TABLE 3.—Comparison of this work with literature values for the concentration of PCB's and DDT residues in surface films and subsurface waters. All values in nanograms per liter, and are the sum of filtrate and filter from Table 2 where applicable.

Reference	Location	PCB's		DDT residues	
		Surface films	Subsurface waters	Surface films	Subsurface waters
Seba and Corcoran (1969)	Biscayne Bay	ND[1]	ND	185-13,710	<1
	Florida Strait	ND	ND	70	<1
Duce et al. (1972)	Narragansett Bay	450-4,200	<50-150	undetected	undetected
Cox (1971)	Nearshore California Current	ND	ND	ND	2.3-5.6 (1-2 m depths)
This work	California coastal	11-50	ND	12.2-15.4	ND
	Mexican coastal	12-90	ND	<0.03-11.2	ND
	Offshore California Current	8.0	2.5	0.4	0.1
	North Central Pacific Gyre	5.2-6.2	4.7	<0.02	<0.01

[1]Not determined.

The primary aim of this work has been to establish open ocean concentrations of PCB's and DDT residues in surface films and subsurface waters in oligotrophic regions of the ocean such as the North Central Pacific Gyre. The PCB content of open ocean waters are significantly lower relative to inshore waters, and represent the first such numbers for an open ocean environment in the Northeast Pacific.

Acknowledgments

We thank H. Bezdek for collection of the surface film samples from the Mexican coastal waters (M 1-4).

This work was supported by AEC Contract AT(11-1)GEN 10, P.A. 20.

Literature Cited

COX, J. L.
1971. DDT residues in seawater and particulate matter in the California Current system. Fish. Bull., U.S. 69:443-450.

DUCE, R. A., J. G. QUINN, C. E. OLNEY, S. R. PIOTROWICZ, B. J. RAY, AND T. L. WADE.
1972. Enrichment of heavy metals and organic compounds in the surface microlayer of Narragansett Bay, Rhode Island. Science (Wash., D.C.) 176:161-163.

GARRETT, W. D.
1965. Collection of slick-forming materials from the sea surface. Limnol. Oceanogr. 10:602-605.
1967. The organic chemical composition of the ocean surface. Deep-Sea Res. 14:221-227.

HARVEY, G. R., V. T. BOWEN, R. H. BACKUS, AND G. D. GRICE.
1972. Chlorinated hydrocarbons in open ocean Atlantic organisms. Proc. Nobel Symp. 20:177-186.

MCCLURE, V. E.
1972. Precisely deactivated adsorbents applied to the separation of chlorinated hydrocarbons. J. Chromatogr. 70:168-170.

MILLER, G. A., AND C. E. WELLS.
1969. Alkaline pre-column for use in gas chromatographic pesticide residue analysis. J. Assoc. Off. Anal. Chem. 52:548-553.

NATIONAL ACADEMY OF SCIENCES.
1971. Chlorinated hydrocarbons in the marine environment. A report prepared by the panel on monitoring persistent pesticides in the marine environment of the Committee on Oceanography. Natl. Acad. Sci., Wash., D.C., 42 p.

SEBA, D. B., AND E. F. CORCORAN.
1969. Surface slicks as concentrators of pesticides in the marine environment. Pestic. Monit. J. 3:190-193.

P. M. WILLIAMS
K. J. ROBERTSON

Institute of Marine Resources
University of California, San Diego
La Jolla, CA 92037

HATCHING SURVIVAL OF HYBRIDS OF *ONCORHYNCHUS MASOU* WITH *SALMO GAIRDNERI* AND WITH NORTH AMERICAN SPECIES OF *ONCORHYNCHUS*

The cherry salmon, *Oncorhynchus masou*, which is native only to Asian watersheds discharging into the northwestern Pacific Ocean, is a recent introduction to North America. While cherry salmon have been crossed with some Asian salmonids, information on their ability to hybridize with North American salmonids has not been reported in the literature. The primary purpose of these experiments was to determine hatching survival of some interspecific crosses involving cherry salmon, leading to a sound basis for predicting their effects on indigenous salmonid species and their potential value in salmon management.

Materials and Methods

From 10 October to 12 November 1972, hybridization experiments were carried out between 1-yr-old male cherry salmon parr from anadromous stock and female rainbow trout, *Salmo gairdneri*; pink salmon, *O. gorbuscha;* chum salmon, *O. keta;* coho salmon, *O. kisutch;* sockeye salmon, *O. nerka;* and chinook salmon, *O. tshawytscha.* Our cherry salmon were reared at the Washington State Department of Fisheries' Minter Creek Hatchery from eyed eggs sent in 1971 by the Hokkaido Salmon Hatchery, Sapporo, Japan. Incubation facilities were located at the Northwest Fisheries Center, National Marine Fisheries Service, Seattle, Wash. The standard dry fertilization technique was used in conjunction with delayed fertilization techniques described by Poon and Johnson (1970). All fertilization took place within 3 h of collection, with the exception of pink salmon eggs (14 h). There were no apparent effects from delayed fertilization. Numbers of eggs incubated ranged from 1,700 to 8,400; survival was based on the total eggs in each lot.

Discussion

Oshima (1957) reported that cherry salmon have successfully hybridized with redspot salmon, *O. rhodurus,* for many years. Other than hybrids of cherry salmon with redspot or Asian pink salmon, hybrids of cherry salmon with other salmon and trout are rare or unreported (Schwartz 1972; Dangel et al. 1973). Results of our own experiments, as shown in Table 1, show that crosses of cherry salmon with chum, chinook, and pink salmon and with rainbow trout were highly successful, each yielding higher hatching percentages than their respective controls. The reason for this phenomenon is not presently understood but it does indicate an area for further research. Only crosses of coho and sockeye salmon with cherry salmon showed poorer survival than their controls (Table 1). It is interesting to note that though there was no hatch of the cherry × sockeye cross, virtually all of the eggs were fertilized and developed to notochord formation. Each of the successful hybrid crosses yielded surviving fry to a 1 g or larger size accounting for over 85% of the hatch, except for the rainbow and coho crosses where survival to this size was less than 10%.

Literature Cited

DANGEL, J. R., P. T. MACY, AND F. C. WITHLER.
1973. Annotated bibliography of interspecific hybridization of fishes of the subfamily Salmoninae. U.S. Dep. Commer., NOAA Tech. Memo. NMFS NWFC-1, 48 p.

OSHIMA, M.
1957. Studies on the dimorphic salmons, *Oncorhynchus masou* (Brevoort) and *Oncorhynchus rhodurus* Jordan & McGregor, found in Japan and adjacent territories. Nire Shobo (Nire Book Company), Sapporo, Japan, 81 p. (Translated from Jap., 1972, Fish. Res. Board Can., Transl. Ser. 2104.)

POON, D. C., AND A. K. JOHNSON.
1970. The effect of delayed fertilization on transported salmon eggs. Prog. Fish-Cult. 32:81-84.

SANO, S., AND H. EGUCHI.
1936. Interspecific hybridization among salmonid fishes. Hokkaido Sakemasu Fukajo (Hokkaido Salmon-Trout Hatchery), 13 p. (Translated from Jap., 1968, Fish. Res. Board Can., Transl. Ser. 1164.)

SCHWARTZ, F. J.
1972. World literature to fish hybrids with an analysis by family, species, and hybrid. Publ. Gulf Coast Res. Lab. Mus. 3, 328 p.

TABLE 1.—Hatching success of eggs of hybrid crosses and controls.

Species[1]	Number of degree-days incubated	Percentage hatched	Previously reported results	Reference
Salmo gairdneri × *O. masou*	396	39.5	85% hatch	Suzuki and Fukuda 1971a, b
Salmo gairdneri (control)	321	34.7		
Oncorhynchus gorbuscha × *O. masou*	512	71.6	37-46% hatch	Smirnov 1969
Oncorhynchus gorbuscha (control)	593	62.5		
Oncorhynchus keta × *O. masou*	436	94.1	77% hatch	Sano and Eguchi 1936
			0-96% hatch	Smirnov 1969
			0-69% hatch	Terao and Hayashinaka 1961
Oncorhynchus keta (control)	504	90.9		
Oncorhynchus kisutch × *O. masou*	300	26.5	None	
Oncorhynchus kisutch (control)	333	90.9		
Oncorhynchus nerka × *O. masou*	660	0.0	0% hatch	Suzuki and Fukuda 1971a, b
			0-3.3% hatch	Terao and Hayashinaka 1961
Oncorhynchus nerka (control)	642	96.0		
Oncorhynchus tshawytscha × *O. masou*	426	97.4	None	
Oncorhynchus tshawytscha (control)	486	72.9		

[1]Female listed first and male last.

SMIRNOV, A. I.
1969. Hybrids of Pacific salmon of the genus Oncorhynchus, characteristics of development and prospects of utilization. *In* B. I. Cherfas (editor), Genetika, selektsiya i gibridizatsiya ryb, p. 139-159. Izdatel'stvo "Nauka," Moscow. (Translated by Isr. Prog. Sci. Transl. 1972, p. 131-147 *in* B. I. Cherfas [editor], Genetics, selection, and hybridization of fish, avail. U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, Va. 22151 as TT 71-50112.)
SUZUKI, R., AND Y. FUKUDA.
1971a. Survival potential of F_1 hybrids among salmonid fishes. Bull. Freshwater Fish. Res. Lab. (Tokyo) 21:69-83.
1971b. Growth and survival of F1 hybrids among salmonid fishes. Bull. Freshwater Fish. Res. Lab. (Tokyo) 21:117-138.
TERAO, T., AND H. HAYASHINAKA.
1961. On the artificial hybridization among the salmonid fishes. I. Sci. Rep. Hokkaido Fish Hatchery 16:51-62. (Translated from Jap., 1968, Fish. Res. Board Can., Transl. Ser. 1047.)

JAMES L. MIGHELL

Northwest Fisheries Center
National Marine Fisheries Service, NOAA
2725 Montlake Boulevard East
Seattle, WA 98112

JAMES R. DANGEL

Alaska Regional Office
National Marine Fisheries Service, NOAA
P.O. Box 1668, Juneau, AK 99801

TRAP CONTRIBUTIONS TO LOSSES IN THE AMERICAN LOBSTER FISHERY

Studies to evaluate the impact of unbuoyed traps on American lobster, *Homarus americanus*, survival were conducted in Maine waters from July 1971 to June 1973.

Materials

On 22 July 1971, 98 tagged lobsters of various legal and illegal sizes and both sexes were placed in 35 unbaited conventional square traps, with 30-mm lath spacing, without buoy lines, on the sea bottom near Jonesport, Maine, in depths ranging from about 10 to 20 m (Table 1). On 29 July 1971, four tagged lobsters were added to one trap from which the previous occupants had escaped by 24 July.

The 84-m^2 study site, considered by fishermen not to be a good lobster habitat, having a muddy bottom and no rocks which could be utilized as cover, was purposely selected because its use would not interfere with commercial fishing and traps would be protected from storm damage.

Methods

Traps were checked on nine occasions before 15 October 1971, by scuba diving. When traps were checked by diving, it was possible to count the lobsters and observe evidence of cannibalism, but tagged lobsters could not readily be distinguished from others that entered the traps. In order to differentiate tagged from untagged lobsters, all traps were brought to the surface for more thorough examination. This practice was commenced on 15 October 1971 and continued throughout the remaining period of the study.

Traps were retrieved 16 times between 15 October 1971 and 26 June 1973, making a total of 25 checks during the investigation. The length of time between observations of the 2-yr period ranged from 1 to 161 days, with a median interval of 13 days and a mean of 28 days. Observations were curtailed during the low temperature months because of the inactivity of lobsters in relatively shallow water.

Results

During the first summer-fall season, 43% of the tagged lobsters cannot be accounted for; 25% remained captive; 20% escaped and were recaptured; and 12% were cannibalized. During the second summer-fall season, 126% recruitment occurred; 22% cannot be accounted for; 18% of both tagged and recruited lobsters were cannibalized; 55% remained in the traps; and 5% of tagged lobsters escaped and were recaptured.

A minimum 67 "wild" lobsters were recruited by the traps, of which 24 still remained captive when the study was terminated. Two tagged lobsters that departed their original traps entered other experimental traps which they in turn left before entering two of the commercial traps surrounding the study site. A tagged male lobster missing from trap no. 6 was caught in a commercial trap 0.4 km from the study area on 28 April 1973, after having remained in trap no. 6 for 22 mo and having moulted once in October 1971 from sublegal to legal size. Four traps failed to recruit any lobsters; 9 recruited one each; 13, two each; 6, three each; 2, four each; and 1, six. Only five traps recruited more lobsters than were initially placed in them, six recruited a like number.