

Dolly Varden (*Salvelinus malma*)

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The Dolly Varden is one of the most beautiful fishes in Southeastern Alaska (Southeast). This species is also highly prized as a sport fish and for delicious eating. The sea-run Dolly Varden has an overall silvery appearance with olive-green to brown on its dorsal surface and numerous red to orange spots on its sides (Fig 1). At maturity the lower body of the breeding male turns brilliant red.



FIG 1. Adult Dolly Varden. (Bob Armstrong)

Dolly Varden live in some of the most beautiful waters in the world. Imagine a long, winding fjord bordered by snowcapped mountains and cliffs. Waterfalls cascade to the edge of the saltwater. A stream teeming with Pacific salmon snakes its way from the head of the fjord up the valley through ancient forests of Sitka spruce and western hemlock. These are environs typical of the Dolly Varden in Southeast.

Resident Dolly Varden, which live their entire lives in streams or small lakes and ponds, are small. They seldom grow longer than 10 in. (26 cm). Those that inhabit larger lakes often grow to 12 in. (30 cm) or more, but they still generally weigh less than 1 lb (0.5 kg). These freshwater fish seldom live more than 8 to 10 years. Exceptions are Dolly Varden weighing up to 9 lb (4 kg) in the few Southeast lakes that contain kokanee (small landlocked sockeye salmon [*Onchorhynchus nerka*]). These larger fish feed on kokanee and tend to live longer, up to 19 years (Armstrong 1991).

Sea-run Dolly Varden, fish that spend part of their lives in salt water, usually grow to 15-22 in. (38-56 cm) long and weigh 1-3 lb (0.5-1.4 kg). Occasionally, large fish weighing more than 10 lb (5 kg) are hauled from large mainland rivers such as the Taku River near Juneau.

Research has shown that sea-run Dolly Varden are not nearly as abundant in Southeast as most people believe. Their behavior of moving from one freshwater system to another and concentrating in lakes and rivers for the winter makes them appear much more numerous than they really are. Therefore, they can be easily overharvested. In addition, populations over a large area could be reduced if harm came to a single key wintering lake or river. This dependency on many different watersheds will make future management and maintenance of Dolly Varden populations in Southeast difficult.

STATUS IN SOUTHEASTERN ALASKA

Distribution

Dolly Varden occur from Arctic Alaska to northern Washington and to the Mackenzie River in Canada, and from the Chukchi Peninsula and Kamchatka in Russia to Japan and Korea. The range includes most islands with suitable streams (Mecklenberg et al. 2002). Dolly Varden are widely distributed in western North America and are particularly abundant throughout Southeast.

In Southeast, Dolly Varden can be found in a wide variety of habitats, including lakes of all sizes with and without access to the sea; tiny, isolated ponds; large rivers; streams; sections of water both above and below barriers to anadromous fish; and even intermittent rivulets (Armstrong 1991). Glacial lakes that fish can access from the sea harbor Dolly Varden from at least September to May, and their outlets are used for rearing by the young. At least some Dolly Varden are present in salt water almost year-round, although populations are highest during late spring and early summer before they begin to enter streams. Dolly Varden inhabit both offshore and inshore saltwater areas but prefer the inshore.

Abundance

The numbers of sea-run Dolly Varden have been counted or estimated at weirs on only a few streams and lakes in Southeast. During a 4-year study in Hood Bay on Admiralty Island, estimates of Dolly Varden entering Hood Bay Creek (in the south arm) ranged from 5,000 to 8,000 fish each year (Armstrong 1974). In a study during one of these years, weirs on two other streams in Hood Bay (in the north arm) yielded estimates of around 8,000 for one stream and 5,000 for the other (Armstrong 1974).

Because many populations of Dolly Varden use lake systems for overwintering, their numbers entering these systems may be larger than the numbers entering systems without lake access. At a weir across the outlet of Eva Lake on Baranof Island, the counts of entering Dolly Varden in 1962, 1963, and 1964 ranged from 83,000 to 101,000 a year (Armstrong and Morrow 1980). In 1995, a count at a weir on Eva Creek revealed about 118,000 Dolly Varden leaving the lake for the sea (Yanusz and Schmidt 1996).

At Sitkoh Lake on Chichagof Island, 50,000 Dolly Varden were counted entering the lake during 1996 (Yanusz 1997). The Hood Bay and Lake Eva Dolly Varden populations were only lightly exploited by sport fishermen during the years of study. In contrast, a

weir across the outlet to Auke Lake, a system along the heavily fished Juneau road system, revealed fewer fish. The counts ranged from 5,800 out-migrant Dolly Varden in 1970 (Reed and Armstrong 1971) to a yearly average of 4,610 from 1997 to 2002 (Taylor and Lum 2003).

Taxonomic Considerations

Ichthyologists have been arguing about the taxonomic status of Dolly Varden for years. Originally described from Kamchatka, Russia by Walbaum in 1792, the Dolly Varden has been variously considered a valid species, a subspecies of the arctic charr (*Salvelinus alpinus*), or the same species as arctic charr (Armstrong and Morrow 1980). Even the name “Dolly Varden,” which originated in the name of a character in a Charles Dickens novel, *Barnaby Rudge*, was applied to a fish that later was classified as a bull trout (*Salvelinus confluentus*) (Robert Benhke, personal communication 2004).

Today, two forms of Dolly Varden are recognized for Alaska—the northern and the southern. Only the southern Dolly Varden is found throughout Southeast. Further study could reveal populations of Dolly Varden that might warrant special consideration. In particular, special consideration may be warranted for populations in isolated ponds or springs and some stream-resident populations that have been isolated from other populations for decades. Also, sea-run Dolly Varden exhibit strong homing tendencies for spawning, and some of these populations may reveal characteristics quite different from those of other sea-run populations.

Significance to the Region and Tongass National Forest

In Southeast, Dolly Varden are of special importance because of their high desirability as a sport fish. They are also significant to Alaska and the nation because Southeast is one of the best places for fishermen to catch them.

An estimated 20,707 Dolly Varden were harvested by sport anglers in Southeast in 2003 (Alaska Department of Fish and Game 2004). These catch figures are much higher than for any other freshwater fish in Southeast. The harvest size emphasizes the importance of Dolly Varden to the sport fishery, especially to anglers who fish along streams and in lakes (Fig 2).

The role of Dolly Varden in various life stages to the food web of Southeast has not been well studied. In some areas, the species appears to be important in the diet of bald eagles (*Haliaeetus leucocephalus*) (Hansen



FIG 2. Sport fishing for Dolly Varden in the Kadashan River on Chichagof Island. (John Schoen)

1987). River otters (*Lutra canadensis*) have been observed by the authors to prey extensively on Dolly Varden when the fish concentrate before leaving Southeast lakes in the spring.

In addition, belted kingfishers (*Ceryle alcyon*) have been observed bringing young Dolly Varden to their nestlings. Young sea-run Dolly Varden in coastal streams during the first 2 to 4 years of their lives are undoubtedly easy prey for American dippers (*Cinclus mexicanus*). Other animals that probably take advantage of the occasional abundance of Dolly Varden include black (*Ursus americanus*) and brown bears (*U. arctos*), mink (*Mustela vison*), mergansers (*Mergus spp.*), great blue herons (*Ardea herodias*), and marine mammals such as harbor seals (*Phoca vitulina*) and Steller sea lions (*Eumetopias jubatus*).

Dolly Varden are well known for preying on salmon eggs. From 1921 to 1940, the U.S. Bureau of Fisheries even offered a bounty on Dolly Varden in Alaska, thinking they were harming salmon populations. Most studies have shown, however, that Dolly Varden predation does not harm salmon populations. The predation may, in fact, benefit salmon because the Dolly Varden eat drifting salmon eggs that would not otherwise survive. If not eliminated, these eggs would eventually die and become hosts for fungi that could infect live salmon eggs and alevins in the gravel.

Dolly Varden may also benefit salmon because Dolly Varden in lakes feed heavily on freshwater snails (Armstrong 1965a), which are intermediate hosts of a parasite that infects the eyes of coho (*Oncorhynchus kisutch*) and sockeye (*O. nerka*) salmon young and eventually causes blindness. The feeding of Dolly

Varden on these snails may help reduce this parasite and its harmful effects (Armstrong 1991).

In a third possible benefit, Dolly Varden compete for space with cutthroat trout (*O. clarki*) in lakes (Andrusak and Northcote 1971). Because cutthroat trout prey heavily on sockeye in lakes (Armstrong 1971), this overall competition for space may play a role in reducing overall predation of the salmon young in lakes.

Special Management or Conservation Designations

Overharvest by sport fishermen has caused severe declines of Dolly Varden in some areas of Alaska. In the Juneau area, for example, during only eight years, the catch rate dropped from more than four Dolly Varden per angler hour to less than 0.2 fish per angler hour (Armstrong 1991). This situation prompted the Alaska Board of Fisheries to close several waters around Juneau to sport fishing for Dolly Varden and, where waters remain open, to reduce the daily bag limit to two fish.

HABITAT RELATIONSHIPS

Lakes and Large Rivers for Overwintering (Sea-run Fish)

Lakes and large rivers are especially important as overwintering habitat for sea-run Dolly Varden in Southeast. Such overwintering places host numerous populations of Dolly Varden that originated from other watersheds, perhaps over a large area and from as far as 100 mi (160 km) away (Armstrong and Morrow 1980).

By habitually overwintering in lakes and large rivers, Dolly Varden are able to use many small to medium-sized streams for spawning and rearing. Most small to medium-size streams not associated with lakes could not support large numbers of sea-run Dolly Varden during the winter. Because of winter droughts and icing, these streams would be able to accommodate only very small pre-smolts or stream-resident-size fish. By entering these systems in summer and fall, leaving after spawning, and spending the winter in larger freshwater systems such as lakes, Dolly Varden have extended their distribution considerably.

In addition to the benefits of increased distribution, the habit of overwintering in lakes also may increase survival and longevity. Because most overwintering lakes approach 32 deg F (0 deg C) in winter, little, if any, feeding is necessary to maintain the metabolic processes of the fish. If the lakes are covered with ice,

they also provide a nearly predator-free environment. Dolly Varden are usually the largest fish present, and otters and other predators cannot generally reach them through the ice.

One example of the survival benefits of overwintering by sea-run Dolly Varden in freshwater is the 94% overwinter survival of marked fish reported by Armstrong (1965b) at Eva Lake on Baranof Island.

Streams for Spawning and Rearing

Dolly Varden may be quite selective when choosing sites to spawn. Spawners probably concentrate in select areas rather than scattering in pairs throughout a stream. Blackett (1968) surveyed Hood Bay Creek on Admiralty Island every other day during September and October and could locate spawning Dolly Varden in only one small section of the stream. The physical and chemical characteristics of the spawning sites chosen by Dolly Varden in Hood Bay Creek were also reported by Blackett (1968). The authors of this summary have also looked for spawning Dolly Varden in numerous streams throughout Southeast. In general, most spawners have been found concentrated near stream headwaters.

Rearing areas are also especially important for the young of sea-run Dolly Varden. The alevins emerge from the gravel in May, and juveniles remain on the stream for two to four years (Armstrong 1970). During this period, before fish leave the streams as smolt, they appear to use a variety of habitats and can be found in most accessible portions of the streams (Armstrong and Morrow 1980). Young of the year are found in small pools and in eddies along stream banks where the flow is reduced (Blackett 1968). In early summer, they can also be found in very small rivulets with depths of 0.5-1.5 in. (1-3 cm) and widths less than 3 ft (1 m) (Armstrong and Elliott 1972).

After their first year of life, the juveniles use a variety of habitats. They can be found in areas of still or moving water, gravel or muddy substrate, dense vegetation, or open water with little or no vegetation (Heiser 1966). Favored habitats appear to be undercut bank areas along the stream (Armstrong and Elliott 1972). The largest pre-smolt fish occur in riffle areas and the smallest in sloughs and isolated pools (Armstrong and Elliott 1972).

Springs and Upwellings for Overwintering (Juveniles)

In some Southeast streams, the overwinter survival of juvenile Dolly Varden may depend on spring or upwelling areas within the stream. In autumn, juvenile

Dolly Varden have been found to move upstream into spring-fed areas or tributaries, if available, where they remain throughout the winter (Armstrong and Morrow 1980). Because of icing conditions in some winters and in some streams, these spring areas may be the only places where a young fish could survive.

IMPLICATIONS FOR CONSERVATION

Threats to Habitat

Although its effects have not been well studied, environmental degradation certainly has reduced the numbers of Dolly Varden in Southeast. Clear-cut logging, stream channelization, and urban development have all caused obvious damage to streams where Dolly Varden live. Fortunately, Dolly Varden are widespread in the region and occur in almost all fresh waters capable of supporting fish; therefore, the current risk of widespread loss of populations is low.

The habit of young Dolly Varden to rear in small stream tributaries and even intermittent rivulets puts them at risk from certain types of development. Spring-fed streams and areas of streams may also be important to maintaining juvenile populations.

Because numerous populations migrate to lakes and larger rivers for the winter, harm to these overwintering areas could result in extensive loss of Dolly Varden. Identification and protection of Dolly Varden overwintering lakes and rivers is important to maintaining their populations in Southeast. Identification of many of these areas could be easy if one considers that any lake with fish access to and from the sea would be important to Dolly Varden.

Threat of Overharvest

Because Dolly Varden are not as abundant as they appear to be in Southeast, they could be more easily overharvested than other species of fish. Their habit of moving from one freshwater system to another means that many of the fish seen in one stream at one time could be the same fish seen in another stream. Successful management of Dolly Varden depends on recognition of their complex migration patterns (Armstrong 1984).

Dolly Varden are also taken incidentally in commercial fisheries for other fish. In one year, for example, more than 3,000 mature Dolly Varden were taken in the commercial salmon fishery near Kotzebue in Western Alaska (Armstrong 1991). The effects of such fisheries on Dolly Varden populations have not been studied, and usually the numbers taken are not reported.

Summary

The authors of this summary have observed many Dolly Varden taken aboard boats during the seine fishery for salmon in Gastineau Channel near Juneau. This type of activity no doubt has contributed to the decline of Dolly Varden in this area.

Three considerations seem most important for conserving healthy populations of Dolly Varden in Southeast:

- Recognize the complex nature of Dolly Varden migration patterns in management decisions;
- Realize that land-use activities that harm one stream or overharvest in a single stream could well affect Dolly Varden populations in other systems; and
- Pay particular attention to the protection and preservation of major Dolly Varden wintering areas.

REFERENCES CITED

- Alaska Department of Fish and Game. 2004. Division of Sportfish web site. <www.sf.adfg.state.ak.us>. Accessed 11-04.
- Andrusak, H., and T.G. Northcote. 1971. Segregation between adult cutthroat trout (*Salmo clarki*) and Dolly Varden (*Salvelinus malma*) in small coastal British Columbia lakes. *Journal of the Fisheries Research Board of Canada* 28:1259-1268.
- Armstrong, Robert H. 1965a. Some feeding habits of the anadromous Dolly Varden (*Salvelinus malma*) in Southeast. Alaska Department of Fish and Game Informational Leaflet 51: 1-27.
- _____. 1965b. Some migratory habits of the anadromous Dolly Varden *Salvelinus malma* (Walbaum) in Southeastern Alaska. Alaska Department of Fish and Game Research Report 3:1-36.
- _____. 1970. Age, food, and migration of Dolly Varden smolts in Southeastern Alaska. *Journal of the Fisheries Research Board of Canada* 27: 991-1004.
- _____. 1971. Age, food and migration of sea-run cutthroat trout, *Salmo clarki*, at Eva Lake, Southeastern Alaska. *Transactions of the American Fisheries Society* 100(2):302-306.
- _____. 1974. Migration of anadromous Dolly Varden (*Salvelinus malma*) in Southeastern Alaska. *Journal of the Fisheries Research Board of Canada* 31:435-444.
- _____. 1984. Migration of anadromous Dolly Varden charr in Southeastern Alaska—a manager's nightmare. Pages 559-570 in L. Johnson and B.L. Burns, editors. *Biology of the arctic charr. Proceedings of the International Symposium on Arctic Charr, Winnipeg, Manitoba, May 1981.* University of Manitoba Press, Winnipeg.
- _____. 1991. Dolly Varden char. Pages 266-272 in Judith Stolz and Judith Schnell, editors. *Trout: the wildlife series.* Stackpole Books Harrisburg, Pennsylvania.
- _____, and S.T. Elliott. 1972. A study of Dolly Varden in Alaska. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Progress Report, 1971-1972, Project F-9-4-13:1-34.
- _____, and J.E. Morrow. 1980. The Dolly Varden Charr, *Salvelinus malma*. Pages 99-140 in E.K. Balon, editor. *Charrs: salmonid fishes of the genus Salvelinus.* Dr. W. Junk Publishers, The Hague, The Netherlands.
- Blackett, R.F. 1968. Spawning behavior, fecundity and early life history of anadromous Dolly Varden *Salvelinus malma* (Walbaum) in Southeastern Alaska. Alaska Department of Fish and Game Research Report 6:1-85.
- Hansen, A.J. 1987. Regulation of bald eagle reproduction rate in Southeast. *Ecology* 68(5):1387-1392.
- Heiser, D.W. 1966. Age and growth of anadromous Dolly Varden char *Salvelinus malma* (Walbaum) in Eva Creek, Baranof Island, Southeastern Alaska. Alaska Department of Fish and Game Research Report 5:1-29.
- Mecklenburg, C.W., T.A. Mecklenburg, and L.K. Thorsteinson. 2002. *Fishes of Alaska.* American Fisheries Society.
- Reed, Richard D., and Robert H. Armstrong. 1971. Dolly Varden sport fishery—Juneau area. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Progress Report, 1970-1971, Project F-9-3 12:1-105.
- Taylor, S.G., and J.L. Lum. 2003. Auke Creek Weir 2002 annual report, operations, fish counts, and historical summaries. Unpublished report. National Marine Fisheries Service, Auke Bay Laboratory, Juneau, AK. 29 pp.
- Yanusz, Richard J. 1997. Sea-run cutthroat trout, sea-run Dolly Varden, and steelhead trout population status at Sitkoh Creek, Southeast, during 1996. Fishery Data Series. Alaska Department of Fish and Game, Anchorage, AK.
- _____, and Artwin E. Schmidt. 1996. Sea-run and resident cutthroat trout and sea-run Dolly Varden population status at Lake Eva, Southeast, during 1995. Fishery Data Series No. 96-47. Alaska Department of Fish and Game, Anchorage, AK.