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# OCEAN SALMON RANCHING IN THE NORTH PACIFIC

Mark J. Fucile\*

## INTRODUCTION

Ocean salmon ranching is broadly defined as any artificial propagation system whereby hatchery-reared juvenile salmon are released into fresh water, grow to maturity in the open sea, and are recaptured in coastal waters as they begin the return to their spawning grounds.<sup>1, 2</sup> Although this definition technically em-

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1. NATIONAL RESEARCH COUNCIL COMMITTEE ON AQUACULTURE, *AQUACULTURE IN THE UNITED STATES* 35 (1978). To fully understand how ocean ranching operates, it is helpful to have a rudimentary knowledge of the life cycle of salmon.

When a female salmon reaches its native spawning grounds, it scoops out a nest in the gravel bottom and deposits eggs. Between 2,000 and 6,000 eggs are laid, depending on the size and species of the female. As the eggs drop into the nest, a male covers them with milt.

The fertilized eggs hatch in 45 to 55 days. The tiny salmon that emerges is called an alevin. It stays buried in the gravel for four to six weeks, nourished by a yolk sac attached to its belly. Then, once the sac has been consumed, the salmon wriggles from its nest to forage for food.

The fish spends the next several months in its parent stream . . . It is during this stage that the salmon is imprinted. In effect, it memorizes certain characteristics of the stream in which it was born. The imprinting is so strong that at the end of the fish's ocean migration . . . it will find its way back to this same stream to spawn.

The saltwater phase of the salmon's life lasts from 1½ to 5 years, again depending on species. The fish stays in the ocean, feeding at first on small invertebrates, then on larger prey, such as anchovies, herring, and shrimp, all the time gaining weight.

. . . [T]he mature salmon then reenters the mouth of its parent stream and battles back to its native spawning grounds, where its life cycle ends. The female lays her eggs, the male fertilizes them, and then both adults die. Dygert, *Ranching Ocean Salmon*, 24 *SEA FRONTIERS* 258-261 (1978).

2. In hatcheries, the early life cycle of the salmon is reproduced by artificial means. Generally about one to two per cent of previously released fish return to the hatchery, the rest falling victim to disease, natural or human predation, or other circumstances. These returnees form the broodstock for further releases. As the fish return, eggs are taken from the females and fertilized in buckets by milt removed

braces the traditional North American public hatchery programs designed to mitigate the damage caused to natural stocks by economic development,<sup>3</sup> the term is more appropriately reserved for a rapidly developing<sup>4</sup> Pacific mariculture industry which utilizes the open sea as a vast pasture to graze large numbers of artificially produced salmon while they grow to a marketable size.<sup>5</sup> Encompassed within this more limited meaning are the already extensive government-sponsored efforts found in Asia<sup>6</sup> and Canada<sup>7</sup> directed at producing salmon for capture principally in the coastal fisheries,<sup>8</sup> and more recent private ventures in the United States<sup>9</sup>

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from the males. The fertilized eggs are then placed in gravel trays to incubate. After hatching, they are usually kept in holding ponds until ready to venture into the natural environment. *See generally* J. LANNAN, NETARTS BAY CHUM SALMON HATCHERY: AN EXPERIMENT IN OCEAN RANCHING (Oregon State University Sea Grant College Program Pub. No. ORESU-H-75-001, November 1975).

3. For a history of public hatcheries on the Pacific Coast, *see generally* R. WAHLE & R. SMITH, A HISTORICAL AND DESCRIPTIVE ACCOUNT OF PACIFIC COAST ANADROMOUS SALMONID REARING FACILITIES AND A SUMMARY OF THEIR RELEASES BY REGION, 1960-76 (U.S. National Oceanic & Atmospheric Ad. Tech. Rep. NMFS SSRF-736, Sept. 1979). In the United States, the concept of public hatcheries is most often associated with facilities which are located upriver from the Pacific and are aimed at restoring or preserving salmon runs in areas where natural spawning habitat has been destroyed, such as the hatcheries placed in the Columbia River basin to compensate for habitat lost from dam construction. Although not centrally geared to the very economic objectives connoted by the term "mariculture", these programs must still be grouped under the umbrella of ocean ranching. Their releases and objectives are of a much more limited scope than those engaging in true mariculture, but traditional public hatcheries still add salmon to the ocean fisheries and contribute to the situation discussed *infra*.

4. Indeed, ocean salmon ranching in the Pacific has been described as being in "a period of exponential growth." U.N. FOOD & AGRICULTURE ORGANIZATION, REPORT OF THE FAO TECHNICAL CONFERENCE ON AQUACULTURE, KYOTO, JAPAN, 26 May-2 June 1976 24 (F.A.O. Fisheries Rep. No. 188, 1976). Another recent report concluded that "[i]t is conceivable that more salmon will be reproduced by artificial than by natural processes before the turn of the century . . ." W. McNEIL, ARTIFICIAL RECRUITMENT OF PINK AND CHUM SALMON IN JAPAN AND EASTERN U.S.S.R. 7 (U.S. National Marine Fisheries Service Northwest & Alaska Fisheries Center Processed Rep., January 1977).

5. The new mariculture ventures can be distinguished from older hatchery operations in a number of ways. First, in terms of objectives, mariculture operations are designed to yield positive economic returns to the providers of the resources, whether individual ranches in the case of the private sector or through the coastal fisheries in the case of government directed programs. *See* note 48 *infra*. Second, in production methods, mariculture hatcheries tend to be located near the sea coast, so as to avoid the very problems traditional public hatcheries were constructed to compensate for, *see* note 18 and accompanying text *infra*, and in the case of fixed site operations because the flesh quality of the mature fish deteriorates rapidly once the salmon reenter fresh water and commence spawning. J. LANNAN, *supra* note 2, at 7. Finally, in scope, the present and projected releases for mariculture purposes simply dwarf those released from traditional hatcheries. *See, e.g.*, note 59 and accompanying text *infra*.

6. *See* text accompanying note 35 *infra*.

7. *See* text accompanying note 60 *infra*.

8. Fishermen have historically employed a variety of techniques to capture salmon in coastal waters. Fixed or floating traps intercept returning salmon in known

geared toward harvesting returning salmon at fixed sites along the coast.<sup>10</sup> Such production methods are feasible because salmon are anadromous,<sup>11</sup> and possess the biological ability to imprint the characteristics of their release point and to return to this location upon the completion of their ocean migrations.<sup>12</sup>

The purpose of this comment is threefold. Section I will examine the development of ocean salmon ranching around the North Pacific Basin. Section II will explore the challenges that increased ocean ranching will present, and will analyze why existing international legal arrangements relating to salmon in the North Pacific are inadequate to cope with them. Section III will suggest a new legal framework to manage future ocean salmon ranching in the North Pacific.

## I. THE DEVELOPMENT OF OCEAN SALMON RANCHING IN THE NORTH PACIFIC BASIN

Ocean salmon ranching in its various forms is growing rapidly throughout the North Pacific Basin.<sup>13</sup> Indeed, it is conceivable that if current trends continue, more salmon will be introduced into the North Pacific by artificial production than by

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routes in rivers and channel them into holding chambers where they may be kept alive until ready for processing. R. BROWNING, FISHERIES OF THE NORTH PACIFIC 54 (rev. ed. 1980). Purse seines are a netting technique used by vessels of fifty feet or more whereby a large school of fish is encircled with a net, the net is closed when the fish are surrounded, and the catch is hauled aboard with heavy winches. A. NETBOY, SALMON 242 (1980). Gillnets are another netting technique, used by vessels about half the size of purse seiners. With this method, fishing is done in bays or estuaries by setting the nets, and then drifting with the current. *Id.* Trollers are boats which employ multiple hook and line polls in offshore areas. *Id.* at 243.

9. See text accompanying note 75 *infra*.

10. These facilities are usually located on coastal bays or streams for the reasons outlined in note 5 *supra*. The salmon are produced at either an on-site hatchery, or at an inland facility and later trucked to the release point. After growing to a suitable release size in freshwater rearing ponds, the fish are placed in saltwater pens at the release site for several weeks to biologically imprint the characteristics of the location. They are then released for the ocean phase of their existence, becoming common property and falling victim to a variety of natural and human predators. Upon their return to the release location, they are harvested in large traps. Eggs are removed from ripe females to supply the broodstock for future releases and then they are processed for market. See generally J. LANNAN, note 2 *supra*. It is estimated that a ranch will be economically viable if about two per cent of a particular release eventually returns to the release point. Dygert, note 1 *supra*, at 264.

11. Anadromous is a term used to refer to fish which originate in fresh water, spend part of their lives in the ocean, and return to fresh water to spawn. Salmon are the best known anadromous fish, but other common varieties such as steelhead trout, sturgeon, striped bass, and shad also possess this characteristic. D. FRY, ANADROMOUS FISHES OF CALIFORNIA 7 (1979).

12. See Hasler, Scholz, & Horrall, *Olfactory Imprinting and Homing in Salmon*, 66 AM. SCIENTIST 347 (1978).

13. See note 4 *supra*.

natural means before the year 2000.<sup>14</sup> It is, therefore, important to survey the historical background, present status, and projected growth of ocean salmon ranching in this region before embarking upon a discussion of the international legal implications of these developments.

### A. Historical Background

Salmon<sup>15</sup> were once in great natural abundance throughout the North Pacific Basin,<sup>16</sup> originating in streams from northern Honshu to northeast Siberia in Asia, and from northern California to Alaska in North America.<sup>17</sup> A number of factors, however, combined to severely diminish natural stocks on both sides of the Pacific.<sup>18</sup> In Asia, the principal causes for the decline were overfishing,<sup>19</sup> the destruction of spawning habitat by pollution,<sup>20</sup> and unfavorable land use policies.<sup>21</sup> In North America many of these same elements were present, with initial commercial overfishing,<sup>22</sup> logging practices,<sup>23</sup> irrigation projects,<sup>24</sup> and hydro-

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14. W. MCNEIL, note 4 *supra*, at 7.

15. The principal varieties of Pacific salmon are pink (*Oncorhynchus gorbusha*), chum (*O. keta*), coho (*O. kisutch*), sockeye (*O. nerka*), chinook (*O. tshawytscha*), and cherry (*O. masu*). R. WAHLE & R. SMITH, *supra* note 3, at 1-2.

16. Indeed, native populations on both sides of the Pacific relied on salmon as the staple of their diet. See A. NETBOY, note 8 *supra*, at 275; and C. SMITH, SALMON FISHERS OF THE COLUMBIA 5 (1979). In the Pacific Northwest, for example, a native population of 50,000 caught an estimated 18 million pounds of salmon annually in the Columbia River before the coming of white settlers. *Id.*

17. For maps and detailed data on the distribution of the various species of Pacific salmon, see generally J. HART, PACIFIC FISHES OF CANADA 108-126 (Fisheries Research Board of Canada Bulletin No. 180, 1973).

18. R. BROWNING, *supra* note 8, at 46. In fact, landings of naturally spawned salmon peaked many years ago in most areas. In California, for example, landings of naturally spawned salmon reached a high in 1882. A. NETBOY, *supra* note 8, at 212. Even the bountiful waters of Alaska yielded the record natural catch in 1929. *Id.* at 260.

19. A. NETBOY, *supra* note 8, at 282-283.

20. Pollution poses an acute problem in Japan. A high level of industrial activity in a comparatively small area, a lack of adequate municipal waste treatment facilities, and agricultural run-off have all contributed to a major water quality problem in Japan. See M. MOTTET, FACTORS LEADING TO THE SUCCESS OF JAPANESE AQUACULTURE WITH AN EMPHASIS ON NORTHERN JAPAN 27-28 (Washington Dept. of Fisheries Tech. Rep. No. 52, 1980).

21. Deforestation, industrial dumping, dam construction, and the destruction of habitat to make way for new economic developments have had a negative impact throughout the great salmon producing areas of the Soviet Far East. A. NETBOY, *supra* note 8, at 284.

22. See e.g., note 18 *supra*.

23. In many heavily forested areas, such as the Pacific Northwest, a once common practice was to transport logs to the mills by water. Timber companies constructed many log dams on salmon streams to provide holding ponds for stored logs and to build a supply of water to move the timber. Yet, useful as these dams were to the loggers, they created impassable barriers for salmon ascending the streams to spawn. Moreover, even after water transportation of logs was replaced by more eco-

electric dams<sup>25</sup> all seriously harming natural salmon stocks.

Numerous efforts have been made over the past one hundred years to correct the damage caused by overfishing and the destruction of spawning habitat. To deal with overfishing, many jurisdictions implemented laws limiting the equipment fishermen could employ and restricting the time periods that salmon could be pursued.<sup>26</sup> To compensate for the destruction of spawning habitat, public hatcheries were introduced soon after the decline in naturally produced stocks was perceived.<sup>27</sup> Yet, because hatchery technology remained on a very unsophisticated level until fairly recently, these early facilities were largely ineffective.<sup>28</sup> In the

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nomical means of conveyance, many of the abandoned log dams remained to block future generations of fish from their traditional spawning grounds. A. NETBOY, *supra* note 8, at 244.

24. Irrigation projects bedevil salmon principally by blocking river migration with water storage dams and by leading straying salmon to their death in unscreened irrigation ditches and canals. In California, for example, the state Fish & Game Department estimated in 1929, and thus even before the mammoth Central Valley Project was begun in the 1930s, that less than ten per cent of original spawning grounds in the entire Sacramento-San Joaquin River system remained intact due to irrigation developments. A. NETBOY, *supra* note 8, at 215.

25. Hydroelectric dams have caused extremely severe damage to salmon runs on the Columbia River, which drains much of Oregon, Washington, Idaho, and parts of British Columbia. See generally E. CHANEY, A QUESTION OF BALANCE (Pacific Northwest Regional Commission Summary Report, November 1978). Since 1933, when the Rock Island Dam was completed near Wenatchee, Washington, 11 more dams have been built on the main stem of the Columbia and 25 additional dams lie on its principal tributaries. PACIFIC NORTHWEST REGIONAL COMMISSION, COLUMBIA BASIN SALMON & STEELHEAD ANALYSIS 60-61 (1976). Although these dams have provided relatively inexpensive electric power for economic development in the Columbia Basin, high mortality rates at dam passages and loss of habitat by the creation of reservoirs have decimated salmon runs in what was once one of the world's premier salmon rivers. E. CHANEY, *supra*, at 1. Indeed, even though all main-stem dams below Chief Joseph Dam on the Columbia and Hell's Canyon Dam on the Snake have fish passage facilities, the barriers which these projects pose are so difficult for migrating fish to surmount that researchers believe that some dams kill up to 15 per cent of all adult salmon attempting to pass. *Id.* at 5. So serious is the decline in the Columbia that the U.S. Government is evaluating whether salmon there should be placed on the endangered species list. See Bodi, *Protecting Columbia River Salmon Under the Endangered Species Act*, 10 ENV'T'L L. 349 (1980).

26. For a critique of these measures, see generally J. CRUTCHFIELD & G. PONTECORVO, THE PACIFIC SALMON FISHERIES (1969).

27. The first salmon hatchery on the Pacific Coast of North America was built in 1872 on the McCloud River in northern California by the U.S. Fish Commission. Subsequently, state and provincial hatcheries were established in California, Oregon, Washington, and British Columbia. The Japanese also ventured into salmon culture during this period, constructing their first hatchery on the Ishikari River on Hokkaido in 1889. A. NETBOY, *supra* note 8, 46-47.

28. This ineffectiveness arose from a variety of sources. First, salmon were released at too young an age, and were extremely susceptible to disease and predation. C. SMITH, *supra* note 16, at 79. Second, hatcheries proved to be veritable breeding grounds for disease, even to the extent that tuberculosis was found among the salmon at Bonneville hatchery in Oregon in 1952. *Id.* Third, diet was very inadequate, with one author recalling:

early 1960s, however, hatchery methods improved significantly<sup>29</sup> and artificially propagated salmon became an important fisheries development tool.<sup>30</sup> In recent years, spurred by increasing salmon prices<sup>31</sup> and continually declining natural runs,<sup>32</sup> these modern hatchery techniques laid the foundation for the creation of an extensive ocean salmon ranching industry throughout the North Pacific Basin.<sup>33</sup>

## B. Present Status and Projected Growth

Currently, the policies governing the prodigious growth of ocean ranching<sup>34</sup> vary greatly among the nations bordering the North Pacific, and are in a considerable state of flux.

1. *Japan*. Ocean salmon ranching in Japan is considered analogous to cultivating an agricultural crop,<sup>35</sup> and is but one component in a huge national aquaculture industry which includes many species of marine life raised for food.<sup>36, 37</sup> Since

[i]f you had visited a Pacific Northwest hatchery as late as the early 1950s you would have seen a kind of butcher shop on the premises. The diet fed the fish consisted largely of ground-up horse meat, liver, fish cannery and packing house scrap, condemned pork and beef, tripe, hearts, etc. A. NETBOY, *supra* note 8, at 48.

29. Among the principal innovations were: (a) the development of disease-free high quality food in pellet form; (b) the construction of automated, antiseptic hatcheries; and (c) the significant improvement in water quality. A. NETBOY, *supra* note 8, at 48.

30. See notes 34-118 and accompanying text *infra*.

31. The index of ex vessel salmon prices in the United States, for example, rose from 100 in its base year of 1967 to 615.4 in 1979. U.S. DEPT. OF COMMERCE, FISHERIES OF THE UNITED STATES, 1980 79 (1981).

32. See note 18 *supra*.

33. See note 30 *supra*.

34. See note 4 *supra*.

35. In fact, the domestic salmon industry in Japan relies on a population of fish which are 97 per cent artificially produced. A. NETBOY, *supra* note 8, at 50. This represents a much higher proportion of artificially spawned to natural stocks than is found in any western country. *Id.* at 291.

36. Among the many other species cultivated are prawns, lobsters, crabs, eels, trout, and carp. *Id.* at 291.

37. See generally M. MOTTETT, note 20 *supra*.

There are many factors which have contributed to the growth of this industry including: (1) the unusual demand for quality fisheries products by the Japanese; (2) a long history of native inventiveness in the fisheries field; (3) government support of research, education, financing, and insurance; (4) fishery cooperative organizations which aid the culturists in many of the business aspects of their operations; and (5) institutional factors which reduce some of the problems associated with common property resource management. All of these taken together have provided a climate where increased investment in the industry have been rewarded with commensurate profits. *Id.* at 1.

Another factor which has lead to increased development of the domestic salmon in-

1962, artificial propagation<sup>38</sup> of chum and pink salmon<sup>39</sup> has been part of a national fisheries development program under the administrative jurisdiction of the Fishery Agency of Japan.<sup>40</sup> Hatchery operations, which are concentrated on Hokkaido and northern Honshu,<sup>41</sup> are conducted both by the Fishery Agency of Japan for capture by coastal fishermen<sup>42</sup> and by private cooperatives<sup>43</sup> which receive most<sup>44</sup> of their income from the sale of fish that return to the release sites.<sup>45</sup> Ocean salmon ranching has become a major industry in Japan,<sup>46</sup> having grown at an average annual rate of 7.3 per cent over the past two decades.<sup>47</sup> Moreover, as the

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dustry in particular has been the increasing restrictions placed on the Japanese high seas salmon fleet by international agreements. *See generally Id.* at 6-7.

38. The Japanese consider artificial propagation to be a much more efficient way to produce fish than by natural spawning, and, therefore, preserve very few rivers for natural spawning. A. NETBOY, *supra* note 8, at 291.

39. Approximately 93 per cent of Japan's salmon catch is composed of chum, with pink making up another 6 per cent and cherry yielding 1 per cent. Chum are produced in greatest numbers because they command the highest market price. T. Kobayashi, Salmon Propagation in Japan 4 (1978?) (paper on file at the UCLA PACIFIC BASIN L.J.).

40. A NETBOY, *supra* note 8, at 290. In fact, a report written by the Japan Fisheries Association in 1975 observed that since 1962

'fish farming has been carried out as a work commissioned by the national government. This was an experiment to increased fishery resources on a gigantic scale, and has attracted the attention of both the Japanese and interested foreigners.' *Id.*

41. There are about 200 rivers containing salmon in Hokkaido, and 123 of these are used for salmon culture. T. Kobayashi, *supra* note 39, at 9. These areas support 37 national, 3 prefectural, and 62 private hatcheries. *Id.* at 11. Hokkaido hatcheries produced 750 million chum and 50 million pink in 1976. W. MCNEIL, *supra* note 4, at 8. Honshu utilizes 129 of its 150 salmon rivers for culture activities. T. Kobayashi, *supra* note 39, at 9. Honshu hatcheries, all of which are privately owned, *Id.*, released 250 million chum in 1976. W. MCNEIL, *supra* note 4, at 8.

42. Government hatcheries have traditionally produced the bulk of Japanese releases. In recent years, however, construction of private hatcheries has been increasing. T. Kobayashi, *supra* note 39, at 11.

43. Private cooperatives occupy an important role in Japanese aquaculture in general. They have aided many fishermen in moving into mariculture by providing much needed business acumen and logistical support to small scale culture operations. *See generally* M. MOTTET, *supra* note 20, at 18.

44. Some subsidies have been granted by the central and prefectural governments. T. Kobayashi, *supra* note 39, at 12.

45. A. NETBOY, *supra* note 8, at 291. Government control mechanisms over the private hatcheries include: (a) federal government ownership of all eggs; and (b) releases by private hatcheries must be in accordance with plans approved by the central government. *Id.*

46. NATIONAL RESEARCH COUNCIL COMMITTEE ON AQUACULTURE, *supra* note 1, at 10. In fact, aquaculture as a whole has achieved a huge scale in Japan. In 1976, for example, the value of Japanese aquaculture products totaled \$1.9 billion, which was a world record. M. MOTTET, *supra* note 20, at 1.

47. NATIONAL RESEARCH COUNCIL COMMITTEE ON AQUACULTURE, *supra* note 1, at 10. This figure is in terms of fish released from hatcheries. *Id.* As an indication of the scope of the Japanese operations, in 1976 1.05 billion chum and pink salmon were released by Japanese hatcheries for future harvest. W. MCNEIL, *supra* note 4, at



economic rate of return for hatchery produced salmon is high,<sup>48</sup> the outlook is for further significant growth in the artificial propagation of salmon in Japan.<sup>49</sup>

2. *The Soviet Union.* The Soviet Union, which ranches salmon as a state business,<sup>50</sup> produces artificially reared salmon on a level surpassed only by the Japanese.<sup>51</sup> The Soviet program, which concentrates on chum and pink salmon,<sup>52</sup> consists of sixteen hatcheries on Sakhalin, two in the Kuriles, two on the Kamchatka Peninsula, and four in the Amur River basin.<sup>53</sup> Stocks are harvested both along the coast<sup>54</sup> and upon their return to the hatcheries.<sup>55</sup> As in Japan, ocean salmon ranching has become an important economic activity in the eastern Soviet Union,<sup>56</sup> with its 7.3 per cent annual growth rate matching the Japanese.<sup>57</sup> Mirroring the outlook in Japan, continued rapid growth is expected in the Soviet Union.<sup>58</sup> In fact, combined Japanese and Soviet releases are projected to grow to approximately four billion by 1986,

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8. Moreover, a total of 17 million returning salmon that year were attributed to previous hatchery releases. M. MOTTET, *supra* note 20, at 50.

48. Indeed,

[a]lthough the rate of return of salmon fingerlings usually lies between 1 and 2 per cent, economically, the 'rate of return' is much higher. The annual investment of ¥1 billion . . . results in ¥50 billion . . . of landings. 38 MARINE FISHERIES REV. 35 (June 1976).

49. W. McNEIL, *supra* note 4, at 7.

50. *Should California Permit Commercial Salmon Hatcheries for Profit? Hearings on A.B. 1458 Before the Assembly committee on Water, Parks, & Wildlife and the Senate Committee on Natural Resources*, 1979-1980 Reg. Sess. [hereafter referred to as *Should California Permit Commercial Salmon Hatcheries for Profit?*], at 9 (testimony of Dr. William J. McNeil).

51. The Japanese, as pointed out previously, have the most extensive aquaculture industry in the world. Releases of artificially propagated salmon totalled 1.05 billion in 1976. W. McNEIL, *supra* note 4, at 8.

52. The Soviets released 500 million chum and 400 million pink salmon in 1976. *Id.* Additionally, they are considering the possibility of raising coho, chinook, and cherry salmon. A. NETBOY, *supra* note 8, at 284-285.

53. *Id.* at 285.

54. Dr. McNeil, formerly of the National Marine Fisheries Service, reports that "unpublished information supplied . . . by Soviet workers on coastal catch and total run of chum salmon returning to Sakhalin . . . show that an average of 81.7% of the total returning run was caught in Soviet coastal fisheries." W. McNEIL, *supra* note 4, at 5.

55. *Should California Permit Commercial Salmon Hatcheries For Profit?*, *supra* note 50, at 9 (testimony of Dr. William J. McNeil).

56. In 1976, for example, the Soviets released 900 million salmon. W. McNEIL, *supra* note 4, at 8. This was roughly equal in scope to hatchery operations in Japan, where 1.05 billion chum and pink salmon were released that year. *Id.* This figure, however, far outdistanced the 278 million salmon released into the Pacific by all North American hatcheries in 1976. R. WAHLE & R. SMITH, *supra* note 3, at 3.

57. NATIONAL RESEARCH COUNCIL COMMITTEE ON AQUACULTURE, *supra* note 1, at 10.

58. W. McNEIL, *supra* note 4, at 7.

and annual harvests may reach eighty million by 1990.<sup>59</sup>

3. *Canada*. For many years, Canada maintained only a very modest hatchery program in British Columbia.<sup>60</sup> Yet, despite a generally better record in preserving salmon spawning habitat than other areas,<sup>61</sup> harvests of this important resource<sup>62</sup> in recent times have never matched the levels common early in this century.<sup>63</sup> To correct this decline, in 1975 the Canadian federal government and the Province of British Columbia announced a joint Salmonid Enhancement Program.<sup>64</sup> This ambitious effort, which is expected to cost \$700 million<sup>65</sup> (Canadian) over the life of the project,<sup>66</sup> includes both the construction of propagation fa-

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59. *Id.* at 6. This figure assumes a two percent marine survival rate. The significance of these projections can be grasped by considering that

[t]he total Alaska harvest of five species of salmon has averaged about 40 million fish over the last 10 years, while the total North America (Canada plus U.S.) harvest has averaged about 80 million fish. Thus, the hatchery program in Asia could approximately match all Alaska salmon fisheries within four years and all North American salmon fisheries within 14 years, assuming that production remains static in the eastern Pacific. However, artificial recruitment of salmon into the eastern Pacific is also expected to expand. *Id.*

60. The first hatchery in British Columbia was constructed by the Provincial government in 1884. From that date until the mid-1930s additional hatcheries were established, and over 2 billion sockeye salmon were released from these facilities from 1885 through 1927. Nonetheless, the entire Provincial hatchery program was abandoned during the Great Depression. It was not until 1967 that hatchery operations were begun again in British Columbia, when the Canadian Fisheries and Marine Services built the Big Qualicum Hatchery on Vancouver Island. From 1967 through 1976, five additional hatcheries were established, but the total number of salmon released during this period only totalled a very modest 16.2 million chinook and coho. See R. WAHLE & R. SMITH, *supra* note 3, at 6-9.

61. The size of the Province relative to both population and manufacturing outside the Vancouver metropolitan area are the chief factors in this relative success. A. NETBOY, *supra* note 8, at 254.

62. Salmon have always been the most important catch from an economic standpoint in British Columbia. Asti-Rose, *Net Profits: The New BC Gold Rush*, 51 CANADIAN BUSINESS 62 (March 1979). In 1976, for example, salmon landed in British Columbia comprised 63.3 per cent of the total product value of the fisheries there. Kabata, *Fisheries of the Pacific Region*, in FOOD FROM WATER—FISHERIES & AQUACULTURE 11 (Canadian Dept. of Fisheries & Environment Misc. Special Pub. No. 39, 1978).

63. The annual harvest of salmon in British Columbia has averaged about 20 million fish, or 145 million pounds, in recent times. By contrast, catches early in the century averaged 40 to 45 million fish, or 300 to 360 million pounds, per year. Groot, *Canada's West Coast Salmonid Enhancement Program—Research and Development*, in FOOD FROM WATER—FISHERIES & AQUACULTURE 16 (Canadian Dept. of Fisheries & Environment Misc. Special Pub. No. 39, 1978).

64. *Id.*

65. Expressed in terms of 1976 Canadian dollars.

66. Groot, *supra* note 63, at 16. The Salmonid Enhancement Program is to be undertaken in two phases.

For Phase 1, covering years 1 to 5 (1977-82), [the Federal] Cabinet has committed an investment of \$150 million. This is expected to increase

cilities and the restoration of habitat.<sup>67, 68</sup> The Canadians hope to restore salmon production to its historic levels in fifteen years, which could add a total of twenty-five million fish to the coastal harvest annually.<sup>69</sup>

4. *The United States.* a. *Public Sector.* Hatchery operations in the United States are conducted on both a public and private basis. In the public sector, federal and state fisheries agencies<sup>70</sup> have been releasing hatchery salmon along the Pacific coast since 1872.<sup>71</sup> In contrast to the large scale mariculture activities of other countries, the principal aim of public hatchery programs in the United States has been simply to compensate for the destruction of habitat by economic development.<sup>72</sup> Thus, releases by public hatcheries in the United States, although certainly playing an important role in the salmon fishery there,<sup>73</sup> are far smaller in scope than the ambitious efforts being mounted in Asia.<sup>74</sup>

b. *Private Sector.* A development which in the future could substantially increase the scope of artificial propagation of salmon in the United States, however, is the advent of private ocean

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production by about 50 million pounds per year. A further commitment for Phase 2, for years 6 to 15, can only be expected if the program demonstrates substantial progress during Phase 1. *Id.*

67. A. NETBOY, *supra* note 8, at 256.

68. Private ocean ranching was not incorporated into the Canadian enhancement efforts. The Canadian position is that the introduction of private ocean ranching at this time would only serve to complicate the efficient management of an already complex fishery. Letter from R.N. Palmer, Assistant Director for Policy, Planning & Program Development of the Pacific Region Office of the Canadian Dept. of Fisheries & Oceans, to the author (April 3, 1981) [on file at the UCLA PACIFIC BASIN L.J.].

69. Groot, *supra* note 63, at 16.

70. Public hatchery operations in the United States are conducted by the U.S. Fish & Wildlife Service, the Alaska Dept. of Fish & Game, the California Dept. of Fish & Game, the Idaho Dept. of Fish & Game, the Oregon Dept. of Fish & Wildlife, the Washington Dept. of Fisheries, and the Washington Dept. of Game. For a very detailed summary of the hatchery operations conducted in each state, see R. WAHLE & R. SMITH, note 3 *supra*.

71. See note 27 *supra*.

72. See, e.g., the Pacific Northwest Electric Power Planning and Conservation Act of 1980, Pub. L. No. 96-501, 94 Stat. 2697 (1980); and the Salmon and Steelhead Conservation and Enhancement Act of 1980, Pub. L. No. 96-561, 94 Stat. 3275 (1980). See generally Blumm, *Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System*, 11 ENV'T L. 211 (1981); and Blumm & Johnson, *Promising a Process for Parity: The Pacific Northwest Electric Power Planning and Conservation Act and Anadromous Fish Protection*, 11 ENV'T L. 497 (1981).

73. In 1976, for example, federal and state hatcheries on the Pacific Coast of the United States released approximately 273 million salmon. R. WAHLE & R. SMITH, *supra* note 3, at 3, 9.

74. By way of contrast, in 1976 Japanese releases totalled 1.05 billion and the Soviets released 1 billion. W. McNEIL, *supra* note 4, at 8.

ranching.<sup>75</sup> Operating from fixed release/recapture sites along the coast,<sup>76</sup> private ocean salmon ranching is just emerging from the experimental stage in the United States.<sup>77</sup> Nevertheless, private release/recapture facilities exist, or are being planned, in every Pacific state.<sup>78</sup> Although significantly affected by a variety of federal policies,<sup>79</sup> the primary regulatory force controlling the growth of ocean salmon ranching has been state government.

i. *California*. California became the first state to authorize a private ocean ranch, when in 1968 special legislation was enacted allowing a single demonstration facility.<sup>80</sup> Despite this early lead, the development of private ocean ranching through the 1970s was slow<sup>81</sup> and remained on an experimental basis.<sup>82</sup> In 1980, a bill<sup>83</sup>

75. For the revolutionary plans of the salmon ranchers, see note 98 *infra*.

76. For a description of the methods employed, see note 10 *supra*.

77. The start-up phase in an ocean ranching operation of this kind can be quite lengthy. Indeed, it has been estimated that it may take up to 8 to 10 years before a ranch becomes profitable. *Should California Permit Commercial Salmon Hatcheries for Profit?*, *supra* note 50, at 45 (testimony of Ernest Lewis).

78. Although Idaho has several public hatcheries, private salmon ranches are not feasible there for the reasons outlined in note 5 *supra*. For a discussion covering Idaho's role in Pacific Northwest salmon fisheries, see generally Comment, *Odd Man Out: Idaho's Bid For a Fair Share of Columbia River Upriver Anadromous Fish Stocks*, 10 ENV'T'L L. 389 (1980).

79. For a discussion of the many federal regulations which have an impact on private ocean salmon ranching, see D. HORNSTEIN, SALMON RANCHING IN OREGON: STATE AND FEDERAL REGULATIONS (Oregon State University Sea Grant Special Rep. 573, January 1980). Additionally, in 1980, Congress approved the National Aquaculture Act, 16 U.S.C.S. § 2801 et seq. (supp. 1981), which calls for the formation of a national aquaculture policy, expresses the sentiment that increased aquaculture must come primarily from the private sector, and provides funding for research into aquaculture matters. Ocean ranching operations are specifically included within the Act, 16 U.S.C.S. § 2802 (supp. 1981).

80. 1968 Cal. Stats., ch. 202, added CAL. FISH & GAME CODE §§ 6550-6555. The principal features of this legislation included: (a) a hearings process before the Fish & Game Commission prior to issuing the permit; (b) that all fish released into the wild become property of the State while in public waters and could be taken by sport or commercial fishermen; (c) continuing supervision of operations by the Commission and the Department of Fish & Game to determine the effect on natural salmon runs and assure healthy hatchery conditions; and (d) that the permit was on an experimental basis, limited to Waddell Creek in Santa Cruz County, and was to expire with the Act in 1972. Subsequently, regulations embodying the above were adopted by the Fish & Game Commission, CAL. ADMIN. CODE, TITLE 14, § 169 (1969), and a permit was granted to Pacific Marine Enterprises. *California Fish & Game Commission, Minutes of Meeting of January 10, 1969*, at 5.

81. Early operations at the Waddell Creek facility appeared quite promising. Fish released through 1971 included 40,000 chinook and 196,000 coho. Returns in fall 1971 of three year old coho exceeded 4000, for a rate of return of better than two per cent. California Fish & Game Commission, Report to the Legislature on Commercial Anadromous Fish Farming on Waddell Creek, Santa Cruz County (January 1972) [on file at the UCLA PACIFIC BASIN L.J.]. However, this operation and a site in Mendocino County were subsequently abandoned. (See note 82 *infra*.) Since 1976, SilverKing Oceanic Farms has reared fish to release size in ponds in the Salinas Val-

which would have allowed extensive private ocean ranching was defeated in the California Legislature.<sup>84</sup> Thus, California law still only permits the operation of one pilot project, located in Santa Cruz County.<sup>85</sup>

ii. *Oregon.* Oregon has permitted private ocean ranching since 1971, when chum salmon hatcheries were approved.<sup>86</sup> Sub-

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ley. When initial rearing is completed, the salmon are trucked to Davenport Landing Creek for release. SilverKing has released a total of 1,590,000 chinook and coho at this location from 1977 through 1980. Returns here have been far below expectations, apparently due to a faulty design in the recapture facilities. Currently, SilverKing continues to release salmon, to modify the recapture equipment, and to conduct research aimed at improving marine survival. California Fish & Game Commission, Report to the Legislature on Commercial Anadromous Fish Farming at Davenport Landing Creek, Santa Cruz County (August 22, 1980) [on file at the UCLA PACIFIC BASIN L.J.].

82. In 1970, 1970 Cal. Stats., ch. 136, extended the life of 1968 Cal. Stats., ch. 202, until 1975. In 1973, 1973 Cal. Stats., ch. 398, added CAL. FISH & GAME CODE §§ 6570-6576. This legislation was virtually identical to the 1968 law, except it authorized the experimental facility to be located on Elk Creek in Mendocino County and provided an expiration date of January 1, 1981. Subsequently, regulations governing this site were approved by the Fish & Game Commission, CAL. ADMIN. CODE, TITLE 14, § 169.1 (1974), and a permit was granted to SilverKing Oceanic Farms (which was previously known as Pacific Marine Enterprises). *California Fish & Games Commission, Minutes of Meeting of May 3, 1974*, at 29. In 1975, the authority of CAL. FISH & GAME CODE §§ 6550-6555 (as amended) expired by its own terms. (This article was officially repealed by 1979 Cal. Stats., ch. 373, § 101.) In 1976, 1976 Cal. Stats., ch. 367, amended 1973 Cal. Stats., ch. 398, to include a facility at Davenport Landing Creek in Santa Cruz County. Subsequently, regulations governing the Davenport Landing Creek site were approved by the Fish & Game Commission, CAL. ADMIN. CODE, TITLE 14, § 169 (1977), regulations relating to abandoned sites at Waddell Creek and Elk Creek were repealed, and a permit for Davenport Landing Creek was granted to SilverKing Oceanic Farms. *California Fish & Game Commission, Minutes of Meeting of January 14, 1977*, at 11. In 1979, 1979 Cal. Stats., ch. 793, limited salmon ranching in California to the Davenport Landing Creek site and extended the life of the article until January 1, 1986.

83. A.B. 1458.

84. A.B. 1458 was introduced in 1979 and was ultimately defeated in the Assembly by a vote of 50 to 20 on January 29, 1980. Assembly Semifinal History, January 30, 1980, at 638. Principal opposition came from fishermen and environmentalists. Johnson, *Aquaculture: Big Business Goes Fishing*, OREGON MAGAZINE, March 1981, at 43. For the concerns raised by these groups, see note 93 *infra* and *Should California Permit Commercial Salmon Hatcheries For Profit?*, note 50 *supra*.

85. All current law on salmon ranching is embodied in CAL. FISH & GAME CODE §§ 6570-6578 (Deering; Supp. 1980) and CAL. ADMIN. CODE, TITLE 14, § 169 (1981).

86. The principal features of Oregon's current private ocean ranching statute, OR. REV. STAT. §§ 508.700-508.745, were embodied in 1971 Or. Laws, ch. 203. The main elements of the present law include: (a) the issuance of permits for the release of chinook, chum, and pink salmon by the Fish & Wildlife Commission; (b) a hearings process prior to issuing a permit to insure that ecological damage will not result; (c) continuing supervision of operations by the Commission and the Department of Fish & Wildlife to determine the effect of releases on natural runs and to maintain healthy hatchery conditions; and (d) fish released into the wild become property of the State while in public waters and can be taken by sport and commercial fishermen. Additional regulations are embodied in OR. ADMIN. RULES §§ 635-40-005-635-40-

sequent legislative sessions have expanded the basic statute to also allow the ranching of chinook,<sup>87</sup> coho,<sup>88</sup> and pink<sup>89</sup> salmon. Thus far, the Oregon Fish & Wildlife Commission has approved twenty-two hatchery permits for fourteen separate sites along the Oregon coast, with a total authorized release of nearly 190 million fish annually.<sup>90</sup> Releases to date, however, have been substantially below the authorized release figure,<sup>91</sup> due principally to an acute shortage of eggs needed for broodstock.<sup>92</sup> The development of ocean ranching in Oregon has not been without controversy,<sup>93</sup>

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185 (1981). These administrative provisions deal primarily with the purchase of salmon eggs, the areas closed to release/recapture sites, and the processing of permit applications. Finally, salmon ranchers face a host of local, state, and federal regulations dealing with everything from building permits to food marketing statutes. For a comprehensive discussion of the various regulatory codes the prospective rancher must satisfy, see D. HORNSTEIN, note 79 *supra*.

87. 1973 Or. Laws, ch. 356.

88. *Id.*

89. 1979 Or. Laws, ch. 556.

90. D. HORNSTEIN, *supra* note 79, at 8. To give some perspective on the size of the release contemplated by private ranchers, their authorized release figure is approximately two and one half times the number released from public hatcheries in the state. *Id.*

91. Releases from all private operators from 1972 through 1980 totaled nearly 57 million. Oregon Dept. of Fish & Wildlife report [on file at the UCLA PACIFIC BASIN L.J.]. The greatest releases occurred in 1979 and 1980, when 18.4 million and 16.5 million fish, respectively, were planted. Thus far, returns to the ranches, which consider themselves to be in the research and development stage, have not been as high as expected. The principal reasons advanced to explain this situation are: (a) with the current shortage of eggs, ranchers have been forced to continually procure eggs from a variety of sources rather than adapting a particular stock over a number of generations to their individual sites; and (b) the ranchers have been experimenting with a so-called "zero-age smolt", which is a coho reared in warm water and fed an enriched diet to greatly reduce the typical one year period that naturally spawned fish spend growing in freshwater before going to sea. The results in terms of both returns and size have so far been disappointing. Johnson, *supra* note 84, at 46.

92. Oregon Dept. of Fish & Wildlife, Information on Private Salmon Hatcheries (undated) [on file at the UCLA PACIFIC BASIN L.J.] at 2. The Oregon Dept. of Fish & Wildlife has only been able to supply seed stock to a portion of the existing permittees from its own surplus supply. Most of the chum permit holders have not received any eggs. *Id.* Ranchers are venturing as far as the Soviet Union and Japan in search of eggs for broodstock. Himsworth, *Impact on Wild Salmon Runs By Oregon's Ranching Industry*, AQUACULTURE, January/February 1981, at 13.

93. The principal opponents of private salmon ranching are fishermen and environmental groups. Fishermen chiefly fear that salmon ranching from fixed sites will prove to be a more cost effective method of harvesting salmon. See, e.g., *Should California Permit Commercial Salmon Hatcheries For Profit?*, *supra* note 50, at 90 (testimony of Robert Hudson). Environmentalists make two major points in opposition. First, they fear that because ranchers have been forced to buy eggs from distant sources, large numbers of fish will stray from their release point upon their return and interbreed with wild stocks in other streams. This, they assert, will cause the natural fish to be less hardy. See Himsworth, *supra* note 92, at 13-14. However, no conclusive proof for these propositions exists, and the proponents of salmon ranching strenuously contest these claims. *Id.* Second, the environmentalists argue that the capacity of estuarine and marine waters to support the releases of fish are already in

<sup>94</sup> and the Oregon Department of Fish & Wildlife has instituted a moratorium on the processing of new permits through 1985 while it undertakes a review of the new industry's impact over the past decade.<sup>95</sup> Nevertheless, private salmon ranchers, who manage operations ranging from relatively modest facilities<sup>96</sup> to multi-million dollar investments by major corporations,<sup>97</sup> remain very optimistic about the potential for ocean ranching to grow into a major Oregon industry.<sup>98</sup>

iii. *Washington*. Washington does not currently permit private ocean ranching within its jurisdiction.<sup>99</sup> A bill<sup>100</sup> which

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grave danger of being overtaxed. *Id.* at 14-16. Proponents, while agreeing that the ocean's resources are finite, argue that this capacity has not been reached yet. *Id.* at 16. Once again, no determinative scientific information exists on this point. *Id.*

<sup>94</sup> Many of the concerns discussed in note 93 *supra* surfaced in connection with a hatchery application by Crown Zellerbach Corp. for Tillamook Bay. After vigorously opposing the permit at the mandatory public hearing, the Federation of Independent Seafood Harvesters, the All-Coast Fishermen's Marketing Association, and the Oregon Environmental Council launched a judicial challenge when the Oregon Fish & Wildlife Commission decided to issue the permit. The plaintiffs argued that the Fish & Wildlife Commission had erred in not requiring Crown Zellerbach to prove before the permit was issued that their releases would not damage the ecology of Tillamook Bay. The Oregon Court of Appeals agreed, and review is pending before the Oregon Supreme Court. *Federation of Independent Seafood Harvesters v. Oregon Fish & Wildlife Commission*, 46 Or. App. 659, 612 P.2d 765, *rev. granted* 289 Or. 677 (1980). For a discussion of how the outcome of this case would affect the biological burden of proof required by OR. REV. STAT. § 508.710, see ANADROMOUS FISH L. MEMO, *The Crown Zellerbach Salmon Hatchery Permit Appeal: A Case Study of Decision-Making in the Face of Scientific Uncertainty*, June 1980.

<sup>95</sup> OR. ADMIN. RULES § 635-40-007(1) (1981). This moratorium is not expected to have a significant impact on the long-term planning of the major corporations interested in entering the Oregon salmon ranching industry. Johnson, *supra* note 84, at 45. Additionally, existing permits can be transferred. OR. ADMIN. RULES § 635-40-007(2) (1981).

<sup>96</sup> Although large corporate ventures in Oregon have attracted much attention, *see* note 94 *supra*, proponents of ocean ranching claim that one of its major virtues is that it can be conducted with a relatively small investment. *See* J. LANNAN, *supra* note 2, at 7.

<sup>97</sup> Weyerhaeuser, for example, has invested \$14.5 million in a hatchery at Springfield and release/recapture sites at Newport and Coos Bay. Other major corporations which are involved in salmon ranching in Oregon are Charter Oil, Campbell Soup, and Crown Zellerbach. Johnson, *supra* note 84, at 40-41.

<sup>98</sup> Those involved in salmon ranching in Oregon are talking about a revolutionary change in the scope of methods of commercial salmon production. For example, William McNeil, manager of Weyerhaeuser's Oregon Aqua Foods, has stated:

'We've got enough estuaries along the Coast to release hundreds and hundreds of millions of salmon . . . Eventually it could be at the same magnitude as the Soviets and Japanese.' *Quoted in* Johnson, *supra* note 84, at 43.

Added John Gallat, managing general partner of Burnt Hill Salmon Ranch:

'Why spend fuel oil going out to the ocean to catch a fish with a hook when they'll be coming back to the hatchery anyway? . . . There should be no commercial fishing for chinook and coho. All harvesting should be done in the river.' *Id.* at 45.

<sup>99</sup> Washington law, however, does permit many other forms of aquaculture. *See*

would have allowed extensive private ocean ranching<sup>101</sup> was tabled in the 1980 legislature,<sup>102</sup> but is given a greater chance of passing in the next session.<sup>103</sup> Indian tribes in Washington, however, do conduct hatchery operations to augment natural runs,<sup>104</sup> and one tribe is establishing a release/recapture facility at its reservation along the coast.<sup>105</sup>

iv. *Alaska*. In 1974, Alaska passed an extremely comprehensive private salmon ranching law.<sup>106, 107</sup> Although the Alaska statute includes many of the same provisions that have been enacted by other states,<sup>108</sup> it contains several unique features.<sup>109</sup>

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*generally* WASH. REV. CODE ANN. § 75.16.100 (1962; supp. 1980). Additionally, the University of Washington operates a large experimental ocean ranch, releasing up to 250,000 fish a year and having returns as high as 6,000. *Hearings on S.B. 3385 Before the Washington State Senate Natural Resources Committee*, February 12, 1981 (testimony of Dr. Ernest Brannon).

100. S.B. 3385.

101. The proposed legislation, which would have authorized the annual release of 80 million fish, was very similar to the Oregon statute. Memorandum from John Woodring, Staff Counsel of the Washington Senate Research Center, to the Members of the Senate Natural Resources Committee (Feb. 12, 1981) [on file at the UCLA PACIFIC BASIN L.J.]. Although touching on ocean ranching in only a tangential way, an important additional factor in the Washington state salmon picture is several recent cases dealing with Indian fishing rights. *See generally* Comment, *Empty Victories: Indian Treaty Fishing Rights in the Pacific Northwest*, 10 ENV'T'L L. 413 (1980). Under the so-called Boldt decision upheld in *Washington v. Fishing Vessel Ass'n.*, 443 U.S. 658, 99 S. Ct. 3055, 61 L.Ed.2d 823 (1979), *modified*, 444 U.S. 806, 100 S. Ct. 34, 62 L.Ed.2d 24 (1979), salmon returning to an ocean ranch are counted against the non-Indian share of the total catch. Memorandum from John Woodring, *supra*, at 12. Nonetheless, it is expected that such facilities would contribute more salmon to the fishery than would be harvested at the release/recapture sites and counted against the non-Indian portion. *Id.*

102. The bill was passed by the Senate, but was tabled in the House Natural Resources and Environmental Affairs Committee. Letter from John E. Woodring, Staff Counsel at the Washington Senate Research Center, to the author (June 9, 1981) [on file at the UCLA PACIFIC BASIN L.J.].

103. *Id.*

104. The 19 tribes represented by the Northwest Indian Fisheries Commission released 23.7 million pink, coho, chinook, chum, and sockeye salmon in 1980. Letter from Robert C. Cumbow, Information Services Manager of the Northwest Indian Fisheries Commission, to the author (June 8, 1981) [on file at the UCLA PACIFIC BASIN L.J.].

105. The Quinalt Nation on the northwest Washington coast is in the process of establishing a release/recapture facility. *Id.*

106. 1974 Alaska Sess. Laws, ch. 111.

107. The basic law establishing private ownership of salmon hatcheries is contained in ALASKA STAT. §§ 16.10.375-16.10.475. The attendant Fisheries Enhancement Loan Program is found in ALASKA STAT. §§ 16.10.500-16.10.620. Additional regulations are embodied in ALASKA ADMIN. CODE Title 3, §§ 88.010-88.900 and Title 5, §§ 40.005-40.037 (1979).

108. The Alaska hatchery law, for example, includes the following features: (a) a public hearings process before the Fish & Game Dep't prior to issuing the permit; (b) all fish released into the wild become the property of the State while in public waters, and may be taken by sport or commercial fishermen; and (c) continuing su-



First, private salmon ranching is limited to non-profit corporations.<sup>110</sup> Second, the formation of regional associations composed of commercial fishermen and other user groups is encouraged to operate the hatcheries.<sup>111</sup> Third, these regional associations are granted preferential rights to hatchery permits<sup>112</sup> and are allowed to levy an assessment on the sale of all salmon within the regional boundaries to support their activities.<sup>113</sup> Fourth, considerable state technical assistance is provided to both independent operators and regional associations in the planning, construction, and operation of hatcheries,<sup>114</sup> and large construction loans are also available.<sup>115</sup> Finally, regional associations may be designated regional salmon enhancement authorities to further aid the State in improving the fishery, and thereby gain a limited tax-exempt status.<sup>116</sup> Under the innovative Alaska program, private ocean ranching has grown rapidly, with twenty-three permits presently

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pervision of operations by the Fish & Game Dep't to assure healthy hatchery conditions. See ALASKA STAT. §§ 16.10.410-16.10.470.

109. The comprehensive goals of Alaska's private salmon ranching program are set out in 1979 Alaska Sess. Laws, ch. 59, which reads in part:

It is the purpose of AS 16.10.375-16.10.620 to provide for continuing efficient aquaculture development in the coastal and interior regions of the state in a manner which equally affects and benefits all persons similarly situated and to encourage the development of small, private non-profit hatcheries that may provide important benefits to the state through increased employment, educational training, and research opportunities. 1979 Alaska Sess. Laws, ch. 59, sl(b).

110. ALASKA STAT. § 16.10.400(a). Monies generated by the sale of returning salmon or salmon eggs may be used to meet operating costs, debt retirement, facilities expansion, research expenses, and regional association costs. ALASKA STAT. § 16.10.450. See generally F. ORTH, THE ECONOMIC FEASIBILITY OF PRIVATE NON-PROFIT SALMON HATCHERIES (University of Alaska Sea Grant Rep. No. 77-4, June 1977).

111. ALASKA STAT. § 16.10.380. Among the user groups, in addition to commercial fishermen, who are encouraged to participate in the regional associations are sport fishermen, processors, subsistence fishermen, and representatives of local communities.

112. ALASKA STAT. § 16.10.400(e).

113. ALASKA STAT. § 16.10.530. The assessment provision includes the following features: (a) the assessments must only be used to fund the activities of the levying regional association; (b) the royalty rate cannot exceed three per cent; (c) the Fish & Game Commissioner and the regional association seeking the levy must agree on a means of collection; (d) limited entry holders within the area must be given the opportunity to vote on the assessments; and (e) the assessments must terminate when the financial need no longer exists, or when the limited entry holders vote to remove it.

114. ALASKA STAT. § 16.10.443. Additionally, express grants up to \$100,000 and matching grants for up to another \$100,000 are available to regional associations for organization and planning purposes. ALASKA STAT. § 16.10.510(9).

115. ALASKA STAT. §§ 16.10.510-16.10.520. Loans range up to \$3 million for regional associations.

116. ALASKA STAT. §§ 16.10.600-16.10.620. The principal powers granted to the authorities, which are considered limited political subdivisions of the state, relate to their ability to assume full fledged corporate form in order to provide greater flexibility in conducting their enhancement activities.

granted or under consideration<sup>117</sup> for a total projected egg capacity of nearly 400 million chum, coho, and pink salmon.<sup>118</sup>

## II. NEW CHALLENGES TO THE EXISTING INTERNATIONAL AGREEMENTS RELATING TO SALMON IN THE NORTH PACIFIC

The tremendous growth projected for ocean salmon ranching in coming years will present major challenges to the existing international legal arrangements relating to salmon in the North Pacific. Thus, it is appropriate at this point to examine the nature of these challenges, to survey the background of existing international salmon regulation in the North Pacific, and to analyze why these current agreements are inadequate to deal with the expected growth of ocean salmon ranching.

### A. The Challenges

The growth foreseen in ocean salmon ranching will present two major challenges to the existing international regulatory structures governing salmon in the North Pacific.

1. *Ocean Carrying Capacity*. The first challenge relates to the introduction of artificially propagated salmon into the common ocean. On one hand, it is widely agreed that even the vast ocean pastures of the North Pacific have only a finite capacity to provide sufficient food for grazing salmon.<sup>119, 120</sup> On the other

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117. As of June of 1981, a total of 14 permits have been granted for private non-profit hatcheries and 9 more are currently under consideration. Additionally, 11 Scientific/Educational permits for hatcheries, which were not included in the total related in the text, have been granted for 1981. Regional comprehensive plans are being developed for Cook Inlet and Prince William Sound, and such plans have been approved for the Northern and Southern Southeast regions. Information supplied by the Alaska Dept. of Fish & Game to the author (June 17, 1981) [on file at the UCLA PACIFIC BASIN L.J.].

118. *Id.* This figure includes permit request totals and releases by Scientific/Education permit holders.

119. As noted at a major F.A.O. conference:

It is not too soon to consider the capacity of marine nursery waters to grow anadromous species. Many states will be competing for rights to graze anadromous fishes in 'open range' which has a finite capacity to grow fish. The problems of establishing and protecting the grazing rights will have to be solved. U.N. FOOD & AGRICULTURE ORGANIZATION, *supra* note 4, at 25.

Echoing this view, a U.S. National Marine Fisheries Service report observed:

It may eventually become necessary to limit artificial recruitment of salmon to assure a proper ecological balance of higher trophic level fishes grazing in the North Pacific Ocean and contiguous seas. W. MCNEIL, *supra* note 4, at 6.

Precisely when the carrying capacity would become overtaxed is difficult to determine. See *Should California Permit Commercial Salmon Hatcheries For Profit?*, *supra*

hand, accepted principles of fishery economics<sup>121</sup> suggest that no motivation exists in this situation for *individual* production sources to conserve this scarce resource<sup>122</sup> by *unilaterally* limiting their releases of salmon.<sup>123</sup> This lack of motivation to conserve arises in the following manner. First, it is reasonable to assume that each nation, or for that matter any individual hatchery, will seek to maximize its economic return by releasing as many fish as feasible into the common ocean to feed.<sup>124</sup> Second, each individual pro-

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note 50, at 65-66 (testimony of Dr. Ernest Brannon). Exacerbating this problem is the fact that although scientists have estimated the historic production levels for salmon, modern factors affecting both the ocean and the fish lessen the value of the historic levels as indicators of the current carrying capacity. *See id.*

120. At present, scientific knowledge on the specific carrying capacity of the North Pacific is woefully inadequate. The few studies on carrying capacity focus on bays, estuaries, and coastal waters. *See* note 93 *supra* and Himsworth, *supra* note 92, at 15-16.

121. *See* Anderson, *A Classification of Fishery Management Problems to Aid in the Analysis and Proper Formulation of Management Problems*, 4 OCEAN DEV. & INT'L L.J. 113 (1977). The literature concerning common property resources in the fisheries area is quite extensive, dating back to Gordon, *The Economic Theory of a Common-Property Resource: The Fishery*, 62 J. POL. ECON. 124 (1954), and Scott, *The Fishery: The Objectives of Sole Ownership*, 63 J. POL. ECON. 116 (1955). Other excellent articles dealing with the problems associated with unregulated common property resources in general include: Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347 (1967); Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968); and Clark, *The Economics of Overexploitation*, 181 SCIENCE 630 (1973).

122. The resource involved here is the ocean's ability to provide food for the grazing salmon.

123. As noted by Gordon, *supra* note 121, at 135:

Perhaps the most interesting similar case is the use of common pasture in the medieval manorial economy. Where the ownership of animals was private but the resource on which they fed was common (and limited), it was necessary to regulate the use of common pasture in order to prevent each man from competing and conflicting with his neighbors in an effort to utilize more of the pasture for his own animals. Thus the manor developed its elaborate rules regulating the use of the common pasture, or 'stinting' the common: limitations on the number of animals, hours of pasturing, etc., designed to prevent the abuses of excessive individualistic competition.

For an application of the common property theory in a very similar, although non-fisheries, setting, *see* Libecap & Johnson, *Legislating Commons: The Navajo Tribal Council and the Navajo Range*, 18 ECON. INQUIRY 69 (1980).

124. As expressed by Hardin, *supra* note 121, at 1244:

As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility to me of adding one more animal to my herd?" This utility has one negative and one positive component.

1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.

2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of -1.

Adding together the component partial utilities, the rational herdsman

duction source finds itself in a situation where it receives all the benefits from the sale of its returning fish, but shares the effects of overtaxing the ocean's carrying capacity with all the ocean's users.<sup>125</sup> Finally, even if any one production source did unilaterally limit its releases, the same individual motives outlined in the first two points make it likely that another production source would simply step up releases even further, and thereby take advantage of the display of unilateral restraint.<sup>126</sup> Thus, the twin pressures of a finite ocean carrying capacity<sup>127</sup> and a lack of individual motivation to limit releases<sup>128</sup> merge to create the potential for overtaxing the ocean's ability to provide sufficient food for grazing salmon in the future.<sup>129</sup>

2. *Harvesting Rights.* The second challenge relates to harvesting rights. As more fish are sent out to graze in the common ocean, harvesting rights for such stocks will become a matter of growing importance.<sup>130</sup> After a nation<sup>131</sup> has invested substantial resources in developing artificially propagated salmon, it has been argued that preferential harvesting rights should be recognized in the producer.<sup>132</sup> However, these salmon are vulnerable to capture

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concludes that the only sensible course for him to pursue is to add another animal to his herd.

For an indication of the actual economic rate of return in salmon ranching operations, see note 48 *supra*.

125. See note 124 *supra*. Hardin concluded that the decision-making process outlined in note 124 will be undertaken by each rational herdsman using the commons, and that each one will reach the same result. Hardin observed that

[t]herein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all. *Id.*

126. As observed by Gordon, *supra* note 121, at 135:

There appears, then, to be some truth in the conservative dictum that everybody's property is nobody's property. Wealth that is free for all is valued by none because he who is foolhardy enough to wait for its proper time of use will only find that it has been taken by another. The blade of grass that the manorial cowherd leaves behind is valueless to him, for tomorrow it may be eaten by another's animal . . . .

127. See note 119 *supra*.

128. See note 124 *supra*.

129. Although scientific research on the impact of increased salmon stocks on the food supply of other important species in the ocean is minimal, it is believed that salmon are not major competitors with other valuable species for the same food supply. See Copes, *The Law of the Sea and Management of Anadromous Fish Stocks*, 4 OCEAN DEV. & INT'L L.J. 249, 257 n.20 (1977).

130. U.N. FOOD & AGRICULTURE ORGANIZATION, *supra* note 4, at 24.

131. This same analysis may be applied on an individual hatchery basis. However, given that it would be impossible (or at the least grossly impractical even if each fish was tagged) for a fisherman to determine the specific origin of a particular salmon, the analysis is simplified considerably if only applied on a national basis.

132. In fact,

[t]here is a strong sentiment in North America, particularly in fisheries circles, that Canada and the United States have property rights to the

by non-origin states in two situations. First, they may be taken as they pass through the coastal waters of the non-origin states and are, therefore, under the exclusive management authority of the intercepting nations.<sup>133</sup> Second, the salmon may also be captured on the high seas, where the states of origin do not possess the power to enforce any claimed preferential rights.<sup>134</sup> These interrelated problems can be expected to become increasingly divisive as the scope of artificial production expands.<sup>135</sup>

## B. International Regulation Concerning Salmon in the North Pacific

International agreements concerning salmon have a long history in the North Pacific. Nonetheless, as the advent of large scale salmon ranching is a comparatively recent development, it is necessary to determine if the arrangements worked out over this long period are capable of accommodating the future challenges created by this new industry. Thus, this section examines the background, purpose, and effect of past and present salmon regulation in the North Pacific. Additionally, the potential impact of the proposed Law of the Sea Convention will be considered.

1. *The Northwest Pacific.* Salmon have been the central focus of Russo-Japanese fisheries relations in the Northwest Pacific for the past two centuries.<sup>136</sup> In the early days of the fishery, agreements were largely concerned with which country could exploit the coastal waters of a particular area. The Japanese, who began fishing for salmon in the rivers of Hokkaido in the mid-1500s,<sup>137</sup> established their first fishing outposts on Sakhalin in 1789.<sup>138</sup> Following its emergence from self-imposed isolation with the restoration of the Meiji dynasty in 1868, Japan sought to ex-

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salmon spawned in their rivers. It is felt that as a matter of principle, fisherman from no other country should be allowed to catch 'their' salmon, regardless of where these salmon might wander. Fishing for salmon by nonstates of origin is considered akin to game poaching or cattle rustling. Copes, *supra* note 129, at 248.

133. See generally *Id.* at 247.

134. See generally *Id.* at 250.

135. All varieties of salmon range widely across the North Pacific during migrations which last from two to five years, and there is substantial intermingling of Asian and North American stocks in the mid-ocean. For an excellent set of maps indicating the scope of these travels for all principal species, see J. HART, note 17 *supra*.

136. Tanaka, *Japanese Fisheries and Fishery Resources in the Northwest Pacific*, 6 OCEAN DEV. & INT'L L.J. 163, 177 (1979).

137. U.S. NATIONAL MARINE FISHERIES SERVICE, DRAFT ENVIRONMENTAL IMPACT STATEMENT/PRELIMINARY FISHERY MANAGEMENT PLAN: HIGH SEAS SALMON FISHERIES OF JAPAN 109 (1976).

138. *Id.*

pand its comparatively limited salmon operations.<sup>139</sup> It achieved this objective in 1875 when an agreement<sup>140</sup> was reached with Russia allowing Japanese fishermen to move into the northern Kuriles and the Asian mainland areas of Primore Province and the Amur River.<sup>141</sup> Japanese fishing privileges grew in the wake of the Russo-Japanese War of 1904, with the Treaty of Portsmouth in 1905 and the Russo-Japanese Fishing Convention of 1907, when Japanese fishermen gained equal rights with Russians to exploit salmon in Russian territorial waters.<sup>142</sup> Utilizing these privileges, the Japanese set up an extensive coastal fishing operation in Russian waters,<sup>143</sup> and in 1927 added a significant high sea fleet to capture salmon in their ocean feeding grounds.<sup>144, 145</sup> Thus, by the outbreak of World War II, Japan had created the largest salmon fishing industry in Asia and dominated the principal salmon waters of the Northwest Pacific.<sup>146</sup>

With its defeat in World War II, however, Japan's dominance of Asian salmon was severely eroded and the Soviet Union began to press aggressively to curtail Japanese high seas salmon fishing. The War and its aftermath brought the destruction of the Japanese high seas fleet, the seizure of southern Sakhalin and the Kuriles by the Soviets, and the cancellation of fishing rights in Soviet coastal waters.<sup>147</sup> Nevertheless, Japan quickly rebounded,

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139. A. NETBOY, *supra* note 8, at 278.

140. The Japan-Russia Treaty of St. Petersburg of 1875. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 109.

141. *Id.* At this time the entire Kurile chain came under Japanese administrative jurisdiction, and Russia gained complete control of Sakhalin. A. NETBOY, *supra* note 8, at 278.

142. A. NETBOY, *supra* note 8, at 279. At this same time, Russia ceded the southern portion of Sakhalin to Japan. *Id.*

143. Areas exploited by Japanese fishermen included the Oliutorsk and Primore Districts, the Kamchatka Peninsula, the north coast of the Sea of Okhotsk, and northern Sakhalin. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 109.

144. A. NETBOY, *supra* note 8, at 280. Then, as now, Japan was the only nation to fish for salmon on the high seas. Most of the fish that were caught originated in Russian streams, and a few were from Alaska. *Id.*

145. The Japanese high seas fishing fleet historically has been composed of two principal elements. First, a mothership fleet comprises the bulk of high seas operations. Each mothership, which range in size from 7,800 to 14,000 tons, is essentially a floating cannery that is capable of staying at sea for long periods of time. Each mothership is accompanied by 32 to 34 catcherboats, which actually capture the ocean salmon in gillnets and then transfer them to the mothership for processing. Second, a land-based driftnet fishery makes up the remainder of the high seas fleet. This segment is composed of fairly small ships, typically under 7 tons, which remain comparatively close to shore and make trips of one or two days. See U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 13-17.

146. *Id.* at 109-111. Indeed, between 1910 and 1944, Japanese fishermen landed more salmon than their counterparts in any other nation. *Id.*

147. *Id.* at 111.

launching a new high seas fleet in 1952 and increasing its catch rapidly.<sup>148</sup> This very success, however, combined with the Soviets' desire to limit high seas capture of salmon originating in their streams and Japan's post-war diplomatic weakness, soon led to the creation of a new international salmon fishing regime in the Northwest Pacific.<sup>149</sup> On March 21, 1956, the Soviets announced their intention to control salmon fishing over an area of the Northwest Pacific encompassing Cape Olyutorskii to the north, a point 48°N. and 170°25'E., and the eastern tip of Hokkaido to the west.<sup>150</sup> This demarcation boundary, known as the Bulganin Line, became the basis of a fisheries agreement concluded in Moscow on May 14, 1956.<sup>151</sup> The treaty created the Japanese-Soviet Fisheries Commission, which met annually beginning in 1957 to set Japanese high seas salmon quotas and determine what areas would be open to the Japanese fleets.<sup>152</sup> Reflecting the Soviet desire to further curtail Japanese interceptions of salmon originating in the Soviet Union,<sup>153</sup> over the next twenty years additional areas came under regulation,<sup>154</sup> some areas were closed altogether,<sup>155</sup> and catch quotas within the convention area were progressively reduced.<sup>156</sup>

With the advent of extended fisheries zones in the mid-1970s,<sup>157</sup> international arrangements pertaining to salmon in the

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148. The Japanese launched three mothership fleets in 1952, and by 1955 had 14 fleets in operation. The total catch in 1955 by these fleets amounted to 170,000 tons. Tanaka, *supra* note 136, at 176.

149. A. NETBOY, *supra* note 8, at 280-281.

150. Tanaka, *supra* note 136, at 176.

151. *Id.* The convention also included crabs and herring. *Id.*

152. *Id.* The Commission was plagued by a lack of agreement concerning stock estimation, making the annual negotiations rather rancorous. *Id.* For a table recording the extent of this discord, see *Id.* at 222.

153. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 25.

154. Significant additional areas were added in two ways. First, although originally the catch quota only applied to waters north of 45°N. (Area A), where mothership operations were centered, a separate quota was established in 1962 for waters south of 45°N. (Area B), where land-based driftnet fishermen operated. Tanaka, *supra* note 136, at 177. Second, regulations were promulgated covering the minimum distances between gillnet sets in the mothership fishery in the area west of the original boundary of 170°25'E. to 175°W. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 25-26.

155. Two principal areas were closed. First, the Sea of Okhotsk was completely closed to Japanese fishermen after 1958. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 25. Second, the western boundary of the agreement off the southern Kamchatka Peninsula was moved from 155°E. to 160°E. in 1959, thereby bringing additional waters under exclusive Soviet control. *Id.*

156. For a detailed table of catch quotas for the areas involved, see *Id.* at 22. From 1957 to 1976, the quota for Area A declined from 170,000 to 40,000 tons. From 1963 to 1976, the quota for Area B declined from 60,000 to 40,000 tons. *Id.*

157. See generally Moore, *National Legislation for the Management of Fisheries Under Extended Coastal State Jurisdiction*, 11 J. MAR. L. & COM. 153 (1980).

Northwest Pacific again moved into a new phase. Initiating a rapid series of events, on December 10, 1976, the Soviet Union announced that it would establish a 200 mile fishery zone on March 1, 1977.<sup>158</sup> Then, on April 27, 1977, it notified Japan that it was terminating their twenty-year-old fishing convention.<sup>159</sup> Finally, on July 1, 1977, Japan followed suit, and established its own 200 mile fishery zone.<sup>160</sup> The net effect of these developments, which brought large portions of the principal salmon waters of the Northwest Pacific under exclusive national jurisdictions,<sup>161</sup> was to further strengthen state-of-origin control over salmon throughout their migratory range.<sup>162, 163</sup>

2. *The Northeast Pacific.* The history of international regulation concerning salmon in the Northeast Pacific is neither as long, complex, nor acrimonious as that found in the Northwest Pacific.

Prior to World War II, the only major international agreement relating to salmon in the Northeast Pacific was the Convention for the Protection of Sockeye Salmon Fisheries in the Fraser River System, signed by the United States and Canada in 1930

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158. PRESIDUM OF THE U.S.S.R. SUPREME SOVIET, Edict on Provisional Measures for the Preservation of the Living Resources and for the Regulation of Fishing in Marine Areas Adjacent to the Coast of the U.S.S.R., December 10, 1976, in 5 *NEW DIRECTIONS IN THE LAW OF THE SEA* 141 (R. Churchill, M. Nordquist, S. Lacy eds. 1977).

159. Tanaka, *supra* note 136, at 177. A prominent feature in the background of these events was the long-smoldering Soviet-Japanese dispute over the Kuriles, which the Soviet Union seized from Japan in the last days of World War II. Also, at this same time, Japan was moving toward the establishment of formal relations with the Peoples Republic of China, a situation which exacerbated the already strained diplomatic relations between the Soviet Union and Japan. For a chronological view of these important background events, see generally *N.Y. Times*, Jan. 18, 1975, at 8, col. 6; *N.Y. Times*, Mar. 16, 1975, § 1, at 10, col. 1; *N.Y. Times*, June 4, 1975, at 9, col. 1; *N.Y. Times*, June 19, 1975, at 9, col. 1; *N.Y. Times*, Jan. 11, 1976, § 1, at 2, col. 3; *N.Y. Times*, Jan. 12, 1976, at 32, col. 4; *N.Y. Times*, Feb. 25, 1976, at 15, col. 3; and *N.Y. Times*, Apr. 10, 1978, § A, at 7, col. 1.

160. Law No. 31 of 2 May 1977 on Provisional Measures Relating to the Fishing Zone, in 7 *NEW DIRECTIONS IN THE LAW OF THE SEA* 128 (M. Nordquist, S. Lacy, K. Simmonds eds. 1980).

161. For a map indicating the extent to which the creation of 200 mile zones by the U.S.S.R. and the U.S. brought significant portions of the traditional Japanese mothership fishing area under exclusive national jurisdiction, see *U.S. NATIONAL MARINE FISHERIES SERVICE, supra* note 137, at 73.

162. Indeed, it has been estimated that before the enactment of extended fisheries zones by the U.S.S.R. and the U.S., Japanese mothership operations caught 85 per cent of their total catch weight within 200 miles of foreign shores. Tanaka, *supra* note 136, at 235.

163. Both the Soviet and the Japanese laws extending their fishing zones also contained language claiming explicit management jurisdiction over migratory (Article 2 of the Soviet law) or anadromous (Article 12 of the Japanese statute) species which originate within their borders.



and ratified in 1937.<sup>164</sup> This agreement, which concerns the Canadian river system that enters the Pacific very near the American-Canadian border, was prompted by a steep decline in its important salmon run<sup>165</sup> due to over-fishing and a large rock slide at Hell's Gate in 1913 that blocked upstream migration.<sup>166</sup> The Convention created the International Pacific Salmon Fisheries Commission<sup>167</sup> and vested it with authority to construct fish passages,<sup>168</sup> to regulate fishing methods involving Fraser River salmon,<sup>169</sup> and to manage the population of salmon produced in the River.<sup>170</sup> Additionally, because the expenses of the rehabilitation program were to be borne jointly, the Convention also provided for an equal division of Fraser River salmon.<sup>171</sup> Despite the problems inherent in such an allocation system,<sup>172</sup> difficulties have been overcome by the close cooperation of the parties involved<sup>173</sup> and the salmon run has been substantially rebuilt.<sup>174</sup> Although new challenges are being presented by Canadian displeasure with the allocation formula<sup>175</sup> and Indian claims to a greater share of salmon on both sides of the border,<sup>176</sup> the agreement continues to

164. Convention for the Protection of Sockeye Salmon Fisheries in the Fraser River System, May 26, 1930, United States-Canada, 50 Stat. 1355, T.S. No. 918. Protocol amending the Convention, Dec. 28, 1956, 8 U.S.T. 1057, T.I.A.S. No. 3867. Additional Amendments, Feb. 24, 1977, — U.S.T. —, T.I.A.S. No. 9854. The 1956 amendment extended the treaty coverage to include pink salmon in the Fraser system, too.

165. The average annual sockeye run for the years 1894 to 1916 was 10.25 million. By contrast, from 1916 until the completion of fishways around the Hell's Gate obstruction in 1949, the average annual run was only 3.4 million sockeye. INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION, REPORT FOR THE YEAR 1979 I (1980).

166. Fairley, *Fisheries Jurisdiction and the Atlantic Salmon: Fact and Law From a Canadian Point of View*, 4 DALHOUSIE L.J. 609, 634 (1978).

167. Convention for the Protection of Sockeye Salmon Fisheries in the Fraser River System, *supra* note 164, Article II.

168. *Id.*, Article III.

169. *Id.*, Article V.

170. *Id.*, Article IV.

171. *Id.*, Article VII.

172. Among the major problems was the difficulty of determining the various paths of the migrating salmon and the significant potential for the capture of certain salmon by the wrong party. Fluharty & Dawson, *Management of Living Resources in the Northeast Pacific and the Unilateral Extension of the 200-Mile Fisheries Zone*, 6 OCEAN DEV. & INT'L L.J. 1, 14 (1979).

173. *Id.*

174. The average run of sockeye was 6.51 million for the years 1976-1979, or approximately 63 per cent of the 10.25 million average of 1894-1916. In 1979, the pink run grew to 14.1 million, which represents about half of its historic size. INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION, *supra* note 165, at 1.

175. Canadian interests object to the allocation formula because the river lies entirely within Canada, and that nation is the party which must assure that suitable spawning habitat is maintained in the river. Fairley, *supra* note 166, at 634.

176. See generally Dearden, *Management of a Commons Resource: The Pacific Coast Fishery of Northwestern North America*, 6 ENV'TL CONSERVATION 272 (1979).

function for this important fishery.<sup>177</sup>

After World War II, the scope of international regulation concerning salmon expanded along with the reconstruction of the Japanese high seas fleet. Before the Japanese launched their high seas fleet in 1927, salmon fishing was conducted only in coastal waters,<sup>178</sup> obviating the need for arrangements governing the high seas of the North Pacific. Moreover, although the Japanese conducted significant high seas operations prior to World War II,<sup>179</sup> strong diplomatic pressure from the United States kept these activities largely confined to the Northwest Pacific.<sup>180</sup> With the re-birth of the Japanese high seas fleet in the post-war era,<sup>181</sup> however, Canada and the United States became greatly concerned about protecting salmon spawned in North America from being taken in international waters by the Japanese.<sup>182</sup> Therefore, they applied pressure to limit Japanese fishing outside the Northwest Pacific,<sup>183</sup> and this effort culminated in the signing of the International Convention for the High Seas Fisheries of the North Pacific in 1952.<sup>184</sup> Although the treaty set up a trilateral commission to oversee research on the species involved,<sup>185</sup> its salient feature was a Japanese promise to abstain from high seas fishing for the covered species east of 175°W.<sup>186</sup> Except for a relatively modest number of salmon originating in Alaska,<sup>187</sup> this line left the great bulk of North American salmon protected from high seas capture by the Japanese.<sup>188</sup> Despite long standing Japanese displeasure with the treaty,<sup>189</sup> an amending protocol<sup>190</sup> was entered into in

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177. The Convention was last amended and extended in 1977. See note 164 *supra*.

178. See note 144 *supra*.

179. See note 137 and accompanying text *supra*.

180. In 1937 and 1938, Japanese fishermen appeared off the North American coast in search of salmon. Grzybowski, *The U.S. Fishery Conservation and Management Act of 1976—A Plan For Diplomatic Action*, 28 INT'L & COMP. L.Q. 685 (1979). After a strong protest from U.S. Secretary of State Cordell Hull, however, the Japanese left the Northeast Pacific. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 111.

181. See note 148 and accompanying text *supra*.

182. Copes, *supra* note 129, at 237.

183. *Id.*

184. Convention on High Seas Fisheries of the North Pacific Ocean, May 9, 1952, Canada-Japan-United States, 4 U.S.T. 380, T.I.A.S. No. 2786, 205 U.N.T.S. 65. Amending Protocol, Nov. 17, 1962, 14 U.S.T. 953, T.I.A.S. No. 5385. Amending Protocol, Apr. 25, 1978, 30 U.S.T. 1095, T.I.A.S. No. 9242. The original agreement also included halibut and herring.

185. *Id.*, Articles II and III.

186. *Id.*, Annex.

187. It has been estimated that Japanese motherships annually captured nearly 2.5 million salmon of North American origin from 1964 through 1973. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 74.

188. Copes, *supra* note 129, at 237.

189. See U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 29.

1978 which moved the abstention line ten degrees farther west.<sup>191</sup> Thus, the North Pacific Convention remains very much alive, even though it may be terminated by any one of the parties with one year's notice.<sup>192</sup>

More recently, both Canada and the United States have sought to further protect their interest in salmon spawned in North America by the extension of their exclusive fishing zones to 200 miles<sup>193</sup> and in treaties regulating other nations entry into these newly protected waters.<sup>194</sup> In 1976, both nations, following a world-wide trend,<sup>195</sup> did extend their exclusive fishing zones to 200 miles.<sup>196</sup> This move not only gave added protection to near-shore stocks,<sup>197</sup> but also provided important bargaining leverage in new bilateral negotiations which had to be undertaken with all nations desiring entry into the exclusively managed fishing grounds.<sup>198</sup> Using this leverage, both Canada and the United States have concluded bilateral treaties with a number of other nations<sup>199</sup> which grant those countries entry into the new manage-

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190. Amendments to the Convention on High Seas Fisheries of the North Pacific Ocean, Apr. 25, 1978, note 184 *supra*.

191. Amendments to the Convention on High Seas Fisheries of the North Pacific Ocean, Apr. 25, 1978, *supra* note 184, Annex. As to why the Japanese continued the agreement, Grzybowski, *supra* note 180, at 698, noted:

The move to establish the 200-mile conservation and management zone raised fears in the salmon industry that this would prompt the Japanese to denounce the treaty and to fish for salmon up to the limits of the zone, thus adding pressure on the salmon stock. . . . The counter-argument was that other fish, rather than salmon, available within the zone were more important to the Japanese diet and fisheries industry, and that therefore the U.S. had a negotiating leverage with which to protect high sea salmon in return for fishing privileges in the zone for other species.

192. Amendments to the Convention on High Seas Fisheries of the North Pacific Ocean, Apr. 25, 1978, *supra* note 184, Article XII.

193. See note 196 *infra*.

194. See note 199 *infra*.

195. See note 157 *supra*.

196. For Canada, see Territorial Sea and Fishing Zones Act, reprinted in 15 INT'L L. MATERIALS 1372 (1976). For the United States, see Fishery Conservation and Management Act, 16 U.S.C.S. § 1801 et. seq. (1978). For assessments of the impact of the American statute, see generally *Symposium on the Fishery Conservation and Management Act of 1976*, 52 WASH. L. REV. 427 (1977); and OFFICE OF TECHNOLOGY ASSESSMENT, CONGRESS OF THE UNITED STATES, ESTABLISHING A 200-MILE FISHERIES ZONE (1977).

197. It has been estimated, for example, that Japanese motherships annually captured over 1.7 million North American salmon within 200 miles of the Alaska coast from 1964 to 1973. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 74.

198. See note 191 *supra*.

199. Canada, for example, has entered into agreements with Poland, the Soviet Union, and Spain. Fairley, *supra* note 166, at 638. The United States, too, has entered into a number of such agreements, including treaties with Spain (Agreement on Fisheries Off the United States Coasts, Feb. 16, 1977, United States-Spain, 28 U.S.T.

ment zones to fish for a variety of species. These treaties also explicitly recognize the exclusive right of Canada or the United States to manage their anadromous stocks throughout their entire migratory range.<sup>200</sup>

3. *Impact of the Proposed Law of the Sea Convention.* The proposed Law of the Sea Convention, which deals with anadromous fish stocks in Article 55,<sup>201</sup> affects the international management of salmon in three principal ways.<sup>202</sup> First, it recognizes that the states of origin have the primary interest in, and responsibility for, the management of salmon stocks.<sup>203</sup> Second,

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1631, T.I.A.S. No. 8523), Poland (Agreement on Fisheries Off the United States Coasts, Aug. 2, 1976, United States-Poland, 28 U.S.T. 1681, T.I.A.S. No. 8524), South Korea (Agreement on Fisheries Off the United States Coasts, Jan. 4, 1977, United States-Korea, 28 U.S.T. 1753, T.I.A.S. No. 8526), East Germany (Agreement on Fisheries Off the United States Coasts, Oct. 5, 1976, United States-German Democratic Republic, 28 U.S.T. 1793, T.I.A.S. No. 8527), the Soviet Union (Agreement on Fisheries Off the United States Coasts, Nov. 26, 1976, United States-U.S.S.R., 28 U.S.T. 1847, T.I.A.S. No. 8528), Taiwan (Agreement on Fisheries Off the United States Coasts, Sept. 15, 1976, United States-Republic of China, 28 U.S.T. 1903, T.I.A.S. No. 8529) and Japan (Agreement on Fisheries Off the United States Coasts, March 18, 1977, United States-Japan, 28 U.S.T. 7507, T.I.A.S. No. 8728).

200. Canada's treaty with the Soviet Union, for example, reads in relevant part:

'1. The Government of Canada and the Government of the Union of Soviet Socialist Republics recognize that States in whose fresh waters anadromous stocks originate have the primary interest in and responsibility for such stocks and agree in principle that fishing for anadromous species should not be conducted in areas beyond the limits of national fisheries jurisdiction. They will continue to work together for the establishment of permanent multilateral arrangements reflecting this position, taking into account all relevant factors.

'2. Pursuant to paragraph (1), the Government of Canada and the Government of the Union of Soviet Socialist Republics shall take measures to ensure that their nationals and vessels avoid the taking of anadromous stocks spawned in waters under jurisdiction of the other Contracting Party.' *Quoted in Fairley, supra* note 166, at 638.

Similarly, the United States agreement with Taiwan, for example, provides:

*Recognizing* that the United States has established a fishery conservation zone within 200 nautical miles of its coasts within which the United States exercises fishery management authority over all fish and that the United States also exercises such authority over . . . anadromous species of fish of United States origin throughout their migratory range; Agreement Concerning Fisheries Off the Coasts of the United States, Sept. 15, 1976, United States-Republic of China, 28 U.S.T. 1903, T.I.A.S. No. 8529.

201. *See* The Revised Single Negotiating Text, U.N. Document A/CONF.62/WP.10, 15 July 1977, or The Informal Composite Negotiating Text, U.N. Document A/CONF.62/WP.10/Rev.1, 28 April 1979.

202. It should be noted that the fisheries provisions of the Law of the Sea Convention largely represent already accepted compromises, and are not expected to change significantly in the event of further negotiations on the Convention as a whole. Moore, *supra* note 157, at 153. For an excellent analysis of the Convention's impact on anadromous species, *see* Copes, *supra* note 129.

203. Revised Single Negotiating Text, *supra* note 201, Article 55, §§ 1-2.

the treaty generally provides that salmon fishing should be conducted only in coastal waters, although it does create an exception for high seas fishing by non-origin states when "economic dislocation" would result.<sup>204</sup> Finally, Article 55 calls for the co-operation of neighboring states in dealing with fish which migrate between their exclusive management zones.<sup>205</sup> In practice, these provisions would have a rather negligible impact on international regulation of salmon in the North Pacific.<sup>206</sup> On one hand, Article 55 does represent a recognition of the long held North American position that states of origin must be accorded preferential rights in the management of anadromous fish stocks.<sup>207</sup> Yet, on the other hand, the exceptions regarding high seas fishing by non-origin states go far toward undercutting the very rights the agreement purports to recognize.<sup>208</sup> In sum, it can be expected that even if the Law of the Sea Convention does become a reality,<sup>209</sup> the accord will do little to alter the status quo in the salmon fisheries of the North Pacific.<sup>210</sup>

### C. Shortfalls of the Present Systems

In evaluating the ability of current international legal mechanisms to accommodate the future challenges expected from increased ocean salmon ranching in the North Pacific, two principal defects are readily apparent.

First, no international agreements exist which confront the problem of regulating the introduction of salmon into the common ocean. Throughout the considerable history of international accords concerning salmon in the North Pacific, the emphasis has always been on how many fish were removed from the commons.<sup>211</sup> However, with the advent of widespread ocean salmon ranching and its attendant ecological implications, heightened at-

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204. *Id.*, § 3.

205. *Id.*, §§ 4-5.

206. As Copes, *supra* note 129, at 245, noted:

But the rules are seriously debilitated by qualifications and escape clauses. Thus, high seas fishing by nonstates of origin is permitted if they can claim that without such fishing they would suffer 'economic dislocation.' This would appear to sanction continuation of present high seas salmon fisheries. One might assume that an expansion of such fisheries is contrary to the intent of Article 55, although it is not explicitly prohibited. The SNT also offers nothing in substance to curb the interception of salmon by coastal states other than states of origin. Article 55 simply admonishes all coastal states concerned to cooperate in conservation and management.

207. See Fairley, *supra* note 166, at 619-623.

208. See note 206 *supra*.

209. Final approval of the Law of the Sea Convention is currently being held up over the issue of seabed mining. See BUS. WEEK, Mar. 16, 1981, at 29-30.

210. See note 206 *supra*.

211. See *e.g.* note 156 *supra*.

tention must be paid to how many salmon are introduced into the ocean.<sup>212</sup>

Second, although since World War II the trend in international salmon regulation has been undisputably toward greater protection of state-of-origin harvesting rights,<sup>213</sup> these efforts have been very disjointed attempts to deal with the same central problem of high seas fishing.<sup>214</sup> Moreover, despite these moves, the potential for capture by non-origin nations remains very real.<sup>215</sup> Even though Japan is currently the only nation with a high seas salmon fleet,<sup>216</sup> the presence of large numbers of artificially produced salmon grazing in the common ocean may induce other nations to begin the pursuit of salmon.<sup>217</sup> Thus, the formulation and implementation of a unified policy by the producing nations for the protection of their grazing salmon will be an increasingly important item.

#### IV. A SUGGESTED FRAMEWORK TO MANAGE INCREASED OCEAN SALMON RANCHING IN THE NORTH PACIFIC

In light of the above, it is clear that new international legal mechanisms must be designed to accommodate the substantial growth expected in ocean salmon ranching in the North Pacific. Any new arrangements must deal with the very substantial problems presented by both regulating the introduction of salmon into the ocean and protecting those fish from capture by non-origin nations. Despite the difficulty of these challenges, the fact that only four nations are involved in large-scale salmon mariculture in this region offers a unique opportunity for them to construct a comprehensive framework for managing both the introduction

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212. See note 119 *supra*.

213. See *e.g.* note 184 *supra*.

214. Indeed, none of the major agreements pertaining to salmon in the North Pacific has ever had all four of the principal salmon producing nations as signatories.

215. For example, the National Marine Fisheries Service concluded that off the coast of Alaska

. . . there is a large area outside 200 miles in the Gulf of Alaska where North American salmon would be particularly vulnerable to high seas fishing. . . . It has been estimated that the potential catch of North American salmon in that area is close to 10 times the number intercepted by the Japanese mothership fishery. . . . [T]here is little doubt that a large-scale salmon fishery outside 200 miles in the Gulf would seriously impact on coastal fisheries and no doubt but that the impact would be widespread, affecting every major salmon fishery—commercial, subsistence, and sport—from Kotzebue Sound to California. U.S. NATIONAL MARINE FISHERIES SERVICE, *supra* note 137, at 78.

216. See note 144 *supra*.

217. In the short run, the nations considered most likely to enter the high seas salmon fishery are South Korea and Taiwan. Copes, *supra* note 129, at 250.

and harvesting of salmon. This section suggests how such a plan might appear and be implemented.

#### A. Regulating the Introduction of Salmon

As pointed out previously, there exists a potential in the future for over-taxing the common ocean's ability to support large numbers of grazing salmon if the introduction of those fish goes unregulated.<sup>218</sup> Even though only four nations—Japan, the Soviet Union, Canada, and the United States—are involved in the development of ocean ranching in the North Pacific,<sup>219</sup> the analysis presented earlier suggests that no individual production source possesses a motive to unilaterally restrain releases of salmon into the common ocean.<sup>220</sup> Thus, in the future these four nations will be challenged to devise a system which will allow them to continue developing ocean ranching to the fullest extent without decimating the very resource that their production system depends on.

One way to overcome this problem would be to vest ultimate management power over the number of salmon introduced into the common ocean in a central authority.<sup>221</sup> This central body would determine the total number of fish which are biologically appropriate for grazing in the common ocean, and then equitably allocate that total number among the various production sources.<sup>222</sup> If each producing nation ceded its decision-making power in this manner, then individual disincentives to conserve would be greatly reduced. First, the central authority, viewing the situation more like a farmer planting his own field than a herdsman grazing his stock on a common pasture, would be able to evaluate both the entire benefit and the total ecological cost associated with the introduction of a particular number of fish into the ocean.<sup>223</sup> Second, vesting decision-making power in a central body would curtail the possible problem of having other producing nations take advantage of one source's unilateral restraint.<sup>224</sup>

Obviously, a number of important prerequisites would be necessary in order to transform this theoretical proposition into an operating reality. First, the central authority would have to be

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218. See notes 119-129 and accompanying text *supra*.

219. See notes 13-18 and accompanying text *supra*.

220. See notes 119-129 and accompanying text *supra*.

221. The analysis presented herein is very similar to that which would be undertaken by one setting up a cartel in an industry with a small number of participants. See, e.g., *United States v. Addyston Pipe & Steel Co.*, 85 F. 271 (6th Cir. 1898). For a similar recommendation in a related resource setting, see Libecap & Johnson, *supra* note 123, at 84.

222. *Id.*

223. See generally Demsetz, *supra* note 121, at 348.

224. See note 126 *supra*.

composed of all four salmon producing nations of the North Pacific.<sup>225</sup> Anything less would defeat the very purpose of the arrangement, because the nation(s) staying out of the agreement could take advantage of any restraint undertaken by the parties to the accord.<sup>226</sup> Second, to determine the total number of releases that would be biologically appropriate, the central authority would have to conduct and collect continuing scientific research on the carrying capacity of the ocean.<sup>227</sup> Without this scientific information to work from, the very goal of the agreement would be impossible to achieve. Third, once the scientific data was generated, it would be necessary to construct management models and a reporting format to make the basic research usable to fishery managers.<sup>228</sup> Just as the agreement would fail without the provision of basic scientific research, so too would it founder if this fundamental knowledge could not be transformed into a basis for action. Fourth, an equitable allocation system would be a crucially important element in any such agreement.<sup>229</sup> Any unresolved inequities would sorely tempt the dissatisfied party to abandon the arrangement. Finally, accurate release data would have to be obtained by the central authority.<sup>230</sup> If the central management authority failed to take measures to insure that the release data of the individual members was correct, then the parties would have a motive to cheat on the agreement, and thereby take advantage of the other members' restraint.

Despite these many challenges, the successful management of a complex international fishery resource is certainly not beyond the capabilities of these parties.<sup>231</sup> Indeed, many of the agree-

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225. See note 221 *supra*.

226. See note 126 *supra*.

227. The costs incurred in operating this system would be borne by the parties. Such assessments have been described as being analogous to a grazing fee. See generally Copes, *supra* note 129, at 248-249.

228. For a discussion of management models available to regulate fisheries, see generally Anderson, note 121 *supra*. As the information sought by the central authority would be highly particularized to its function, the creation of its own scientific research and management staffs would be desirable.

229. A number of allocation systems could be formulated by the parties. For the sake of simplicity the initial allocation procedures would probably have to involve some form of a national quota system. See generally J. GULLAND, *THE MANAGEMENT OF MARINE FISHERIES* 145-155 (1974). Once a management authority was functioning, it might then be possible to set up to a more efficient system in which release rights were allocated on a market basis to clearly reflect the actual economic value a production source placed on such rights. See generally Kury, *The Application of a Market Theory to the Regulation of International Fisheries*, 1 *OCEAN DEV. & INT'L L.J.* 355 (1974).

230. Given the clear incentive to cheat on the agreement, it would be desirable to have the central authority directly involved in the collection, or at least the monitoring of the collection, of this data.

231. For example, these four nations are parties to what is generally considered to



ments discussed earlier have caused them to perform several of these stock management functions for some time.<sup>232</sup> In conclusion, given the resources that these nations are devoting to the development of ocean salmon ranching, it is certainly incumbent upon them to devise a system to protect and preserve the very pasture that their production system so crucially depends on.

## B. Regulating the Harvesting of Salmon

1. *Coastal Interception of Migrating Salmon.* One of the most difficult problems encountered in trying to design a comprehensive framework for the development of ocean salmon ranching in the North Pacific is that of coastal interception of migrating salmon.<sup>233</sup> This occurs when the salmon produced in one nation are caught by the coastal fishery of a neighboring state while they are migrating through the intercepting state's exclusive fishing zone.<sup>234</sup> The difficulties encountered in this situation are both legal and practical. First, as to the legal issue, although the salmon captured in this situation are spawned in another country, they are taken while subject to the exclusive management authority of the intercepting nation.<sup>235</sup> Second, and on a more practical level, it is impossible for fishermen in this situation to determine the specific origin of the salmon they harvest.<sup>236</sup> Nevertheless, even though

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be one of the most successful international fisheries agreements in history, the North Pacific Fur Seal Convention. See J. GULLAND, *supra* note 229, at 6; and note 252 *infra*.

232. For example, the Convention for the Protection & Preservation of Sockeye & Pink Salmon Fisheries, note 164 *supra*, has long caused Canada and the United States to work together on such matters as basic scientific research, data collection, and harvest allocation.

233. For a very complete analysis of this situation, with special emphasis on the position of Canada, see Copes, *supra* note 129, at 250-254.

234. For an indication of the coastal migration patterns of salmon, see the maps included in J. HART, note 17 *supra*.

235. Both the producing nations and the intercepting states are able to make credible arguments in this situation. On one hand, the producers could argue that the intercepting states

. . . are not contributing to the existence of those salmon. The salmon are merely taking up transient space in that country's waters and may be feeding on natural organisms which are present. The passage of those salmon could be likened to the innocent passage of ships through such waters. Any interceptions there should be by agreement with the country of origin.' Canadian House of Commons, Standing Committee on External Affairs and National Defense, *Proceedings*, No. 1 (March 12, 1974) at 34-35, *quoted in* Fairley, *supra* note 166, at 623.

On the other hand, the position of the intercepting states might well be:

Where salmon spend a major part of their life feeding in the coastal waters of a state other than the state of origin, the intercepting coastal state may well consider that it has contributed significantly, through its biological resources, to the growth of the salmon and is therefore entitled to a share of the catch. Copes, *supra* note 129, at 251.

236. If the production of salmon ever evolved to the point that all harvesting was

this presents both legal and practical difficulties, they are largely limited to two geographic theaters—Japan and the Soviet Union, and Canada and the United States.<sup>237</sup> Moreover, as each of the parties within the same geographic area faces the same set of regional problems, there is a significant incentive to engage in bilateral management of their intermingling stocks.<sup>238</sup> Thus, it must be acknowledged that this particular problem is better left to detailed bilateral negotiations, such as those concerned with allocating Fraser River salmon,<sup>239</sup> rather than being part of a comprehensive plan to regulate salmon in the common pasture of the North Pacific.

2. *High Seas Capture of Grazing Salmon.* a. *Policy.* Moving beyond the problems associated with coastal interception, the tremendous present and projected growth in artificial salmon propagation in the North Pacific Basin<sup>240</sup> makes it desirable that any comprehensive framework designed by the salmon producing countries include a recognition of explicit national property rights<sup>241</sup> in their salmon and measures aimed at achieving an attendant prohibition of all high seas salmon fishing.

This twin-edged policy can be justified on a number of grounds. First, because each producing nation has incurred costs in raising its salmon ranging from hatchery development expenses to foregone alternative uses of its bays and rivers, it is highly inequitable for non-origin states to then capture those fish on the high seas.<sup>242</sup> Second, it is a misallocation of capital, energy, and labor resources to pursue salmon across the high seas when they will eventually return to convenient coastal areas anyway.<sup>243</sup> Third,

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done at fixed coastal sites as are being developed along the American West Coast, then, of course, this entire problem area would be eliminated.

237. As indicated by the maps contained in J. HART, note 17 *supra*, there are also a few areas, such as in the Aleutians, where Asian stocks pass within the American exclusive fishing zone.

238. Copes, *supra* note 129, at 254.

239. See note 164 *supra*.

240. See note 4 *supra*.

241. Although it would be possible to extend this analysis in the abstract to include an explicit recognition of property rights vested in individual hatcheries, such a recognition would be extremely difficult to implement on a practical level. See note 131 *supra*. Indeed, in those American jurisdictions where private ocean ranching is allowed, the salmon released from private facilities are considered to be common property while in state waters. See notes 80, 86, 108 *supra*. The closest any state comes to even recognizing an implicit property right is Alaska, where the assessment program in effect there does reward a hatchery's contribution to the coastal fishery. See note 113 *supra*.

242. Fairley, *supra* note 166, at 622.

243. J. CRUTCHFIELD & G. PONTECORVO, *supra* note 26, at 192. In the case of Japan, unlike the other salmon producing nations of the North Pacific, the general wage level still makes it possible to conduct a high seas fishery. *Id.* In other nations,

because salmon reach their greatest weight just before they enter their spawning rivers, a considerable portion of potentially harvestable weight is sacrificed by capturing immature salmon on the high seas.<sup>244</sup> Finally, taking salmon on the high seas makes it extremely difficult to manage individual runs.<sup>245</sup>

b. *Implementation.* Naturally, the implementation of such property rights and an attendant prohibition of high seas fishing may prove difficult, both with regard to the Japanese and to other nations which may be tempted to enter the fishery.

i. *Japan.* Despite its position as the leading salmon ranching nation in the world<sup>246</sup> and the apparent vulnerability of its own stocks to capture by other nations in the future,<sup>247</sup> Japan is expected to continue its high seas operations.<sup>248</sup> However, as artificially propagated fish assume a growing proportion of the Pacific salmon stock, this position will become increasingly untenable. Thus, in order to prevent the continued economic injury inflicted by Japanese salmon fishing on the high seas<sup>249</sup> and to aid the formation of a unified producer position to confront possible entry by outside nations,<sup>250</sup> it is desirable as a part of any comprehen-

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however, salmon are caught very near the coast. In the United States, for example, 95.7 per cent of the salmon landed in 1979 were caught within three miles of the coast, and the remainder were harvested within 200 miles. U.S. DEP'T OF COMMERCE, STATISTICAL ABSTRACT OF THE UNITED STATES 1980 745 (1980).

244. J. CRUTCHFIELD & G. PONTECORVO, *supra* note 26, at 192.

245. *Id.*

246. *See* note 47 *supra*.

247. *See* note 135 *supra*.

248. As expressed by Nobuo Imamura, Director-General of the Fishery Agency of Japan, in an address to the 26th Annual Meeting of the International North Pacific Fisheries Commission:

' . . . Japanese fishermen have traditionally been most dependent on the fishery resources in the North Pacific Ocean, and fishery products from that area have vital significance for the food supply in Japan. Therefore, we have every reason to have great concern for the optimum utilization of resources in this area . . . and in the case where resources are not practically utilized by the coastal country, traditional fishing activities should be fully respected.' *Quoted in* INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION ANNUAL REPORT 1979 2 (1980).

249. In areas where fishing is allowed under the International Convention for the High Seas Fisheries of the North Pacific, note 184 *supra*, for example, Japanese mothership fleets captured over 8.3 million salmon in 1978. Dahlberg, *Statistics of the Japanese Mothership Salmon Fishery*, in INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION ANNUAL REPORT 1979 68 (1980).

250. As pointed out in note 217 *supra*, the nations considered the most likely entrants in the short run are South Korea and Taiwan. Although the United States currently possesses powerful diplomatic leverage with regard to these two nations, "a danger remains . . . that American influence with these countries will wane and that any number of other countries may appear on the scene to indulge in salmon fishing on the high seas of the North Pacific." Copes, *supra* note 129, at 250.

sive ocean ranching plan to secure a halt to the Japanese operations. A variety of devices exist to achieve this end, ranging from bargaining leverage obtained from the ability to limit entry into the other salmon producers' exclusive fishing zones<sup>251</sup> to a direct buy-out of Japanese facilities following the precedent of the North Pacific Fur Seal Convention.<sup>252</sup>

ii. *Other Possible Entrants.* With regard to other nations which might be tempted to embark upon high seas fishing to take advantage of the large numbers of salmon grazing in the common ocean, the situation is in one sense more difficult than that with the Japanese. Even if the states-of-origin were to recognize national property rights among themselves for the protection of their salmon, they do not currently possess the means to enforce such rights against others on the high seas.<sup>253</sup> Nonetheless, the combined economic and diplomatic weight of the four salmon producing nations, *if wielded in a co-ordinated fashion*, would undoubtedly go far toward discouraging the entry of non-origin states into the fishery.

## CONCLUSION

Ocean salmon ranching is growing rapidly throughout the North Pacific Basin. Indeed, so great is this growth that it is con-

251. See note 191 *supra*.

252. Interim Convention on the Conservation of North Pacific Fur Seals, Feb. 9, 1957, 8 U.S.T. 2283, T.I.A.S. No. 3948, 314 U.N.T.S. 105. Amending Protocol, Oct. 8, 1963, 15 U.S.T. 316, T.I.A.S. No. 5558, 494 U.N.T.S. 303. Amending Protocol, Sept. 3, 1969, 20 U.S.T. 2992, T.I.A.S. No. 6774, 719 U.N.T.S. 313. Amending Protocol, May 7, 1976, 27 U.S.T. 3371, T.I.A.S. No. 8368, — U.N.T.S. —. The parties to this agreement, which was originally entered into in 1911 and then renewed after World War II, are Canada, Japan, the Soviet Union, and the United States. The Convention was prompted by the fact that by

. . . 1911 unrestricted hunting of fur seals on the high seas and on the limited number of islands in the Bering Sea on which they bred, had reduced the stock to a small fraction (about 120,000 animals) of their original numbers. . . . [A]n . . . agreement between the four countries concerned . . . prohibited killing of seals on the high seas, and put the harvesting of animals on the breeding islands under the strict control of the Governments concerned (U.S.A. and U.S.S.R.). In return for abstaining from pelagic (high-seas) sealing, Canada and Japan, who had no breeding islands, were given a share of the skins taken by U.S.A. and U.S.S.R. Under this arrangement, which has been renewed a number of times, and is now supervised by the International North Pacific Fur Seal Commission, the stocks have been rebuilt to a high level, and a substantial excess in value of furs over the costs of harvesting and administration is obtained. J. GULLAND, *supra* note 229, at 6.

Applying this precedent to the Japanese high seas salmon fleet, the other salmon producing nations could attempt to buy out the Japanese fleet in return for a Japanese promise to abstain completely from high seas salmon fishing in the North Pacific. See Kury, *supra* note 229, at 359.

253. See text accompanying note 134 *supra*.

ceivable that more salmon will be introduced into the North Pacific by artificial means than by natural spawning before the year 2000. This development of ocean salmon ranching will present two principal challenges to the existing international regulatory structures concerning salmon in the North Pacific. First, if the introduction of fish into the common ocean goes unregulated, then at some point in the future the ocean's ability to provide sufficient food for grazing salmon will likely become overtaxed. Second, these fish will present an increasingly tempting target for capture by non-origin states. Despite a long history of international agreements concerning salmon fishing in this region, the current management structures are not well suited to accommodate the challenges that increased ocean ranching presents. Thus, a new comprehensive framework must be developed by the producing states to manage ocean ranching from the introduction through the harvest of these valuable marine products. The plan suggested here includes the creation of a central management authority by the producers to regulate the introduction of salmon into the common ocean, and the regulation of harvesting through the recognition of explicit national property rights in salmon and an attendant prohibition of all high seas salmon fishing.