

STATE OF ALASKA

William A. Egan, Governor



Annual Progress Report for

A STUDY OF DOLLY VARDEN IN ALASKA

by

Robert H. Armstrong and

Richard D. Reed

ALASKA DEPARTMENT OF FISH AND GAME

Wallace H. Noerenberg, Commissioner

DIVISION OF SPORT FISH

Rupert E. Andrews, Director

Howard E. Metsker, Coordinator

RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-3 *Name:* Sport Fish Investigations of Alaska.

Study No.: R-IV *Study Title:* A Study of Dolly Varden in Alaska.

Job No.: R-IV-A *Job Title:* Life History of Dolly Varden.

Period Covered: July 1, 1970 to June 30, 1971.

ABSTRACT

This report presents the results of the sixth year of study at Hood Bay and the ninth year of investigation on the life history of Dolly Varden, Salvelinus malma. Emphasis of study included behavior observations of Dolly Varden and coho salmon, Oncorhynchus kisutch, fry and fingerling; evaluation of the Dolly Varden smolt transplant conducted in 1969; an experiment to determine the role of sight and olfaction in homing Dolly Varden; and float tracking of mature Dolly Varden.

During observations in the natural environment and in an aquarium, coho fry frequently attacked Dolly Varden fry; no incidence of Dolly Varden fry aggression toward coho fry was recorded. As fingerling, Dolly Varden attacked coho on several occasions, with only one record of a coho attacking a Dolly Varden obtained.

Coho fry and fingerling sampled food more often at the surface than Dolly Varden fry and fingerling, which sampled food mostly at the stream bottom. Coho fingerling obtained food introduced into the aquarium more often than Dolly Varden fingerling.

Stomach content of Dolly Varden and coho fingerling sampled in Hood Bay Creek indicate coho fed more frequently on surface insects than did the Dolly Varden.

A total of 10.5% of the 1,184 Dolly Varden smolts transplanted from the North Arm streams to Hood Bay Creek returned to spawn in Hood Bay Creek in 1970. Of the smolts originating from Hood Bay Creek in 1969, 9.4% returned to spawn in 1970.

Olfactory occluded fish returned as well as the control fish displaced from Hood Bay Creek. The return of blinded Dolly Varden was only one tenth the return of the other groups. These results were considered inconclusive because of incomplete destruction of the olfactory lamellae and the possibility of increased predation on the blinded fish.

Float tracking of mature Dolly Varden indicated that they follow close to the shoreline and may use a compass orientation to locate shore from open water areas.

RECOMMENDATIONS

The life history segment of the Dolly Varden study should be discontinued. The basic life history has been determined and enough information has been gathered to formulate general management practices for this species.

The rearing requirements and habits of Dolly Varden are probably the least known aspect of their life history. Although a considerable amount of information on this subject has been gathered, there is still much to be learned. Land-use activities, especially logging, may be quite detrimental to Dolly Varden during their rearing phase. These activities are being investigated under the effects of logging segment of the Dolly Varden study. If logging is found to be detrimental to Dolly Varden young, then a more detailed investigation of their rearing habits may be necessary.

OBJECTIVES

1. To determine rearing habits and requirements of Dolly Varden prior to their migration to sea as smolts.
2. To determine if Dolly Varden smolts transplanted from one stream to another will home to the receiving stream at maturity.
3. To design and instigate experiments which will determine the stimuli used by mature Dolly Varden to locate their home stream.

TECHNIQUES USED

Observations were made of Dolly Varden and coho fry and fingerling in Hood Bay Creek and in a 40-gallon aquarium to determine behavioral differences between these two species.

During each observation period (10 minutes), one fish was watched and the following items were recorded on a tape recorder:

1. Number of acts of aggression either toward another fish, or on the fish being observed. Aggression was defined as obviously chasing or being chased by another fish and nipping.
2. The amount of time spent swimming and resting. Resting was considered to be physical contact with the bottom in an immobile condition.
3. The number of times food was sampled at the surface, bottom, and mid-depth. Food sampling was considered to be each time a fish mouthed an item such as floating debris.

Trichoptera (without case) and salmon eggs were introduced into the aquarium containing a mixed population of coho and Dolly Varden fingerling and the species grabbing the food first was recorded. The food introductions were made through a tube from the second story of the cabin. An observer located on the first floor near the aquarium in a darkened area precluded frightening the fish. No movement other than the food item hitting the surface or appearing at the bottom of the aquarium occurred. These experiments were distributed over several days and when more than one introduction of food was made on a given day, at least 1/2-hour elapsed between experiments.

Coho and Dolly Varden young were sampled from different habitat types in Hood Bay Creek during August. The stomach content from the esophagus to the pylorus was identified and the different food items were enumerated.

The Dolly Varden smolts transplanted from the North Arm streams to Hood Bay Creek in 1969 were enumerated at the weir as they entered Hood Bay Creek to spawn in 1970. In addition, the weirs on the North Arm streams were operated to determine return of these smolts to their home stream.

Groups of 50 each of mature, blinded, olfactory occluded, and control fish from known Hood Bay Creek Dolly Varden were displaced to the junction of the North and South arms of the bay. Methods of blinding and olfactory occlusion were identical to that described by Gunning (1959). A sample of five each of blinded fish, olfactory occluded fish, and control fish were held in a pen in the creek for 66 days. No mortality occurred during this period.

Styrofoam floats (Jahn, 1966) were attached to known mature Hood Bay Creek Dolly Varden and displaced to the junction of the North and South arms of the bay. Movements after release were then plotted on a map of the bay. The two ultrasonic tracked fish reported on last year (Armstrong, 1970) are included in the findings for comparison.

FINDINGS

Aggression

As fry, coho, Oncorhynchus kisutch, were observed to be dominant over Dolly Varden, Salvelinus malma. In 200 minutes each of observation in the natural environment and in the aquarium, no incidence of a Dolly Varden fry attacking a coho fry was recorded (Table I). In contrast, several incidents of coho attacking Dolly Varden were recorded.

As fingerling, Dolly Varden were observed to be dominant over coho. In 200 minutes each of observation in the natural environment and in the aquarium, Dolly Varden were recorded attacking coho on several occasions, with only one incidence of a coho attacking a Dolly Varden (Table I). When Dolly Varden and coho fingerling occurred together in the natural environ-

ment, a Dolly Varden fingerling was always observed to be the despot in a given pool area. This despot would have the greatest amount of territory, in what appeared to be the most favorable feeding area, and would immediately attack another fish entering the territory. On occasion, the despot would swim through the entire pool area and attack all fish present before returning to its station. This type of behavior was also repeatedly observed in the aquarium. The despot was usually one of the larger fish in the area, but not necessarily the largest.

TABLE 1 Number of Aggressive Acts Observed in 800 Minutes of Observation of Dolly Varden and Coho Fry and Fingerling Mixed, in the Natural Environment and in an Aquarium.

	Fry		Fingerling	
	Natural	Aquarium	Natural	Aquarium
DV attacked DV	3	3	2	11
DV attacked Coho	0	0	20	4
Coho attacked DV	6	11	1	0
Coho attacked Coho	30	20	17	2

Food Sampling

Coho fry and fingerling were recorded sampling food at the surface more often than Dolly Varden. Dolly Varden fry and fingerling sampled food at the bottom more often than coho (Table 2).

TABLE 2 Number of Times Food Sampling was Recorded during 400 Minutes of Observation of Dolly Varden and Coho Fry and Fingerling in the Natural Environment.

	Fry		Fingerling	
	Dolly Varden	Coho	Dolly Varden	Coho
Surface	15	71	10	30
Bottom	76	27	92	15
Mid-Depth	3	14	11	8

Dominance in Acquiring Food

Food introduced into the aquarium containing five Dolly Varden and five coho fingerling was reached first by the coho more often than the Dolly Varden (Table 3). Usually, both species raced for the food at the same time; however, coho fingerling appeared to be faster swimmers. Dolly Varden appeared slightly more successful at obtaining food introduced on the bottom than at the surface.

TABLE 3 Number of Times Dolly Varden or Coho Fingerling Reached Food First When Introduced at the Top or Bottom of Aquarium.*

	<u>Dolly Varden</u>	<u>Coho</u>
Surface	11	39
Bottom	17	33

*Summary of 100 introductions.

Food Preferences

Coho young sampled in August fed more frequently on surface insects than did the Dolly Varden young (Table 4). The allochthonus-autochthonus ratio showed that Dolly Varden young fed on 39 surface insects for every 100 food items taken below the surface, and coho young consumed 249 surface insects for every 100 taken below the surface.

Smolt Transplant

Smolts from the North Arm streams were transplanted to Hood Bay Creek in 1969. The return of these fish to spawn in Hood Bay Creek in 1970 was nearly identical to the 1970 return of smolts originating from Hood Bay Creek in 1969. The numbers released in 1969 and recovered in 1970 at Hood Bay Creek were:

	<u>Released</u>	<u>Recovered</u>	<u>% Return</u>
Transplanted smolts	1184	124	10.5
Hood Bay Creek smolts	5011	469	9.4

TABLE 4 Numerical Relationship of Insect Groups to the Feeding Habits of Dolly Varden and Coho at Hood Bay Creek, August, 1970.

	No. Fish Sampled	Ephemeroptera- Plecoptera		Diptera- Trichoptera		Surface Insects		<u>Allochthonus</u> <u>Autochthonus</u> Ratio
		% Comp. of Stomach	% Incidence of Feeding	% Comp. of Stomach	% Incidence of Feeding	% Comp. of Stomach	% Incidence of Feeding	
Dolly Varden	120	24.0	65.0	65.9	76.6	10.1	36.6	0.39
Coho	93	18.1	51.6	39.1	43.0	42.8	86.0	2.59

Only four of the smolts transplanted to Hood Bay Creek were recovered at the weirs on the North Arm streams in 1970.

Displacement Experiment

This experiment was an attempt to determine whether sight or olfaction aided Dolly Varden in their homing migration. Mature, blinded, olfactory occluded, and control fish from known Hood Bay Creek Dolly Varden were displaced to the junction of the North and South arms of the bay. The number recaptured at the Hood Bay Creek weir were:

	<u>No.</u> <u>Displaced</u>	<u>No.</u> <u>Recaptured</u>	<u>%</u> <u>Recaptured</u>
Blinded	50	1	2.0
Olfactory occluded	50	10	20.0
Control	50	10	20.0

Four of the returning olfactory occluded fish were dissected to determine extent of damage done to the olfactory organ. Approximately 50% of the olfactory lamellae had been completely destroyed. The remaining lamellae had been only partially destroyed or they appeared to be completely unaltered. Therefore, the return of the olfactory occluded fish should be considered inconclusive.

Although the data suggests that sight may play a role in the homing of Dolly Varden, these results may also be inconclusive. The blinded fish may have been less able to avoid predators, such as the harbor seal, Phoca vitulina, than the non-blinded fish and a higher mortality may have resulted. The blinded fish may have experienced more difficulty in locating the weir traps and may have been more likely to enter the stream during periods when the weir screens were removed.

The weir screens were removed more frequently during the 1970 immigration than in the previous study years. This is probably the reason for the low recapture rate.

Mortality due to the technique of blinding the fish could also be a reason for the lower recapture of these fish. However, this was considered unlikely since the five blinded fish held in the stream were still alive and appeared in good condition after 66 days.

The mean number of days between release and recapture were blinded 14, olfactory occluded 34 (5 - 66 days), and control 29 (5 - 54 days).

Float and Ultrasonic Tracking

Movements of the 12 Hood Bay Creek Dolly Varden tracked were generally inconclusive (Figure 1). However, the results were indicative of certain behavior patterns which may be important.

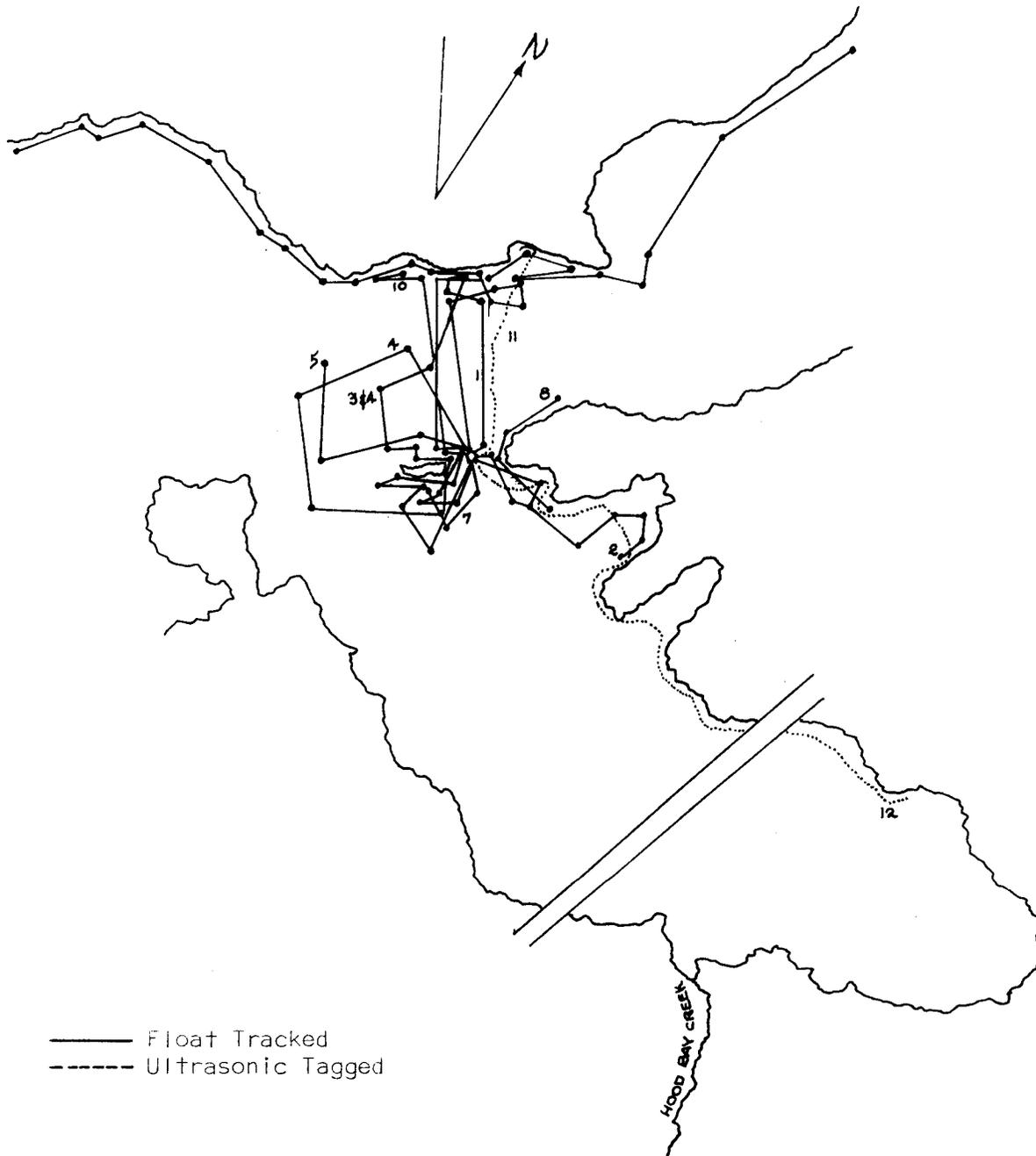


FIGURE 1 TRACKS OF 10 FLOAT TRACKED AND 2 ULTRASNOIC TAGGED MATURE DOLLY VARDEN DISPLACED FROM HOOD BAY CREEK.

In open water, the fish moved continually often changing directions. Upon encountering a shoreline, they would rest from 15 minutes to 1 hour before moving again. Once the main shoreline of the bay was encountered, they did not return to open water. Those tracked along the shoreline (2, 6, 8, 9, and 12), tended to travel within 20 feet of shore, occasionally leaving shore to cross small inlets or shoal areas. Those that encountered the small island near the release point (3, 4, and 6), moved along the island's shoreline, occasionally resting for up to one hour, then moved off shore to open water. Except for an initial dive upon release by some of the float tracked fish, they did not make any further effort to dive, as indicated by pulling the float underwater. The ultrasonic tracked fish appeared to travel near the surface, probably within 20 feet, when in open water.

The main shoreline of the bay was initially reached by the tracked fish in only two areas, either in a northerly or an easterly direction from the release point. Those that reached the nearby east shore (2, 8, and 12) could have done so accidentally because of its close proximity to the point of release. Those that reached the north shore (1, 3, 4, 6, 9, 10, and 11) may have used a compass orientation similar to what white bass (Roccus chrysops) (Hasler, et. al., 1969) or cutthroat, Salmo clarki (McCleave and Horrall, 1970), are thought to use in their location of the shoreline from open water areas.

Of those that were tracked for some distance along the shore, two (8 and 9) were moving away from their home stream and three (2, 6, and 12) were moving in a direction toward their home stream.

There were no obvious differences in the movements of those tracked by float and those tracked with ultrasonic tags.

Some indication of speed of travel was obtained from one of the ultrasonic tracked Dolly Varden (12). This fish moved steadily along shore and was tracked for 3.91 miles at an average speed of 0.69 mph. The greatest speed calculated was an average of 3.3 mph for a distance of 0.65 miles.

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Prepared by:

Approved by:

Robert H. Armstrong
Fishery Biologist

s/Howard E. Metsker
D-J Coordinator

Date: May 1, 1971

s/Rupert E. Andrews, Director
Division of Sport Fish

