UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TECHNICAL LETTER NUMBER 6

FISH KILL FROM UNDERWATER EXPLOSIONS*

by

David J. Stuart**

DENVER, COLORADO

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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Technical Letter
Crustal Studies-6
November 13, 1962

Dr. Charles C. Bates
Chief, VELA UNIFORM Branch
Advanced Research Projects Agency
Department of Defense
Pentagon
Washington 25, D. C.

Dear Dr. Bates:

Transmitted herewith are 10 copies of:

TECHNICAL LETTER NUMBER 6

FISH KILL FROM UNDERWATER EXPLOSIONS*

by

David J. Stuart**

This report was written to present the available facts on the number of fish killed as a result of nonmarine, underwater, high-explosive shots set off by the U. S. Geological Survey in conjunction with our study of seismic propagation paths and regional traveltimes in the California-Nevada region.

Sincerely,

L. C. Pakiser

L. C. Pakiser, Chief
Branch of Crustal Studies

* Work performed under ARPA Order No. 193-62

** U. S. Geological Survey, Denver, Colorado

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The U. S. Geological Survey has used 23 different shotpoints during two seasons of field work in our seismic study of crustal structure in western United States. Without exception, it has been found that underwater shotpoints result in a more efficient conversion of explosive energy into seismic energy than do drilled-hole shotpoints. This experience, together with elimination of drilling costs, has led to the use of underwater shotpoints wherever possible.

Three of the 23 shotpoints were in the Pacific Ocean, and for these we have no detailed information on the fish kill. Another six shotpoints were located in inland bodies of water. These are:

Soda Lake near Fallon, Nevada

Mono Lake near Lee Vining, California

Lake Mead near Boulder City, Nevada

Shasta Lake near Redding, California

C. J. Strike Reservoir near Bruneau, Idaho

Lucky Peak Reservoir near Boise, Idaho.

* Work performed under ARPA Order No. 193-62

** U. S. Geological Survey, Denver, Colorado

Soda Lake and Mono Lake contain alkaline water that does not support fish life, so no fish were killed by the 37 charges, weighing a total of 190,700 pounds of high explosives, fired in these lakes.

Table 1 gives some statistics relating to all game and non-game fish recovered at the surface following underwater shots in the other four bodies of water. Numbers, weights, and types of fish killed were compiled by Fish and Game Department representatives of the states involved. The table shows numerical percentages for the types of non-game fish killed, and weight percentages for the types of game fish killed. The "fish-recovered" columns show the types of fish killed in the order of decreasing numbers.

Table 1.--Fish kill from underwater explosions

Shotpoint	Date (1961)	Time	Water depth (ft.)	Charge size (lbs.)	Explosive type	Non-game fish recovered		Game fish recovered		
						No.	Type	No.	Wt. (lbs.)	Type
Lake Mead, Nevada	11-14	7:00	190'	2,000	Nitramon WW	21	carp, suckers	59	105.7	crappie, bass, catfish
--do--	11-15	8:30	190'	4,000	---do---	90	-do- -do-	14	26.0	bass, crappie, catfish
--do--	11-16	9:30	190'	6,000	---do---	71	-do- -do-	7	14.2	bass, crappie, catfish
				12,000		182	carp 95.6%; suckers 4.4%	80	145.9	bass 55.6%; crappie 41.0%; catfish 3.4%

Table 1.--Fish kill from underwater explosions--Continued

Shotpoint	Date (1962)	Time	Water depth (ft.)	Charge size (lbs.)	Explosive type	Non-game fish recovered		Game fish recovered		
						No.	Type	No.	Wt. (lbs.)	Type
Lake Mead, Nevada	6-8	13:45	210'	6,000	---do---			33	42.8	bass, crappie, catfish
--do--	6-11	9:30	210'	6,000	---do---			75	52.0	catfish, bass, crappie
--do--	6-12	9:30	210'	4,000	---do---			38	27.0	catfish, bass, crappie
--do--	6-14	13:00	210'	4,000	Composition "B"			5	2.3	catfish
--do--	6-19	12:40	210'	2,000	---do---			25	23.0	catfish, bass, crappie, rainbow trout
--do--	6-20	9:35	210'	2,000	---do---			57	37.9	catfish, bass, crappie
Lake Mead, Nevada	6-21	9:30	210'	4,100	Composition "B"			49	23.6	catfish, bass
--do--	6-22	9:30	210'	6,000	---do---			49	32.9	catfish, bass, crappie
--do--	6-25	9:30	210'	6,000	---do---			80	46.0	catfish, bass, crappie
				40,100		1,810	carp 100%	411	287.5	catfish 60.6%; bass 29.1%; crappie 9.9%; rainbow trout 0.4%

Table 1.--Fish kill from underwater explosions--Continued

Shotpoint	Date (1962)	Time	Water depth (ft.)	Charge size (lbs.)	Explosive type	Non-game fish recovered		Game fish recovered		
						No.	Type	No.	Wt. (lbs.)	Type
Shasta Lake, California	7-31	7:00	125'	6,000	Composition "B"	1021	hardhead, shad,catfish	665	33.8	kokanee salmon, bluegill, rainbow trout
--do--	8-1	7:00	125'	6,000	---do---	51	hardhead, suckers	194	16.8	kokanee salmon, bluegill, bass
--do--	8-2	7:00	125'	6,000	---do---	150	hardhead	33	4.0	kokanee salmon, bluegill, rainbow trout
--do--	8-3	7:00	125'	3,000	---do---	101	hardhead, carp	28	3.0	kokanee salmon, bluegill, silver salmon
				21,000		1323	hardhead 98.3%; shad 1.5%; catfish 0.1%; suckers<0.1%; carp<0.1%	920	57.6	Bluegill 50.0%; Kokanee salmon 41.7%; bass 3.5%; rainbow trout 3.1%; silver salmon 1.7%

Table 1.--Fish kill from underwater explosions--Continued

Shotpoint	Date (1962)	Time	Water depth (ft.)	Charge size (lbs.)	Explosive type	Non-game fish recovered		Game fish recovered		
						No.	Type	No.	Wt. (lbs.)	Type
C.J. Strike Reservoir, Idaho	7-9	13:00	70'	2,500	Composition "B"	455*	carp, suckers, chub	225*	67*	crappie, perch
	7-10	15:00	70'(?)	2,500	---do---	398*	carp, chub, suckers	152*	35*	crappie, perch, bluegill, bullhead
	7-11	11:30	70'(?)	5,000	---do---	36*	carp, suckers, chub	174*	47*	crappie, perch, bluegill, bullhead
				10,000		889*	carp 75.0%; suckers 20.8%; chub 4.2%	551*	149*	crappie 75.2%; perch 22.1%; bluegill 1.4%; bullhead 1.3%

* Estimated

Table 1.--Fish kill from underwater explosions--Concluded

Shotpoint	Date (1962)	Time	Water depth (ft.)	Charge size (lbs.)	Explosive type	Non-game fish recovered		Game fish recovered		
						No.	Type	No.	Wt. (lbs.)	Type
Lucky Peak Reservoir, Idaho	7-10	7:15	135'	2,000	Composition "B"			194	57	whitefish, trout, perch
	7-10	14:30	135'	4,000	---do---			167	35	perch, whitefish, trout
	7-11	10:00	135'	6,000	---do---			90	27	trout, whitefish, perch
				12,000		12,381*	suckers 44.7%; shiners 43.4%; squawfish 11.4%; chiselmouth 0.5%	451	119	whitefish 46.1%; trout 36.6%; perch 17.3%

* Estimated

The 22 high-explosive charges, weighing a total of 95,100 pounds, that were fired in lakes containing fish life resulted in the known death of 2,413 game fish with a total weight of 759 pounds. The average mortality was 110 game fish or 34.5 pounds of game fish killed per average shot of 4,325 pounds of high-explosives.