



Fish Health and Monitoring

Here at Blue Ocean Mariculture, we are proud of our environmental stewardship and continuously strive to produce sustainably raised Hawaiian Kanpachi (*Seriola rivoliana*), locally known as Kahala, with minimal environmental impact. As environmental stewards, we routinely monitor the health of our fish and their surrounding environment, as well as the integrity of our farm. Please [contact](#) us for any other information regarding monitoring reports, or click [here](#) for more information.

Ectoparasite Monitoring and Treatment

Monitoring the health of our fish involves parasite management. The ectoparasites we find on our Hawaiian Kanpachi, called trematodes (*Neobenedenia spp.*), are monogenean parasites common to aquaculture and aquarium fish species. Also known as skin flukes, *Neobenedenia* are native to Hawaiian waters and have been identified at the Blue Ocean farm site since 2005. The fish are rigorously observed daily by crew and divers during feed events, routine mortality removal, and infrastructure maintenance activities. Key indicators of increasing or high *Neobenedenia* load include reduced voracity of feeding, increased frequency of fish flashing (rubbing) on the netting, increased mucus on the skin, and mottled coloration. If the crew observes these indicators, a sample of fish from the net pen will be collected for a detailed analysis. Fish from each net pen are sampled once per month for parasite load, individual weight, and general condition.

When the number of *Neobenedenia* on our farmed fish is high enough to potentially impact fish behavior or general health, the fish are treated (bathed) in a diluted hydrogen peroxide solution to remove the parasites. The FDA-approved compound used for this bath is 35% Perox-Aid® (produced by Eka Chemicals, Marietta, GA). The results of the treatments are monitored by the U.S. Fish and Wildlife Service and the FDA. The treatment has minimal environmental impact as the 35% Perox-Aid® (H₂O₂) breaks down into water (H₂O) and oxygen (O₂) during the treatment procedure and is dispersed as water and oxygen. The weekly average threshold of parasites per fish that triggers a treatment event depends on the fish's weight.

Treatment Trigger Points for optimal health:

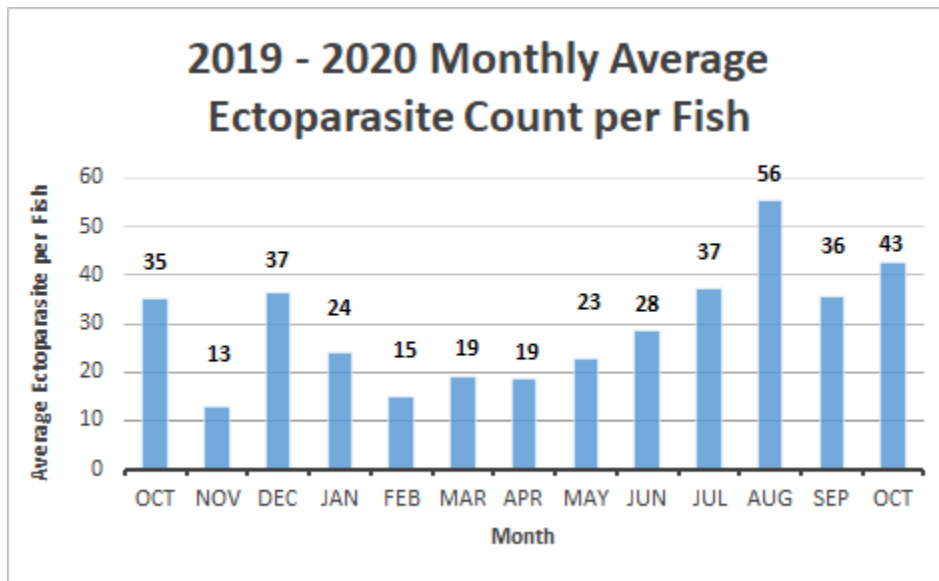
20-500 grams = 10 parasites / fish

500 -1000 grams = 40 parasites / fish

1000 grams + = 60 parasites / fish

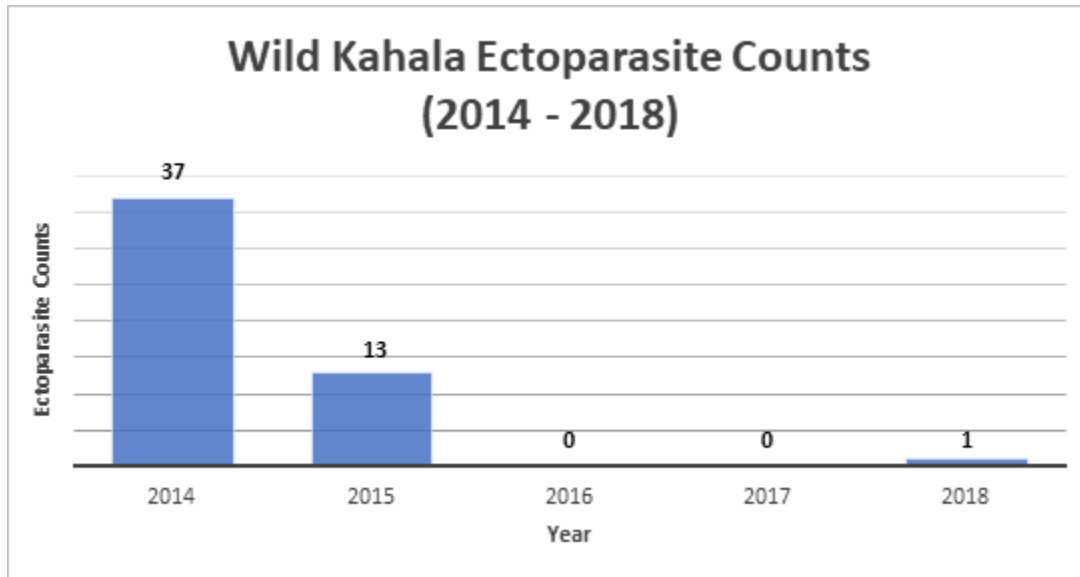
Farmed Fish

Ectoparasite sampling of our farmed Hawaiian Kanpachi, from October 1, 2019 – October 31, 2020, was conducted according to the procedure described above. The prevalence of *Neobenedenia* on the Blue Ocean farm site is illustrated below as monthly averages.



Wild Fish

Blue Ocean maintains a population of local, wild Kahala caught off the Kona coast for its broodstock program. Periodically through the year, we supplement the brood fish population with additional wild caught Kahala. Every animal caught under this program is sampled for trematode prevalence using the same procedure performed on our farmed fish. No new broodstocks were added to the hatchery in 2019. Since 2014, the annual ectoparasite average of wild caught Kahala has decreased, as shown in the graph below. The number of trematodes on wild caught Kahala has no direct correlation to the trematode counts of the farmed Hawaiian Kanpachi, thus; the trematode counts of both wild and farmed Hawaiian Kanpachi should not be compared.



Fish Escapes

According to Gruenthal et al., escapes of farmed fish could have a significant impact on wild fish populations and their ability to successfully reproduce in the wild. However, [the study](#) from Gruenthal et al. shows that even large amounts of farmed Hawaiian Kanpachi escapes had very little effects on wild Kahala populations. We understand the risks associated with fish escapes; therefore, we closely monitor the farm to ensure no breaches occur from our net pens, which are made of 4mm copper wire and 45mm copper alloy mesh. However, due to factors beyond our control such as predator interactions, accidents have happened.

All net and infrastructure issues are recorded and repaired immediately. We keep detailed records of all events, including rick events, fish inventory, escapes, or wildlife interactions. We do not use technology to count fish stocks, harvests, escapes, and mortalities. All records of data are undertaken via staff observation, which precedes the recording of data on datasheets and then into the computer database. Furthermore, all fish escapes larger than 50 are reported to the Department of Aquatic Resources.

Proceeding each escape event, the staff reviews the event rigorously to mitigate future escape events. To mitigate net holes from predator bites, we inspect the integrity of the net pens daily and conduct monthly inspections. To mitigate handling issues from divers, we discuss offshore operations and safety procedures during daily staff meetings. Staff members debrief after every escape event to review the cause of the escape and discuss how to prevent future occurrences. A table of escape events is provided below from October 1, 2019 -October 31, 2020.



Unrecorded Stock Escapes

The unrecorded stock escape for the most recent production cycle is provided below

SR- 20/21

(stocking count) - (harvest count) - (mortalities) - (recorded escapes) = Unrecorded stock escape

$$(203,186) - (131,990) - (64579) - (213) = 6,404$$

Date	Cohort	Net Pen	Stock Number	Estimated Escapes (Adjusted)	Observed Escapes	Cause of Escape	Details of Escape	Recoveries
11/8/19	SR-23	4	112636	3000	3000	Predator Bite	Hole in net	2400
1/20/20	SR-24	2	128995	5	5	Predator Bite	Hole in net	
3/3/20	SR-23	4	111071	1000	50-100	Predator Bite	Hole in the kikko net	
3/14/20	SR-24	2	127474	5	5	Predator Bite	Hole in net	
3/15/20	SR-24	2	127435	2	2	Predator Bite	Hole in net	
3/16/20	SR-23	4	111026	2	2	Predator Bite	Hole in net	
4/21/20	SR-25	2	120196	5	5	Predator Bite	Hole in net	
4/28/20	SR-23	4	102853	8000	1500-2000	Predator Bite	Hole in net	
6/5/20	SR-25	2	113676	400	400	Improper Rigging	Removed nursery net	
6/10/20	SR-23	4	102205	20	20	Predator Bite	Hole in copper net	
6/13/20	SR-23	4	102154	40	40	Predator Bite	Hole in net	
6/15/20	SR-23	4	102150	3	3	Predator Bite	Hole in net	
6/25/20	SR-23	4	102056	6	6	Predator Bite	Hole in net	
7/26/20	SR-23	4	101667	35	35	Predator Bite	Hole in net	
7/29/20	SR-25	1	108574	50	50	Improper Rigging	Zipper on portal open 12 in.	
8/21/20	SR-23	4	100812	7	7	Predator Bite	Hole in net	
8/22/20	SR-23	4	100807	1	1	Predator Bite	Hole in net	
8/23/20	SR-23	4	100795	2	2	Predator Bite	Two holes in net	
8/24/20	SR-23	4	100785	1	1	Predator Bite	Hole in net	
8/27/20	SR-25	1	107986	3	3	Predator Bite	Hole under swim wall	
9/18/20	SR-23	4	100378	2	2	Predator Bite	Hole in net	
10/9/20	SR-23	4	100023	2	2	Predator Bite	Hole in copper and swim wall	
10/20/20	SR-25	1	106176	2	2	Improper Rigging	Escaped through zipper	