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GOVERNOR OF HAWAII



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DEPARTMENT OF LAND AND NATURAL RESOURCES

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MEMORANDUM

TO: Division of Aquatic Resources, files

FROM: Francis Oishi, Program manager *FO*
Division of Aquatic Resources

SUBJECT: February 2009 Fish Kill Interim Report

The following administrative report memorandum was completed in response to requests for information regarding a reported fish kill from the island of Niihau, Hawaii, and this Division's investigation of that incident.

Introduction – Background

On February 2, 2009: Department of Land and Natural Resources, Division of Aquatic Resources (DLNR-DAR), Kauai office was alerted to a fish die-off on the island of Niihau. The island's owner brought our Kauai biologist fish samples that had been collected along the island's shorelines. The landowner estimated that the total kill of dead fish could be "50-100 tons". The owner also reported a dead humpback whale. Some of the dead fish collected by the landowner were left with the Kauai biologist.

DAR-Kauai alerted our Honolulu office and in turn, alerted the Department chairperson, the Department's enforcement, the humpback whale sanctuary state co-manager, wildlife offices, and the Department of Health, Clean Water Branch (DOH-CWB).

On February 3, 2009, DLNR-DAR conducted a site investigation. The State DOH accompanied DAR. Initial reports of a massive die-off were not confirmed when inspecting the Niihau shorelines. One location, Keanahaki, had about 100 dead fish, mostly triggerfishes. It appeared that the fish had been dead for a long time. The landowner had stated that dead fish were first noticed on/about January 17, 2009. The investigating party collected fish and water samples. All fish (except one) displayed varying degrees of decay.

On February 4, 2009, DLNR and DOH jointly issued a news release to inform the public about the fish kill event and to advise the public to avoid harvesting and consuming fish caught from around Niihau.

Purpose:

Reports of fish kill events are of programmatic interest to the Division. Whether their causes are natural or anthropogenic, understanding these events assists the agency that manages aquatic life and serves the public purpose in terms of accurately reporting incidents, causes of incidents, and remedies. To this end, the Division will investigate all reports of fish kills and try to determine the cause and impacts for aquatic life, and its implications for the public.

Methods/materials:

The following field investigations were conducted.

First field investigation:

On February 3, 2009: Upon receiving the report, DLNR-DAR prepared for a site investigation. DOH accompanies DLNR. With the assistance of the landowner, the DAR Kauai biologist and a DOH-CWB specialist traveled to Niihau to conduct the investigation. Initial reports of a massive die-off were not confirmed when touring the Niihau coastline. At one location, Keanahaki, investigators observed about 100 dead fish, mostly triggerfishes. It appeared that the beached fish had been dead for a long time. The landowner stated that dead fish first appeared on/about January 17, 2009. Fish and water samples were collected by the investigators. All fish (except one) displayed varying degrees of decay. For further detail on this field investigation, please see the attachment, "fish kill Niihau Feb 2009".

Because of public health-related concerns, the DLNR collaborated with the DOH, and the DOH would receive one-half of the fish samples collected and to be tested. Early in the investigation, DAR learned that a rodenticide-laced food pellet was dropped onto nearby Lehua Island (to eradicate alien rodents that were destroying native birds and plants). Therefore a specific test for the active ingredient, diphacinone was to be conducted by the DOH lab.

Queries were also made into the testing and necropsy analysis of these samples. They included: U.S. Geological Service office in Honolulu, a NOAA lab in Seattle, and two UH-Manoa labs.

Second field investigation:

A second field investigation was conducted on February 6, 2009. The DLNR-DAR, Kauai biologist, a Hawaii Humpback Whale National Marine Sanctuary state co-manager specialist, and a NOAA-retained veterinarian traveled to Niihau to inspect the condition of the monk seals and to investigate the report of the whale carcass. A concern had been expressed for seal health in the event they were consuming dead or contaminated fish.

No whale carcass was located and it was reported to have washed out to sea.

Monk seals were observed, and because they did not appear to be in any stress, only fecal and urine samples were collected off the beach for follow up testing. Less than 10 dead fish were observed during this investigation.

Third field investigation:

A follow up investigation was initiated when it was reported that diphacinone had not been tested for in the February samples submitted to the DOH. There was community speculation that the rat poison used on Lehua Island was responsible for the fish kill. Further, community concerns persisted for the food safety of consuming fishes from around Niihau. It was decided that fresh fish samples would be collected from around Niihau to determine whether fish had levels of diphacinone.

A DAR team was deployed to Niihau for fish collection on April 18, 2009. A DOH specialist accompanied the DAR team. A member of the Robinson family and a Niihau resident assisted with the fish collection.

Fish were collected from Oahu in an effort to provide control samples (away from the fish kill site).

Laboratory assays

The following two laboratories were selected to test for diphacinone based on their experience with testing for the chemical:

State of Hawaii, Department of Agriculture (HDOA), Pesticides branch. Have the capability to test for diphacinone. 2-3 weeks processing time once samples are received. (Credibility: EPA-funded laboratory.) No charge to DLNR.

State of California, Department of Fish and Game, Water Pollution laboratory. Routinely test for anticoagulants, including diphacinone. 2-3 weeks processing time once samples are received. (Credibility: USFWS contract laboratory.) \$500/sample.

Fish collected from the February fish kill incident, and an Oahu control site were submitted to these two laboratories for diphacinone analysis. Tables I and II show the results of the testing for diphacinone. The HDOA laboratory had requested offsite control specimens for test procedure calibration purposes.

Nearshore marine fish were also collected during April 2009 Niihau surveys and were used to determine whether or not nearshore reef fishes were exposed to diphacinone. Control site specimens from Oahu were also submitted for testing. Table III shows the results of the diphacinone testing. Various persons were involved in the collection effort: Niihau landowner, Niihau resident, DLNR-DAR (Kauai, Oahu), and DOH-CWB (Kauai).

Results

Observations from first field investigation:

On February 2, 2009, DLNR-DAR Kauai was first alerted to a fish die-off on Niihau by the landowner. The landowner brought a bag of dead fish containing mainly triggerfishes, file fishes and rudderfishes (See Photo 1). He also reported a dead humpback whale.

On February 3, 2009, the DLNR-DAR Kauai biologist and a DOH CWB specialist traveled to Niihau to conduct an investigation of a reported fish kill. They were accompanied by the landowner. During the investigation, they traveled to different shorelines of the island where they noted some dead fish, but not in the amounts initially estimated by the landowner (See Photo 2). At one location, Keanahaki, located near the southeastern end of Niihau (See Photo 3), they found about 100 dead fish. Specimens were collected. Species included members of the triggerfish family, some file fishes, rudderfishes, and other fish species in smaller numbers. The dead fish were in various stages of decomposition, and the landowner stated that fish started washing up on the beaches about mid-January. The investigators did not examine the whale carcass as it had been reportedly already washed out to sea.

One-half of the fish collected was turned over to the Department of Health for testing. The other half was retained by DLNR-DAR, Kauai. When it was learned that DOH had not tested for diphacinone, DLNR DAR split the February 2 and February 3 collections that had been retained in its custody into two batches, with one batch going to the Hawaii Department of Agriculture, Pesticide Branch, and the other batch going to the California Fish and Game Water Pollution Control Laboratory. Both labs were asked to test the fish for the presence of diphacinone. The results of the analysis for diphacinone are reported in Tables I and II. No diphacinone was detected in any of these samples. Included as part of their routine testing, the California lab detected the presence of a microcystin toxin, which is produced from a freshwater blue-green algae usually found in warm, high nutrient freshwater systems. A microcystin toxin, MC-RR, ranging between 4.55 to 97.6 ppb was detected in the stomach samples of both *Melichthys* species from both sampling dates. MC-RR was not detected in liver samples from the same fish, and it was not detected in the stomach sample of the *Naso* sp..

One fish sample retrieved by the DAR biologist during the February 3, 2009 survey was in good condition in that it was still alive when collected. This specimen was preserved in formalin and transferred to a USGS National Wildlife Health Center in Honolulu, where it was examined. The examination revealed that it had a markedly distended swim bladder, and acute inflammation and swelling of the gills that suggested an acute insult. Final diagnosis of death was undetermined (T. Work, Diagnostic Case Report, 2//25/09).

The DAR biologist noted that there was evidence of recent stormwater runoff in the vicinity of Keanahaki. A drainage channel created by the runoff resulted in freshwater and sediment flow into Kealea Bay. This bay is adjacent to Keanahaki. A Niihau resident relayed that a significant storm occurred in late December/early January and may have accounted for the runoff. No other observations were noted which potentially represented any causative link to the fish kill.

Reports of results from second field investigation:

On February 6, 2009, DLNR-DAR, Kauai biologist accompanied a NOAA-retained veterinarian and a staff from the state's humpback whale co-manager's office to Niihau to conduct an assessment of the island's monk seal population to evaluate whether or not the seals could have been affected by consuming the tainted fish. The team found the seals in good health and apparently not in a stressed condition. Therefore planned procurement of blood samples was aborted, and only feces and urine samples (from the beach sand) were collected. The team noted about 10 dead fish in their surveying of the seals.

Feces and urine samples were sent to UC Davis, Marine Ecosystem Health Diagnostic & Surveillance Laboratory for testing. Dipahcinone was not detected in any of the fecal samples (LOD: 5 ppm). Additionally, the urine samples were tested for domoic acid, a marine toxin; it was not detected (LOD: 5 ppb). (UC Davis School of Veterinary Medicine, 3-25-09)

Third field investigation:

On April 18, 2009, a DLNR-DAR team composed of the Kauai biologist, a biologist and a fisheries technician both from Oahu, along with a DOH-CWB, Kauai specialist accompanied the Niihau landowner and a resident to collect fish samples to determine if current fish stocks may be affected by diphacinone. In all, 90 specimens were collected from several locations around the island (See Photo 4), both from shore and by boat. A sub-sample of 21 specimens representative of the species collected was processed for laboratory assay. The species that were collected represented both triggerfishes (the species most commonly observed from the fish kill) and other species that are commonly harvested for food. Those samples (see Table III) did not test positive for diphacinone. The HDOA laboratory performed the assays.

Another subset of the 90 specimens was delivered to the USGS National Wildlife Health Center in Honolulu for examination on April 21, 2009. Seven specimens mostly representing species commonly collected for food were examined, and included one triggerfish specimen (of the species that was affected in the fish kill). Six specimens exhibited good body condition, including the triggerfish; one exhibited fair body condition. This observation along with the microscopic findings was considered to be expected when examining wild fish, and no common underlying problem was found that would indicate a disease. (T. Work, Diagnostic Case Report, 5/15/09)

The DLNR relayed the results of the test findings to the Niihau landowner, and to the DOH in mid May 2009. A news release of the findings was also issued by the DLNR on June 3, 2009.

Discussion

Upon the notification of the fish kill, the DLNR-DAR immediately made arrangements to conduct a field survey. It is unfortunate that DLNR was not notified earlier, since dead fish washing ashore had reportedly been occurring as early as two weeks before. Earlier notification could have yielded fresher specimens, and more accurate data on the types and amounts of marine life impacted, very critical when trying to determine cause of death, and the extent of the kill could also have been more precise. Moreover, dying or moribund specimens could have yielded better clues as to the cause of death. In this event, the greatest density of dead fish occurred only at one site, Keanahaki, and amounted to about 100 dead fish. One fish that was still alive when collected was provided to the USGS for examination. However observations on

this lone specimen may need to be distinguished from being associated with the fish on the beach which could have been days to weeks old. In other words, the cause of death of the fresh specimen may be unrelated to the older dead fish (on the beach).

Additionally, it was observed by our investigators that Keanahaki seemed to be a natural collection point as evidenced by the amount of marine debris on the shoreline. This may indicate that the fish kill had occurred elsewhere. Enough time elapsed so that decomposition of the fish then resulted in the fish to float, and become subject to wind and current action. Speculation as to where the fish kill could have occurred cannot be accomplished with only the data that is available.

This fish kill event is likely to be the first report of a major kill for Niihau and is significant in that regard. DLNR DAR biologists cannot recall any fish kills reported for Niihau in the last 30 years.

There has been much speculation as to possible causes for the kill: diphacinone-laced rat baits applied to Lehua Island, just offshore of Niihau (See Photo 5); military exercises conducted during the time of the rat poison applications that might have involved a physical, or chemical pollutant; a land-based pollutant in the island's run-off. Regardless of which possible cause is being considered, they all do not address one aspect: that the majority of the fish killed were isolated to a few species: triggerfishes, filefishes, and rudderfishes. In the case of the trigger and file fish, different size classes were affected (see attached fish kill Niihau Feb 2009). All the aforementioned causes for a fish die-off do not account for the specificity in the species mortalities.

Conclusion

The testing of the fish from the fish kill by two independent laboratories did not detect diphacinone. Both labs preferred to test fish organs (as opposed to fish tissue), notably the livers, as a logical site for toxin deposits. The California lab found a freshwater blue-green algae toxin in the stomachs of several of the February triggerfish samples. This toxin is sometimes responsible for the mortality of certain marine species in temperate zones (Ricker, pers. communication). Follow up attempts to retrieve freshwater samples from Niihau to test for these algae were unsuccessful.

Subsequent fresh fish samples of triggerfishes and those species that are considered food fish also failed to test positive for diphacinone. Additionally post mortem exams considered several of the fish species that we collected to be in normal states.

The cause for the Niihau fish kill reported to the DLNR-DAR remains unknown.

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DLNR-DAR

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David Nichols, marine conservation specialist
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DOH-CWB

Gary Ueunten, Kauai specialist

Niihau residents

Bruce Robinson
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Binh Loo, chemist
Anne Kam, Kauai investigator
Steven Ogata, Oahu investigator

California F&G Water Pollution Laboratory

David Crane, Lab director

NOAA Office of Response and Restoration

Rob Ricker, Regional Manager
Tracy Collier, NOAA NW Fisheries Science Center

U.S. Geological Survey, National Wildlife Health Center

Thierry Work, Wildlife Disease Specialist

NOAA

Robert Braun, DVM

Photos used in this report by: Don Heacock, Paul Murakawa.

Table I: Results of testing for diphacinone in fish specimens recovered from the February 2009 fish kill on Niihau, and from fish submitted as control specimens collected on Oahu, April 1, 2009.

Date of collection	Collected by	Species, (sample n), type	Test Result	Laboratory
2/2/09	B. Robinson	M.v., (2), muscle, pooled sample	N.D.	HDOA
		M.v., (1), liver	N.D.	
2/3/09	D. Heacock	M.n., (2), muscle, pooled sample	N.D.	HDOA
		M.n., (1), liver	N.D.	
4/1/09	DAR-Oahu	B.sp., (1), muscle (from Oahu, control)	N.D.	HDOA
		T. sp., (4), muscle (from Oahu, control)	N.D.	

M.v. – *Melichthys vidua*
M.n. – *Melichthys niger*
B.sp. – *Balistidae* sp.
T.sp. – *Tilapia* sp.
N.D. – Not Detected (Test Limit of detection: 5 ppb)
HDOA – Hawaii Department of Agriculture, Pesticides Branch

Table II: Results of testing for diphacinone in fish specimens recovered from the February 2009 fish kill on Niihau.

Date of collection	Collected by	Species, (sample n), tissue type	Test Result	Laboratory
2/2/09	B. Robinson	M.v., (2), liver composite	N.D.	Cal. F&G
		M.v., (2), stomach composite	N.D.	
		M.v., (2), gills composite	N.D.	
2/2/09	B. Robinson	M.n., (2), liver composite	N.D.	Cal. F&G
		M.n., (2), stomach composite	N.D.	
		M.n., (2), gills composite	N.D.	
2/3/09	D. Heacock	M.n., (2), liver composite	N.D.	Cal. F&G
		M.n., (1), stomach	N.D.	
		M.n., (1), gills	N.D.	
2/3/09	D. Heacock	M. v., (2), liver composite	N.D.	Cal. F&G
		M.v., (2), stomach composite	N.D.	
		M.v., (2), gills composite	N.D.	
		N.sp., (1), liver	N.D.	
		N.sp., (1), stomach	N.D.	

M.v. – *Melichthys vidua*

M.n. – *Melichthys niger*

N.sp. – *Naso* sp.

N.D. – Not Detected (Test Reporting limit: 5 ppb)

Cal. F&G – California Department of Fish and Game,

Fish and Wildlife, Water Pollution Control Laboratory

Table III: Results of testing for diphacinone in fish samples collected by DLNR-DAR, April 18, 2009 from Niihau, and control samples collected from Oahu, April 22, 2009.

Date of collection	Collected by	Species, (sample n), tissue type	Test Result	Laboratory
4/18/09	Various	N. unicornis, (1), muscle and liver, separately	N.D.	HDOA
		Kyphosus sp., (4), muscle and liver, separately	N.D.	
		P. sexfilis, (6), muscle and liver, separately	N.D.	
		R. rectangulus, (2), muscle and liver, separately	N.D.	
		K. xenura, (1), muscle	N.D.	
		M. niger, (4), muscle and liver, separately	N.D.	
		A. triostegus, (1), muscle and liver, separately	N.D.	
		C. strigosus, (2), muscle and liver, separately	N.D.	
4/22/09	DAR-Oahu	M. niger, (4), muscle composite (Oahu control)	N.D.	HDOA
		M. niger, (7), liver composite (Oahu control)	N.D.	

N.D. – Not Detected (Test limit of detection: 5 ppb)
HDOA – Hawaii Department of Agriculture, Pesticides Branch



Photo 1: Dead fish submitted to DLNR-DAR, Kauai, February 2, 2009 by the Niihau landowner.



Photo 2: Example of dead triggerfishes observed on Niihau, February 3, 2009.



Photo 3: Shoreline: Keanahaki, Niihau.



Photo 4: Island of Niihau. Note: Lehua Island, seaward of the northern end of Niihau. Push-pin locations are 4-18-09 fish sample collection sites (by boat).



Photo 5: Lehua Island taken from Niihau's Kalani Hale shoreline.

**Division of Aquatic Resources
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MEMORANDUM {NiihauFishKill}

4 February 2009

To: Dan Polhemus

Thru: Francis Oishi

cc. Bob Nishimoto

Subject: Fish-kill on Niihau: observations and samples taken, preliminary report

February 2 (Monday):

At about 10:30, am on February 2, 2009, Keith Robinson called to inform me that Bruce Robinson reported a very large (as high as 50 tons) fish-kill along the north, east and west shores of Niihau and that Bruce would be bringing samples of dead fish to me to be picked from him at PMRF. The samples (n>100) included fresh and very necrotic fish; relatively fresh samples were taken from the larger sample of dead fish and were labeled and preserved for evidence (n=13; 12 frozen, 1 in 10% formalin). Bruce Robinson stated that most of these samples were collected on the east side of Niihau, but dead fish were washing up on all beaches on the north, east, and west shores.

<u>Species composition of samples (dead):</u>	<u>(# of n, est. size):</u>	<u>necrotic n; est.size</u>
<u>Melichthys niger</u> (Humuhumu 'ele'ele)	3 (12-15 cm)	37 (5-15 cm)
<u>M. vidua</u> (Humuhumu hi'ukole)	8 (10-15 cm)	52 (5-15 cm)
<u>Sufflamen capistratus</u> (Humuhumu mimi)	1 (15 cm)	9 (7-20 cm)
<u>Lutjanus kasmira</u> (ta'ape)	1 (10 cm)	1 (15 cm)
<u>Kyphosus cinerescens</u> (Nenu)	1 (35 cm)	8 (10-25 cm)

February 3 (Tuesday):

Meet Robinson's and Gary Uenton (DOH/CWB; to assist with collection of water samples) at Makaweli helipad at 12 noon, and departed for Niihau; landed near Keanahaki (S-E tip of island) and collected most of these samples between 1:30 to 2pm (although we came back at about 4:30pm and collected more samples); there were 6 seals on the beach and one in the water, and about 100 dead fish windrowed along the beach; most fish were very necrotic (dead 3-5 days) but some (the samples taken) were relatively fresh (<1day). In the field, most fresh specimens were photographed, and all were placed into labeled zip-lock bags and placed into a cooler with ice. Water conditions were too rough to sample or make underwater observations. However, opihi were abundant in the upper intertidal and a'ama crabs were relatively common along the shoreline (Bruce Robinson adamant that the 'a'ama populations and the general nearshore fish abundance

has declined significantly since the fish-kill began. A live opihi sample was taken for possible future comparative studies.

We traveled on foot westward across the island to Kaumuhonu where we found no dead fish ashore, only four (seals) were resting on the beach; Bruce Robinson said there were many dead fish there in the past week or so, and that dead fish started washing ashore on Niihau on January 17, 2009. He expressed regret that he had not contacted me earlier regarding the fish-kill.

We then traveled back to Keanahaki and collected a few more fish samples at about 4:30pm, including live 'a'ama crabs (for possible future comparative studies).

Subsequently, we traveled north by jeep along the Westside and saw three necrotic humuhumu niger on the beach at Kamalino Bay, but numerous stops along the southwest coastline on the way to Kamalino revealed no dead fish. Prior to departing Niihau at 6 pm, a single dead and necrotic humuhumu 'ele'ele was found on the north end of Niihau but was not kept.

<u>Species composition of samples (dead):</u>	<u>(# of n, est. size):</u>	<u>necrotic n; est.size</u>
<u>Melichthys niger</u> (Humuhumu 'ele'ele)	7 ¹ (12-15 cm)	49 (5-15 cm)
<u>M. vidua</u> (Humuhumu hi'ukole)	4 (10-15 cm)	53 (5-15 cm)
<u>Sufflamen capistratus</u> (Humuhumu mimi)	3 (15 cm)	5 (7-20 cm)
<u>Naso spp.</u> (kala)	1 (10 cm)	0
<u>Neomyxus chaptalli</u> (Uouoa)	1 (10 cm)	0
Grapsid crab ² :		
<u>Samples of live specimens:</u>		
Cellana exarata (opih)	14 ³ (3-7 cm)	n/a

¹ One very fresh specimen was preserved in 10% formalin, body cavity opened, gut full of food.

² Placed in same sample bag with two live ha'uke'uke.

³ Eight (8) were frozen and (6) were kept on ice.