processing of fish. Even before the end of the civil war, V.I. Meisner, a prominent biologist at the Astrakhan laboratory, argued for the creation of an entire industry in Astrakhan based on sprat. The Caspian sprat, he noted, had been studied prior to the revolution, but expeditions had not recommended harvesting it in large amounts because the requisite infrastructure was not in place. Now, with a revolutionary government set upon industrializing the country, major capital investment appeared possible.[35] A heightened focus on large-scale production was also on display in the Astrakhan laboratory's 1922 yearly report. The laboratory listed nineteen priorities for the year—eleven related to the biological and hydrological study of fish and their environment, three to nets and techniques for increasing catches, and five to chemical and logistical analysis of industrial methods of fish processing.[36]

In 1922, A.N. Derzhavin, a biologist at the Baku Laboratory, promoted a simple mathematical model for estimating the size of the sturgeon fishery in the Caspian using as inputs biostatistical breakdowns of fish harvests by age, a statistic popularized by Norwegian biologist Johann Hjort in the previous decade and by the 1920s regularly kept in fisheries. With several notable exceptions, the general practice for determining the health of a fishery had been to track the size of yearly catches by age. A healthy stock was considered one that exhibited a stable and sufficiently mature average age of harvested fish. Thus, conclusions on the health of stocks were relative to previous years without requiring that absolute population sizes be estimated. In contrast to prior models, Derzhavin proposed one in which total stocks fluctuated from year to year. Yet, while his model demonstrated volatility and instability in fish stocks, it made other assumptions of stability. It relied on statistics provided by the fishing industry, thus it only provided a total of the stock of fish that would be caught sooner or later by said industry. More importantly, it assumed stability in the age make-up of catches over a number of years. While Derzhavin agreed that this was problematic, he found it preferable to a model showing stable

34. "Godovoi otchet Astrakhanskoi ikhtiologicheskoi laboratorii za 1924 [Yearly report of the Astrakhan Ichthyology Laboratory for 1924]" in *Trudy Astrakhanskoi ikhtiologicheskoi laboratorii*, t. VI, vyp. 1 (1924): 12.This was a frequent complaint in fisheries science and has been taken as evidence of under-funding in Russia vis-à-vis Europe. While certainly possible, such statements might equally have been exaggerations, purposeful or not, to secure more funding rather than simple statements of fact, a point Michael Gordin has made regarding nineteenth-century Russian chemistry. See Josephson et al, *An Environmental History of Russia,* 51, 64 and Gordin,"Was There Ever a 'Stalinist Science'?:" 631.

35. V.I. Meisner, "Kaspiiskaia kil′ka i ee vozmozhnoe promyslovogo znacheniia [Caspian sprat and its possible commercial significance]," in *Materialy dlia izucheniia estestvenykh proizvoditel′nykh sil Rossii* [Materials for the study of productive forces], v. 29 (1919): 9.

36. "Godovoi otchet Astrakhanskoi ikhtiologicheskoi laboratorii za 1921 [Yearly report of the Astrakhan Ichthyology Laboratory for 1921]" in *Trudy Astrakhanskoi ikhtiologicheskoi laboratorii*, t. V, vyp. 1 (1922): 1.

total fish stocks.[37] Derzhavin's primary goal was to reorient ichthyology away from relative catch statistics to absolute (and, he hoped, realistic) population numbers.

By studying population sizes of fish in the Caspian, Derzhavin could show the degree to which their number fluctuated. He calculated the stellate sturgeon population at 9.9 million in 1884-5, 5.3 million a decade later and 7.8 million in 1915-6. What had caused this? Derzhavin argued that, aside from human fishing, the greatest influence on spawning sturgeon was the river water level, where a high river would provide more space for spawning and greater amount of nutritional biomass. He further drew parallels between the river level and larger climatic phenomenon such as air and water temperature, winds, and humidity all of which followed cycles that roughly corresponded to 11- and 32-year Brückner periods of sunspot activity, named after German scientist Eduard Brückner who argued that sunspots directly and predictably affect the climate on earth.[38] Important events in the life-cycle of the sturgeon corresponded with the 5- and 11-year half Brückner cycles, a correspondence that Derzhavin suggested intensified the cyclical nature of fluctuations in sturgeon stocks.[39] There was no indication that he believed this method lead to the ability to make reliable predictions, nor that prediction was a goal of his work.

Another model was suggested by Fedor Baranov, an engineer who had worked at the Astrakhan Laboratory. In 1918, Baranov had published an article theorizing a new way of understanding overfishing and a method for modeling fisheries that included calculating growth rates of fish taken from actuarial mathematics and incorporating a variable for fishing intensity. Whereas actuarial curves were composed of a natural rate of mortality that increased with age and an unnatural rate due to external and random causes, in an intensely fished population the second factor reduced the first to insignificance. Thus, in Baranov's model humans took over the role of chance in determining survival rates and likelihoods of fish.[40] The equilibrium model was ahistorical, assuming that changes in exploitation patterns would lead to new equilibria. He urged biologists to devote more attention to individual biological processes such as life cycles, growth and mortality rates, and, most

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37. A.N. Derzhavin, "Sevriuga, biologicheskii ocherk [Stellate sturgeon, biological characteristics]," in *Izvestiia bakinskoi ikhtiologicheskhoi laboratorii* [Proceedings of the Baku Ichthyological Laboratory], t. 1, (1922): 10-20.

38. Brückner had also published work on the fluctuation of the level of the Caspian Sea, though this work was not cited in the Soviet fisheries literature. See: Nico Stehr, Hans von Storch, eds., *Eduard Brückner: The Sources and Consequences of Climate Change and Climate Variability in Historical Times* (Boston: Kluwer Academic Publishers, 2000). Mapping sunspot cycles onto processes on Earth has a long history. The British economist Stanley Jevons also found correlation between sunspot activity and economic crisis as did British colonial officials in India. Anderson, *Predicting the Weather*, 265-276.

39. A.N. Derzhavin, "Sevriuga, biologicheskii ocherk," in *Izvestiia bakinskoi ikhtiologicheskhoi laboratorii,* t. 1, (1922): 32, 191.

40. F.I. Baranov, "K voprosu o biologicheskikh osnovaniiakh rybnogo khoziaistva [On the biological foundations of the fisheries sector]," *Izvestiia otdela rybovodstva i nauchno-promyslovykh issledovanii* [Proceedings of the Department of Fishing Industry and Research], 1, 1 (1918): 84-85. Baranov cites here the 1912 publication of the well-known Kiev mathematician Dmitrii Grave *Matematika strakhovogo dela* [Mathematics of the insurance business].

importantly, human fishing intensity and to develop models that would incorporate these factors to the exclusion of all others. Fisheries science, he argued, should be mathematical: "the systematic study of biological statistics gives the means—the only one as the case may be—for constant control of the state of the [fisheries] trade and, it seems, such control should be one of the fundamental goals for ichthyological laboratories."[41]

In 1925 he published a follow-up study based on the same model, now taking data from the Caspian bream fishery. Planning by then was in the air and Baranov issued an "energetic call to lay the foundation for planned management (*planovoe khoziaistvovanie*) without delay."[42] Drawing a number of relationships between food, growth of fish, yields and natural populations, Baranov solved for a series of coefficients for which the assumption of hypothetical and actual equilibrium in the Caspian bream fishery was critical. With enough variables solved, he was able to graph [Fig. 1] the equilibrium curves of the yearly catch and "primary stock"—the base population which generated the growth exploited by industry—in relation to fishing intensity. According to this model, a more intense fishery would lead to smaller stocks of fish but greater capacity for growth and thus greater yields, though at high intensities the marginal increase in yield was low. The result was

> a picture that diverges in a fundamental way from the notion that has been essentially dominant until the present that a natural stock of fish is reserve capital from which only interest, without touching the capital itself, should be utilized by the fishing industry. Our theory says, to the contrary, that the industry and natural stock of fish are incompatible, that the commercial stock of fish is of variable size which depends precisely on the intensity of fishing.[43]

Or, as he would quip several years later, "it is not production [of new fish] that determines yields, but yields which determine production."[44] And, as in his previous article, Baranov found biological equilibrium to be possible at any level of fishing, thus industry would find the point at which further investment in fishing would be unprofitable.

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41. Baranov, "K voprosu o biologicheskykh osnovaniiakh rybnogo khoziaistva," 113. Theodore Porter has called such scientific ways of seeing the world "thin description"—a means of obtaining an "ordered visibility." It is a standardized and frequently quantified vision that seeks to be uniform and synoptic, congruent with Scott's notion of "high modernity." It is, Porter warns, the dominant mode in our modern world. Theodore Porter, "Thin Description: Surface and Depth in Science and Science Studies," *OSIRIS*, 27 (2012): 209-213.

42. F.I. Baranov, "K voprosu o dinamike rybnogo promysla [On the dynamics of fisheries]," *Biulleten´ rybnogo khoziaistva* [The fisheries newsletter], 8 (1925): 7. See Smith, *Scaling Fisheries,* 196-7.

43. Baranov, "K voprosu o dinamike rybnogo promysla," 9.

44. Quoted in N.L. Chugunov, "Biologiia molodi promyslovykh ryb Volgo-Kaspiiskogo raiona [Biology of juveniles of species of commercial fish in the Volga-Caspian region]," *Trudy Astrakhanskoi Nauchnoi Rybokhoziaistvennoi Stantsii*, 6, 4 (1928): 239.

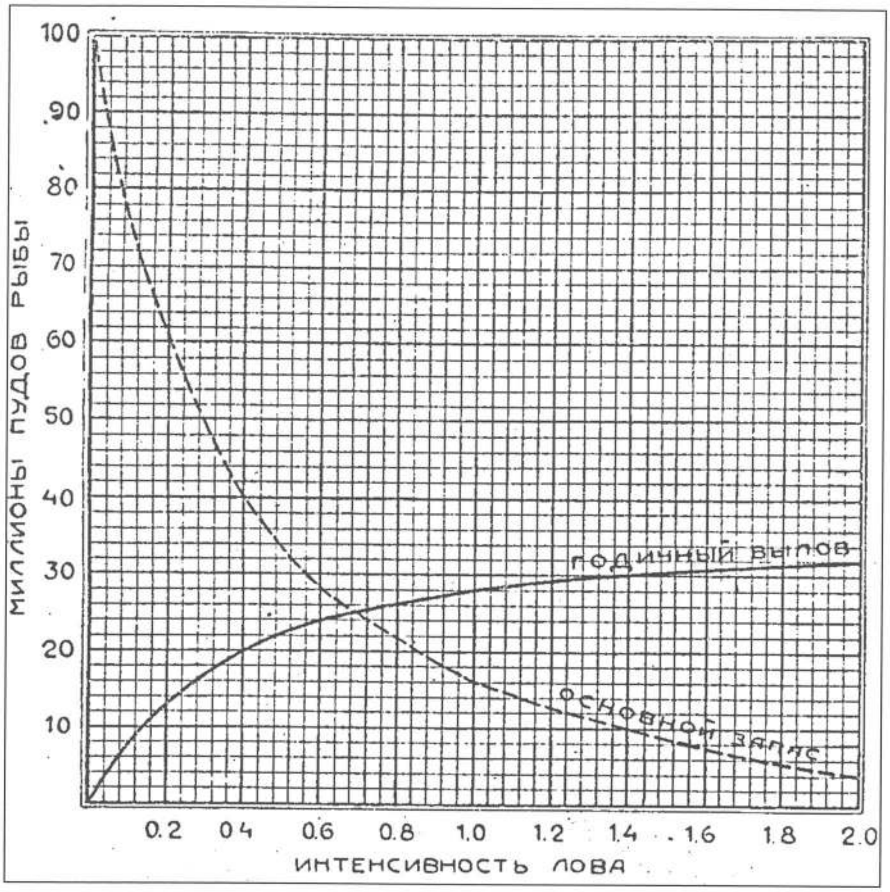

Fig. 1 – The equilibrium curves of yearly catch (solid line) and base stock (dotted line) illustrating Baranov's claim that increased fishing intensity causes decreases in base stock but will, in turn, lead to increased yield. Aggregate weight (in millions of poods) of fish is on the vertical axis, fishing intensity on the horizontal. F. I. Baranov, "K voprosu o dinamike rybnogo promysla," *Biulleten' rybnogo khoziaistva*, 8 (1925): 9.

His claims led to an acrimonious public back-and-forth on the proper conduct of science, role of mathematics in biology, and ways of representing complexity. His sparring partners included several prominent fisheries scientists, in particular Nikolai Knipovich, a senior and well-established hydrologist and biologist with Bolshevik connections and significant institutional power.[45] For Knipovich, the natural stock of fish could not be deduced from equations made on countless shaky assumptions using possibly unreliable data. Repeating the banking metaphor, he asked "what is correct forestry, correct animal husbandry, correct hunting if not the use of natural productivity which is, one might say, interest on capital, which

45. On Knipovich, see Josephson et al, *An Environmental History of Russia,* 63.

itself remains in reserve and untouched."[46] Nature produced and humans harvested the excess, exactly the opposite of Baranov's conception where humans were at the center. Then, in a line that would later earn him ridicule, Knipovich wrote:

> For me, as a biologist, I consider completely unacceptable an approach to a conclusion through formulas. The number of individuals of a certain species inhabiting a given body of water is determined, as any biologist knows, by not just the quantity of food, which Prof. Baranov manipulates, but by an extraordinarily complex combination of biological and physical-geographical factors among which is, indeed, the amount of food and the effects of other factors, along with the interactions of many factors. All these make up the variables."[47]

Knipovich was not denying the power of mathematics but was suggesting that the supremely complex host of natural factors relating to fisheries could not be meaningfully reduced to such simplified formulas. This was a debate about the proper method for obtaining knowledge about a fishery but also, importantly, the ability to reliably plan a fishery to human specifications.

Baranov responded by quoting Karl Pearson. "The main goal," according to Pearson, "of a person of science is to remove himself from his thinking and present an argument which is true and useful not only for him, but for all others as well."[48] Baranov mockingly asked if Knipovich would have him "lay his head down before the wisdom of the creator, before the complexity of the world, and the powerlessness of the scientific method?"[49] He defended mathematics as not only something that had clearly proven its value in other areas of science, but as a method that unfailingly led its user to clearly pose questions and forced one to formulate explicit hypotheses and assumptions that would otherwise remain unspoken and unrecognized. In a footnote, he suggested that a position such as Knipovich's would rule out speaking to state authorities in the name of science because it denied the scientific method. Baranov was no doubt aware that Knipovich was an outspoken promoter of nature preservation both before and after the revolution.

Perhaps unsurprisingly, Knipovich, far better-known and senior, failed to respond. After waiting for a continuation of the duel for several months, Baranov published an open letter to Knipovich challenging him to respond. The debate had gone to fundamental questions and first principles of fisheries science that needed to be sorted out, he argued. Furthermore, to leave such a disagreement unresolved before the public—the back-and-forth was published in the pages of a trade journal—threatened the authority of fisheries science. He admitted that he could

46. F.I. Baranov, "Po povodu vozrazhenoi (sic) prof. N.M. Knipovicha na stat'iu: 'K voprosu o dinamike rybnogo promysla' [On the objections of Prof. N. M. Knipovich to the article 'On the dynamics of fisheries']," *Biulleten' rybnogo khoziaistva*, 12 (1925): 9.

47. Ibid., 10.

48. Quote of Karl Pearson, source not identified, in Baranov, "Po povodu vozrazhenoi (sic) prof. N.M. Knipovicha," 10. On Peason, see Theodore Porter, *Karl Pearson: The Scientific Life in a Statistical Age* (Princeton: Princeton University Press, 2006).

49. Baranov, "Po povodu vozrazhenoi (sic) prof. N.M. Knipovicha," 10.

be mistaken in his theory, however, he was sure that "the view that [Knipovich] espoused has never been formulated by anyone in an orderly, entirely coherent system of theses."[50] Baranov wanted to meet on his own terms. It is perhaps no surprise that Baranov's models, now a foundational part of modern fisheries science, were not widely adopted in Soviet biology for several decades.[51]

Others proposed models gaining popularity at the time were also quantitative, though not mathematical in the way that Baranov advocated. In 1923 N.L. Chugunov conducted a quantitative study of the benthos (sea floor) modeled after the well-known investigations of Danish researcher Johannes Petersen who, in 1915, performed a "valuation of the sea" in Kattegat, the body of water between Denmark and Sweden. Petersen, for many years around the turn of the century head of the Danish Biological Station for fisheries research, was involved in early efforts to tag and count fish, with particular interest in growth rates and population numbers, which directly led to his subsequent attempts at taking inventories of living matter in the sea to understand the "economy of the sea." [52] Earlier research seemed to have suggested that "overpopulation" of fish was possible, where the perspective was an economic one in which a high density caused slower growth rates. This led to a series of "transplanting" experiments where fish were caught in areas of denser populations, tagged, and released in areas with smaller populations. Results seemed to indicate that growth of fish could be increased by humans moving them to less densely populated areas.[53] In a subsequent publication, he suggested that "overfishing" might, therefore, be desirable to keep an area from becoming "overpopulated," which would decrease productivity.[54]

Chugunov came to similar conclusions. Using Petersen's method to measure the total weight of organisms on the seabed of the northern Caspian and analyze its make-up, he mapped his findings in a diagram, similar to those published by Petersen, that showed relationships of consumption from benthos organic matter up to large carnivorous fish. Reducing the northern Caspian seabed to a single number that signified overall "productivity," Chugunov was able to compare it to other fisheries. He found the Caspian Sea to be only slightly less "productive" than Kattegat, but that it significantly trailed the most prolific fisheries of the world. However, all organisms were not equal. Petersen had created two classes

50. F.I. Baranov, "Otkrytoe pis′mo prof. N.M. Knipovichu [Open letter to Prof. N.M. Knipovich]," *Biulleten′ rybnogo khoziaistva*, 6 (1926): 9.

51. On the postwar (re-)discovery of Baranov's work in English-language fisheries science, see Smith, *Scaling Fisheries,* 307-309.

52. On the long history of viewing nature in economic terms, see Donald Worster, *Nature's Economy: A History of Ecological Ideas* (Cambridge: Cambridge University Press, 1977) and Lisbet Koerner, *Linnaeus: Nature and Nation* (Cambridge, MA: Harvard University Press, 1999).

53. Described in C.G. Joh. Petersen, *Report of the Danish Biological Station to the Home Department* (Copenhagen: Centraltrykkeriet, 1896), on the general "small plaice problem" of the early twentieth century, see Smith, *Scaling Fisheries*, 72-85.

54. C.G.J. Petersen, "What is Over-fishing," *Journal of the Marine Biological Association*, 6 (1903): 587-595.

of benthos-level organic matter: "useful" organisms that provide nutrition for commercially-valuable fish, and "useless." Chugunov found that the northern Caspian organic benthos was made up almost exclusively of useful organisms, whereas in Kattegat the useless outnumbered the useful five to one.[55] If the north Caspian was quantitatively comparable to other high-yield fisheries around the world, it, too, could be expected to support similarly high yields. Chugunov's finding of the Caspian sea floor's high usefulness coefficient became a common refrain for researchers thereafter.

In a subsequent 1928 article, Chugunov commented on the biological and physical cycles that influenced commercial fish stocks. He suggested that fluctuations in fishery yields were the result of variations in the abundance of young fish that could be traced to the physical conditions at certain times in their life cycles. He agreed with Derzhavin that it was more than just coincidence that the principle periods in the fluctuations of fisheries catches were 3, 6, and 11 years, which match the periodicity of sunspot cycles.[56] [Fig. 2] Fisheries stocks, then, could be understood to be in a state of natural "mobile balance," a seemingly new way of understanding the fluctuations of fish populations in the Caspian context. In addition to biological and physical hydro-meteorological factors, Chugunov, like Baranov, added another variable needed to understand fisheries dynamics: fishing intensity. Intensity of fishing, which he suggested could be quantified based on the absolute amount of fish caught in a given season, might be controlled by humans to provide high yields and sustainable stocks. To do this, he advocated a "rational maximum of fisheries," though no details were given on how to calculate such a figure. The rational maximum, he suggested, needed to be studied well, as there was reason to believe that if the number of spawning fish was greatly reduced by intense fishing, the decrease in competition would cause an increase in the percentage of fry surviving to maturity.[57] More intense fishing might actually increase reserves and possible production, as both Petersen and Baranov had argued. Greater use of fisheries statistics could enable calculation of a maximum rational intensity, which would provide a "balance of fishing at which the fished basin will yield the greatest quantity of fish possible for its natural productive force, without exhausting the fishery."[58] The intensity of fishing, therefore, interacted in complicated and sometimes counterintuitive ways with fish biology and physical geographical conditions. At the conclusion of his article, Chugunov suggested that prediction ("foreseeing variations in the quantity of fisheries yields") might be possible and desirable. By 1928, prediction

55. N.L. Chugunov, "Opyt kolichestvennykh issledovaniia produktivnosti donnoi fauny v severnom Kaspii i tipichnykh vodoemakh del´ty Volgi [Experiments in quantitative study of the productivity of seabed fauna in the northern Caspian and Volgia delta basin]," *Trudy Astrakhanskoi Ikhtiologicheskoi Laboratorii*, t. 5, vyp. 1 (1923): 107-192.

56. Chugunov, "Biologiia molodi," 276.

57. Ibid., 277.

58. Ibid., 278.

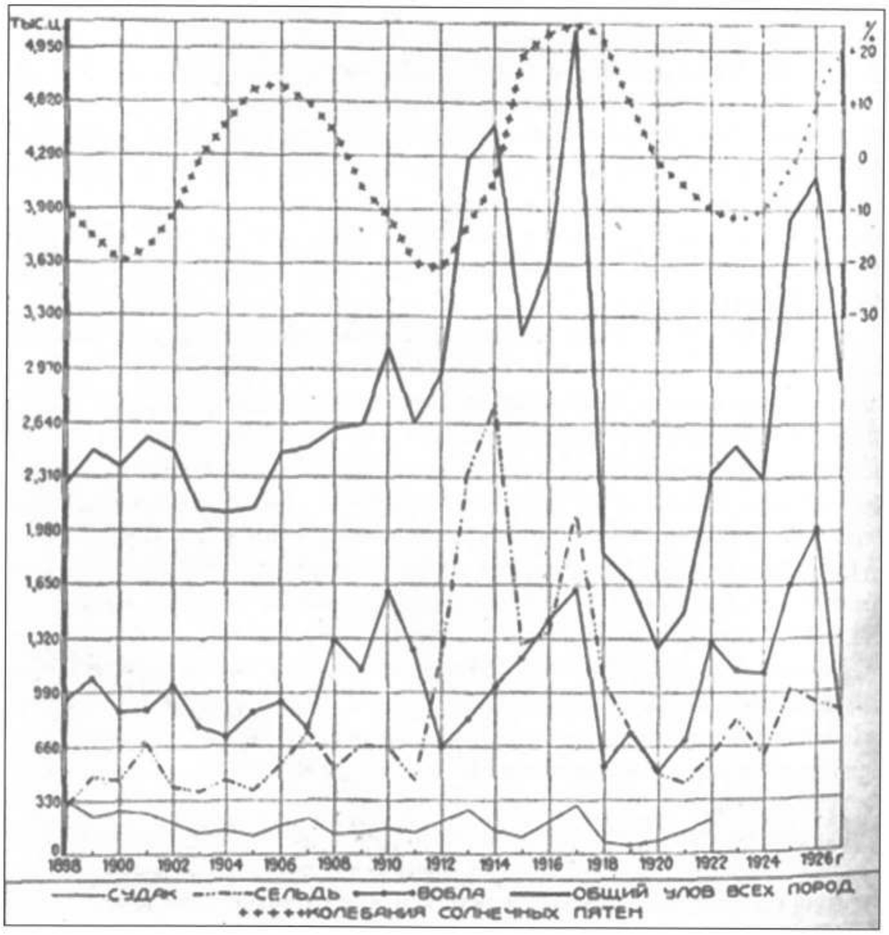

Fig. 2 – Chugunov's plot of historical yields of various sorts of fish superimposed on sunspot activity (wave at the top). Chugunov, "Biologiia molodi," 228.

was making tentative inroads into the agenda of Caspian fisheries science. In the hands of Baranov and increasingly biologists such as Chugunov, it suggested not only that humans could forecast nature's production of fish, but that humans could alter nature to increase production even more.

The year 1928 was a dramatic one. In the upheaval, the rhetoric used by state actors and fisheries scientists themselves changed abruptly and dramatically. Both Astrakhan and Baku Ichthyological Laboratories were given new names, more in line with the Marxist philosophy of science of the day, becoming the Astrakhan and Baku Scientific Fisheries Stations under the People's Commissariat of Agriculture. There was also a push to more effectively coordinate and unite the work of all Caspian-area research stations, which had in the past operated with a large degree of autonomy. In 1929, representatives of research stations, government fishing and economic planning agencies and the Astrakhan Fishing Trade Union gathered several times to discuss coordination and consolidation of future work. The chair, the head of the Astrakhan research station, announced the goals of the meetings: to unite all on-going research under one program and attain better coordination and linkage (*uviazka*) between scientific organizations and the fishing industry with the goal of developing a science that "takes upon itself the responsibility to closely and carefully study all questions of interest to the economy (*khoziaistvo*)."[59]

Beginning in 1928 writers for the trade journal *Rybnoe khoziaistvo,* some of whom worked or had previously conducted research at local fisheries stations, launched aggressive attacks against the supposedly bourgeois subject of ichthyology. Ichtyologist-holdovers from a previous scientific era, they charged, preferred detailed and obscure morphological study of individual specimens rather than take the species as a whole as the subject of research. This had led ichthyologists to a dead end—they were not asking the questions that would be the most beneficial to the country, namely: how many fish should be caught at a given time in a given place to ensure maximum yield without depleting stocks. What was needed was the development of qualitative and quantitative methodologies enabling approximations of current fish reserves.[60] Other authors accused fisheries researchers of hewing to "false divisions of science between pure, partially pure, and applied" and asserted that it was only because of Communist intervention in 1930 that the Astrakhan research station had abandoned its "old and pernicious approach of 'science for science's sake.'"[61]

Established researchers began to defend their positions by couching their language in the terms of dialectical materialism but, for fisheries scientists, focusing on "practical" science was not particularly difficult; their research even before 1917 had already been geared toward industry. Much research had also been conducted, as shown above, in developing methodologies for estimating the size of fish stocks. Thus, fisheries scientists were unusually well-positioned to weather a sudden intrusion of Bolshevik ideology and Marxist philosophy of science into their practice. All it required was a shift in rhetoric—inclusion of Bolshevik vocabulary and adorned by citations of Stalin and Lenin. Yet, while the underlying scientific

59. *Protokoly pervogo soveshchaniia 18-20 oktiabria 1928 g. v Astrakhani i vtorogo soveshchaniia 8-11 iiunia 1929 g. v Makhach-Kala* [Protocols of the first meeting Oct. 18-20, 1928 in Astrakhan and second meeting June 8-11, 1929 in Makhachkala] (Astrakhan′: Izd. Astrakhanskoi nauchnoi rybokhoziaistvennoi stanstii, 1929), 3.

60. I.N. Gol′dentrakht, "Ob eksperimental′nom napravlenii v rybokhoziaistvennoi nauke [On the experimental tendency in fisheries science]," *Rybnoe khoziaistvo*, 4-5 (April-May 1931): 48-9.

61. V.D. Bolkhovtianov, "O rybno-khoziaistvennoi nauke [On fisheries science]," *Rybnoe khoziaistvo*, *2* (February 1931): 34; "Osnovnye momenty raboty volgo-kaspiiskoi nauchnoi rybokhoziaistvennoi stantsii na 3-em godu piatiletki [Important results from the work of the Volga-Caspian Station for Fisheries Science in the third year of the five-year plan]," *Rybnoe khoziaistvo*, *2* (February 1931): 31.

program of research was already congruent with a Bolshevik science, the objectives and priorities of fisheries science did change after 1928. This was not caused or forced by those policing and enforcing ideological purity so much as it was a response to the new Soviet economy and the sorts of input required by a state that plans its economy five years in advance.

Gosplan, the state organ responsible for planning the Soviet economy, had been issuing economic plans for the government fishing industry since the early 1920s, initially producing only half-year plans.[62] However, despite the fact that the Astrakhan and Baku stations were subordinate to Glavryba, the state fisheries directorate, no mention was made of planning targets in the scientific literature in the 1920s.[63] In 1928, however, the first all-encompassing five-year plan was announced. This was followed by a resolution of the Soviet Central Committee and Council of the People's Commissars which provided financing for industrialization of the fisheries industry and raised the Union-wide planning target for fish yields, of which the Caspian was to supply one-third.[64]

With the first five-year plan, fisheries were collectivized. Little secondary literature exists on the topic of fisheries collectivization and collectives, thus it is difficult to say anything in detail on this question.[65] However, a critical reading of Soviet sources suggests that the process of collectivization of fisheries in the Caspian region was similar to the better-known story of collectivization of agriculture. A dekulakization campaign was conducted alongside a movement to drive peasants into collective fisheries organizations. Like agriculture, it was a highly coercive affair and Soviet sources admit that in the process "local administrators committed large mistakes."[66] The tempo of collectivization was slowed in March following Stalin's "Dizzy from Success" article in *Pravda* and Soviet sources report collectivization

62. S.G. Strumilin, *Na planovom fronte: 1920-1930* [The advance and spread of planning] (M.: Gosudarstvennoe Izdatel'stvo Politicheskoi Literatury, 1958), 274.

63. Sysoev, *Ekonomika Rybnoi Promyshlennosti SSSR*, 39.

64. Boris Nikolaevich Babin, *Iz istorii kollektivizatsii rybolovetskikh khoziaistv Astrakhanskogo kraia* [History of the collectivization of Astrakhan fisheries] (Astrakhan': Izdatel'stvo Gazety Volga, 1958), 35.

65. One exception is the discussion of co-operativization and collectivization in the Soviet Far East in A.T. Mandrik, *Istoriia rybnogo promyshlennosti rossiiskogo Dal'nego Vostoka, 1927-1940 gg.* [History of the fisheries industry of the Russian Far East, 1927-1940] (Vladivostok: Dal'nauka, 2000), 80-99. In general, analysis of the political economy of fishing in the Soviet Union has been largely absent from recent work. On Soviet fisheries science see the work of Julia Lajus, including "Uchenye, promyschlenniki i rybaki: istoriia nauchno-promyslovykh issledovanii na Murmane, 1898-1933 [Scientists, industrialists, and fishers: the history of scientific-commercial research on the Murman Coast]," *Voprosy istorii estestvoznaniia i tekhniki*, 1 (1995): 64-81. On the environmental consequences of Soviet fishing, see Josephson et al, *An Environmental History of Russia* and for the postwar Pacific, Carmel Finley, *All the Fish in the Sea: Maximum Sustainable Yield and the Failure of Fisheries Management* (Chicago: University of Chicago Press, 2011) and *All the Boats in the Ocean: How Government Subsidies Led to Global Overfishing* (Chicago: University of Chicago Press, 2017). A sizable literature in political science and international relations discusses Soviet/Russian participation in international fisheries treaties and frameworks.

66. Videtskii, ed., *Promyshlennaia Astrakhan'*, 30.

levels in Astrakhan dropped temporarily from 80% in February to 62% by April only to rise again in the following months.[67] In 1932, Motorized Fishing Stations (*motorno-rybolovnye stantsii*), analogous to the Machine and Tractor Stations in agriculture, were created. Their number expanded through the 1930s. Operations requiring imported labor or large investment of capital were organized as state fisheries, equivalent to *sovkhozy* in agriculture. An article in *Rybnoe khoziaistvo* easily likened the work of collectivized fisheries and farms and noted that similar means of planning and organization on farms, fisheries, and battlefields should be used. "Just as on the fields of the *kolkhozy* tractors are coordinated, like individual combat units on the battlefield, so too should fishing boats on the sea be coordinated by a plan and system."[68]

The institution of the planned economy soon led to a reorientation of scientific priorities in fisheries science. The 1932 issue of the *Transactions of the Azerbaijan Scientific Fisheries Station* explicitly recognized these new priorities while also implicitly admitting how fast the change had taken place. In an unsigned preface, the editors apologized for an article appearing in that same issue. The article, the editors stated, ignored the current important issues because it was written before the rapidly-reorganizing (*burno reorganizuiushcheesia*) fishing industry began to focus on economically relevant questions in the study of fish stocks, movement over space and time of fish, and prognosis for future catches. Thus, quite suddenly, these issues had become all important.[69] The new priorities were on display during the All-Caspian Fisheries Expedition conducted in 1931-2 by the five research stations of the Caspian region. The objectives of the expedition included familiar goals of aiding industry by studying migration patterns of fish and testing fishing techniques and equipment, now with a particular slant to deep sea fishing that industry was eager to develop. Here, too, was a new emphasis: forecasting. The expedition was to collect "biostatistical data on commercial fish and develop methods of quantitative estimation on which to base fishing predictions."[70] Methods developed without implications for prediction were now revisited and proposed as means to make prognosis. One biologist participating in a cross-republican Caspian research expedition in 1932 returned to correlations of the sunspot cycle with fish yields but now suggested it as a predictive tool, tellingly extending the graph of sunspot cycles to swings in fisheries yields into an uncertain future. [Fig. 3] The ability to forecast future yields of fish had acquired new significance.

67. Ibid., 33; Babin, *Iz istorii kollektivizatsii rybolovetskikh khoziaistv*, 41-55. On the process in the Far East, including discussion of transfer of entire kolkhozes from European Russia to the Far East, see Mandrik, *Istoriia rybnogo promyschlennosti*.

68. A.I. Ivanovskii, "K voprosu o regulirovanii morskogo lova i dislokatsii lovetskogo morskogo flota [On regulation of yields and location of the sea fishing fleet]," *Rybnoe khoziaistvo*, 6-7 (June-July 1931): 40.

69. *Trudy Azerbaidzhanskoi nauchnoi rybokhoziaistvennoi stantsii*, t. III, vyp. 1 (1932): preface.

70. *Biulleten' vsekaspiiskoi nauchnoi rybokhoziaistvennoi ekspeditsii* [Bulletin of the All-Caspian scientific fisheries expedition], t. 3-4 (1932): 7.

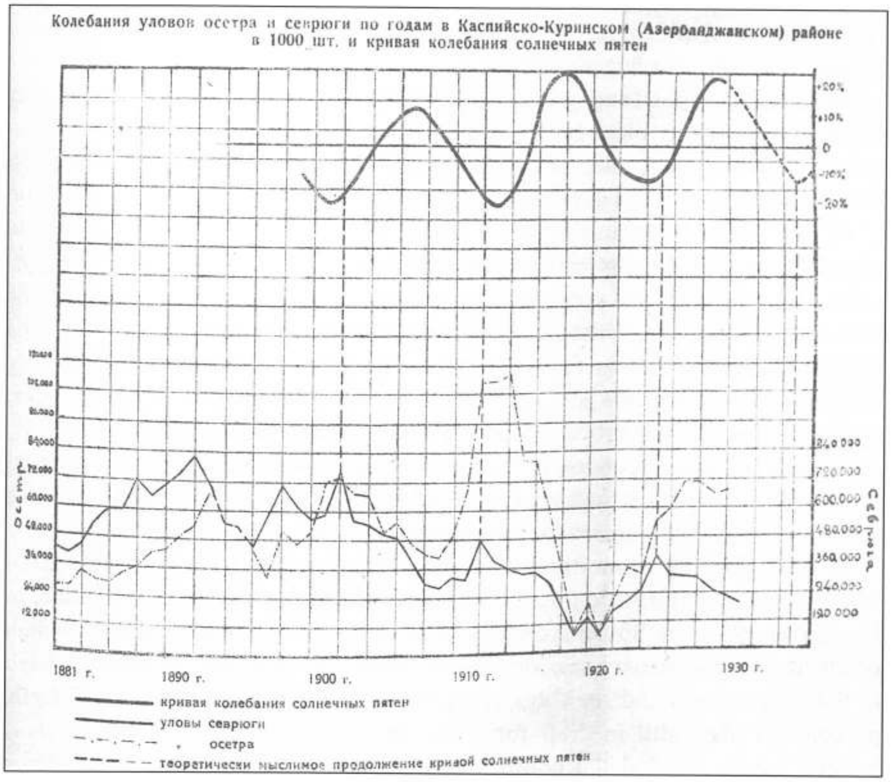

Fig. 3 – Curves showing the the regular fluctuation in the sunspot cycle, top solid line, and the total catches of stellate and Russian species of sturgeon, bottom in thin solid and broken lines respectively, with vertical dotted lines showing the correspondence of low sunspot radiation and peak sturgeon harvests. V.N. Beliaev, "Osetr [L'esturgeon]," *Biulleten' Vsekaspiiskoi Nauchnoi Rykokhoziastvennoi ekspeditsii*, t. 3-4, (1932): 74.

Fisheries researchers were not immune to the tendency of the day to set, fulfill and over-fulfill increasingly audacious planning goals, indeed, quantitative predictive models promised greater control over nature and the possibility for ever greater exploitation. In establishing what was seen to be a more quantitative and, therefore, more reliable biostatistical basis for making stock estimates and predictions, many also criticized the conservative nature of the "traditional" method of tracking and managing fisheries. This method, as critiqued by Derzhavin in 1922, involved measures to keep the age composition of catches steady from year to year without reference to total population of the stock, or size of the yield, as a whole. Numerous members of the All-Caspian Expedition of 1932 suggested that this method underestimated the true limits of what could be harvested without reducing future yields. Chugunov argued that the "stubborn facts of nature" showed that a higher than usual percentage of young fish in catch figures might be the result of an unusually high birth rate in a particular generation of fish, rather than an unsustainable, "predatory" level of fishing.[71] New methods to predict and plan fisheries could also be used to justify ever larger yields.

By the 1930s explicit engagement with scientific literature from outside the Soviet Union had become atypical; however, citations of foreign work still occurred infrequently, especially regarding methods of prediction. In 1932, a review of a work on fisheries studies published in English by the International Council for the Exploration of the Sea featured prominently in a Caspian fisheries science journal. The review included a separate, lengthy summary of one article deemed to be of particular importance—on measuring and predicting fluctuations in the stocks, here herring off the Irish coast.[72] Chugunov in the same year recognized the important work done in the field by Europeans such as Fridtjof Nansen, Bjørn Helland-Hansen and especially Johan Hjort—Norwegians all—to better understand fluctuations in yields. Such work, he noted, "has exceptional value in founding a planned Soviet fisheries sector." Thus, quickly during the course of the first five-year plan collecting relevant data and developing the analytical tools to make better forecasts became the primary objective and central subject of research for Soviet fisheries scientists by the early 1930s.

In state planning committees and commissions, it became increasingly clear that this was the information that fisheries scientists were expected to provide. In November 1933, the Soviet Academy of Sciences in cooperation with Gosplan conducted a large plenary session with 69 papers given to discuss issues related to the Caspian Sea and its Volga river basin. At the session, Gosplan officials presented a plan, still in draft form, for the "Great Volga" *(Bol'shaia Volga)* project, which entailed the construction of a series of hydroelectric stations, navigational canals and increased irrigation infrastructure on the Volga and tributaries. Opportunities and consequences of this project were discussed in a range of fields: agriculture and food, transportation, hydroelectric power, geology, and fisheries. The faction made up largely of engineers marching under the banner of "rational" use of resources, including "rationally" determining the paths of rivers, argued that the potential economic gains from such a plan outweighed any possible negative consequences. From this viewpoint, the goals of fisheries science were clear. As one leading engineer stated, "we currently are at the mercy of chance, we have no fishing industry. We have a fishing trade, and we now must transform that into a fishing industry."[73] Here, again, was Baranov's modeling

71. V. Petrov, "Nekotorye dannye o promysle sazana v Azerbaidzhane v sviazi s izucheniem ego zapasov [Some data on the carp fishery in Azerbaijan and the study of its stock]," *Biulleten' vsekaspiiskoi nauchnoi rybokhoziaistvennoi ekspeditsii*, t. 3-4 (1932): 108; N.L. Chugunov, "K predvaritel'nomu otchetu o rabotakh syr'evogo sektora Vsekaspiiskoi nauchnoi rybokhoziaistvennoi ekspedistii [Towards a preliminary account of the work of the primary stock section of the All-Caspian scientific fisheries expedition]," ibid.: 12; V.N. Beliaev, "Osetr [Sturgeon]," ibid.): 74.

72. V. Petrov, "Rapports et Procès Verbaux de Réunion," *Biulleten' vsekaspiiskoi nauchnoi rybokhoziaistvennoi ekspeditsii*, t. 3-4 (1932): 175-181.

73. *Problemy Volgo-Kaspiia: Trudy noiabrskoi sessii 1933 goda* [Problems of the Volga-Caspian region : Proceedings of the November session of 1933] (L. : Izdatel'stvo Akademiia Nauk SSSR, 1934), 236.

decision playing out. A fishery could either be determined naturally by "chance" or be built and rationally determined by humans. Engineers called on fisheries scientists to help create a new, human-determined natural order with predictions. According to another engineer the task of fisheries scientists was clear: "to better understand fisheries in order to know what will happen to them under different scenarios for development projects."[74]

In Western Europe and North America, a similar but more gradual shift to prediction in fisheries science took place over the course of the 1920s and 1930s, without perhaps constant exhortations to build a new and better nature but with, as discussed above, growing belief that fisheries under human influence could be made more productive. In the United Kingdom William Hodgson used Hjort's method of establishing the age and classifying herring to estimate both the size of the upcoming catch, as well as the seasonal distribution of the catch. Hodgson's first prediction was made in 1927 and continued over the next three decades. According to Tim Smith, Hodgson's predictions were enabled by Hjort's discovery and desired by fishermen from the north of England and Scotland who came down to the south-eastern shores of East Anglia to fish for cod in October and November. Fishermen in these situations wanted to know not only how much fish could be expected, but when to start fishing to maximize yields. Other studies, such as those of Norwegians Oscar Sund and H. Gran sought to find correlations between fish abundance and environmental factors. Like Knipovich on the Caspian, they hypothesized that rivers carrying chemical and biological nutrients to the seas would provide these elements in greater abundance in years of high river water. Thus, they expected years of high precipitation to correspond to years of large class years of fish. The correlation they found was, in fact, the exact opposite of this and broke down after several years. Other attempts were made to link water temperature and other meteorological phenomena with fisheries abundance, though with little success. In the United States and in particular in California, whose Fish and Game Commission was the most active US institution in fisheries science prior to the late-1920s, the issue of overfishing overshadowed prediction as fishermen pressured the Commission and federal Bureau of Fisheries to take measures against declining yields.[75]

While the demands of the planned economy for concrete forecasts for planning purposes might have been unique to the Soviet Union, this was part of a wider movement by states and societies in major fish-producing countries of Europe to structure and rationalize their industries. The Norwegian Association of Fishermen was formed in 1926 to control exports and domestic trade through cartels and regulations. The Norwegian government was heavily involved in these efforts and assisted fishermen's organizations in establishing quotas and regulating the quantity of fish made available in different areas of the country for different

74. Ibid, 234.

75. Smith, *Scaling Fisheries*, p. 163-193. Smith, a fisheries biologist by training, treats prediction as an inherent and obvious goal of fisheries science. Even in his account, however, prediction is not mentioned until the late 1920s.

types of production and export.[76] In Germany, fishermen and fish traders formed limited liability cooperative organizations (*Betriebsgenossenschaften GmbH)* to pool resources around ports of trade of fish products.[77] In Denmark, which in the interwar period had a still unindustrialized fishing sector, the state played a central role in pooling resources, building a capital-intensive industrialized fishing industry and creating a fisheries council for regulation of the fishing sector with similar responsibilities to its Norwegian counterpart.[78] The problem of market fluctuations was further aggravated by the worldwide depression and was duly met by further state involvement in organization and regulation of the industry. Thus, while the contours of the Soviet economy made the need for predictions in fisheries science particularly salient, the impetus existed across "modernizing" fisheries industries and states of the interwar period. The Soviet experience was part of a general trend, unusual only for its suddenness.

Lynne Viola has argued that Stalinist planning was more akin to art than engineering. "It represented life as it *should* become, not as it was becoming."[79] Not that this was by design, of course, so when realities inevitably shaped up nothing like the plans, the recourse was to violence. Planning and reality were parts of the same process. Such a feedback loop was also present in environmental engineering and administration projects, making this a point at which the analytical frames of environmental history and socio-political history of the Soviet Union overlap in general terms and sometimes even in the concrete instruments and technologies of social and environmental control.[80] Fisheries scientists found that the drive to plan in the early 1930s extended farther—and deeper—than it ever had. Of course,

76. Pål Christensen and Abraham Hallenstvedt, *I kamp om havets verdier: Norges Fiskarlags historie* [In battle for the values of the sea: the history of the Norges Fiskarlag] (Trondheim: Norges Fiskarlag, 2005), chapters 1-2, Petter Holm, "The Dynamics of Institutionalization: Transformation Processes in Norwegian Fisheries" *Administrative Science Quarterly*, 40, 3 (1995): 398-422, and Petter Holm, "Kan torsken temmes? Moderniseringsprosesser i norsk fiskerinæring 1935-1995 [Can cod be tamed? Modernisation processes in Norwegian fisheries 1935-1995]," in E.O. Eriksen, ed., *Det nye Nord-Norge: Avhengighet og modernisering i nord* [The new Northern Norway: Dependence and modernization in the North], (Bergen: Fagbokforlaget, 1996), 109-132.

77. Hans Jurgen-Teuterberg, "The Industrialization of Seafood: German Deep-Sea Fishing and the Sale and Preservation of Fish, 1885-1930," p. 201.

78. Morten Karnoe Sondergaard, "The State and Formation of the Fishing Industry: Denmark in the Interwar Period," in Sven-Olof Olsson, ed., *Managing Crises and De-Globalization: Nordic Foreign Trade and Exchange, 1919-1939* (London: Routledge, 2010), p. 178-184.

79. Lynne Viola, "The Aesthetic of Stalinist Planning and the World of the Special Villages," *Kritika*, 4, 1 (2003): 128.

80. The history of Soviet fisheries monitoring and protection, for one, is littered with ideas such as fisheries reconnaissance missions (*razvedka*), passports for rivers and natural objects, statistical methods of correcting for overstatements of kolkhoz yields applied to fishing, and fishing quotas initially applied internationally as a geopolitical tool and later reshaped as a method of natural conservation. See Gregory Ferguson-Cradler, *Liberalism in Numbers Only: Science, Politics, and State Power in Global Postwar Fisheries Administration* (Ph.D. Dissertation, Princeton University, 2016), ch. 2. The nexus here is also suggested by James Scott's *Seeing Like a State*, a foundational work both for the "modernist" school of Soviet history and

exact prediction would always remain a utopian goal—as Knipovich had held. There were simply too many factors to be considered. Yet it had to be the goal. The outcomes as reality met plan were not so immediate or visible as in the "special villages" analyzed by Viola but no less real in the end, an example of the gradually unfolding environmental deterioration Rob Nixon has provocatively called "slow violence."[81] To take just one example, all commercially valuable species of Caspian sturgeon are now classified by the International Union for Conservation of Nature as "critically endangered."

The informational demands of the newly-instituted planned economy changed not so much the overarching ideology of fisheries science so much as they re-ordered and re-formulated the questions scientists sought to answer, which implied changes in concrete methodologies and practices. When the objectives of scientific study of nature shifted, so too did ways of knowing and representing natural objects and processes. This new mode of representation was neither unique to the Soviet Union nor the first five-year plan. As pressure was applied to fisheries scientists to provide predictions, they had a set of tools—models—that they could turn to and, like the sunspot cycle graphs, extend and re-purpose. So, too, were relevant techniques from foreign scientists adopted and adapted. The result was to change what it meant to know something about nature. As qualitative methods not producing predictions were increasingly attacked and pushed aside, prediction replaced contextualized understanding. And, as human fishing became more intense and fisheries scientists were increasingly called to help prepare plans, to study fish increasingly meant to study humans catching fish.

A number of prominent environmental historians have recently called for environmental history to engage more with theory and generalizations rather than retreat to ever more local and particular histories.[82] The prioritization of prediction and its corresponding mode of representation in Soviet fisheries science in the 1930s was both a contingent and structurally determined process in how it came to pass and the implications it had for the way fish as natural objects were conceptualized. Thus, thinking in terms of "modes of representation," could be a means to bridge the micro-macro gap, showing how local processes have been part of larger trends happening all over the world, but still sensitive to local contingency and

environmental historians that discusses "high modernist" attempts to bring legibility and order from afar to both natural and social worlds.

81. Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2013).

82. Sara Pritchard, "Joining Environmental History with Science and Technology Studies: Promises, Challenges and Contributions," in Dolly Jørgensen, Finn Arne Jørgensen, eds., *New Natures: Joining Environmental History with Science and Technology Studies* (Pittsburgh: University of Pittsburgh, 2013), 1-17, John McNeill, "Observations on the Nature and Culture of Environmental History," *History and Theory*, 42 (December 2003): 5-43, and Sverker Sorlin and Paul Warde, "The Problem of the Problem of Environmental History: A Re-reading of the Field," 12 (January 2007): 107-30.

detail.[83] Studying past and present practices of knowing nature, in connection with political economic constellations of order and power in different places and times, might reveal similarities and connections across time and space, another means of constructing global—though by no means necessarily universalizing—narratives of environmental history.[84] So too might it provide a framework of analysis and array of alternative possibilities for current environmental politics and policy.

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83. On this see Lorraine Daston, "Towards a History of Reason," in Marco Beretta, Karl Grandin, and Svante Lindqvist, eds., *Aurora Torealis: Studies in the History of Science and Ideas in Honor of Tore Frängsmyr*, (Sagamore Beach: Science History Publications, 2008): 165-176 who makes an argument for a similar sort of method to counter localism in the history of science.

84. For recent work that situates the history of a particular place within the wider sweep of global environmental history, see David Moon, *The Plow that Broke the Steppes: Agriculture and Environment on Russia's Grasslands, 1700-1914* (Oxford: Oxford University Press, 2014).