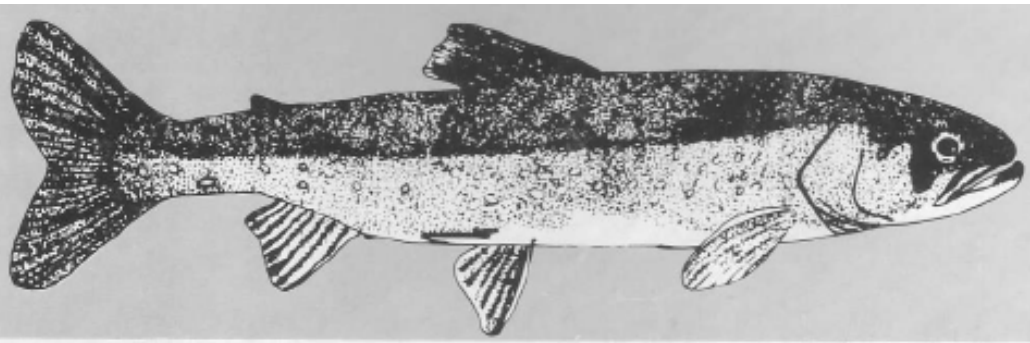
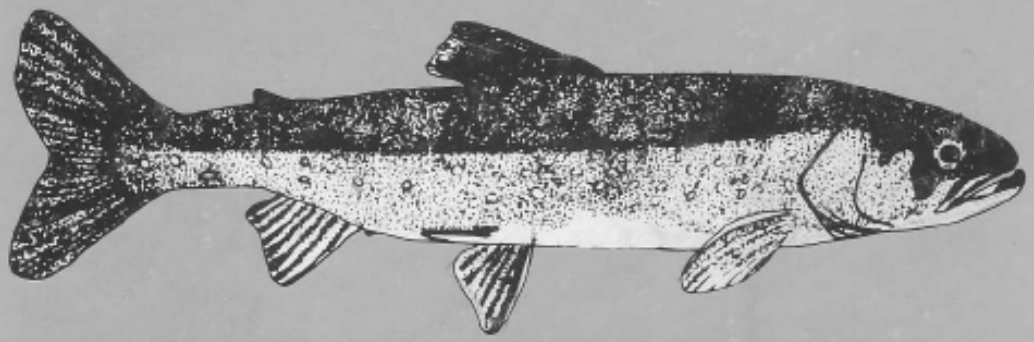
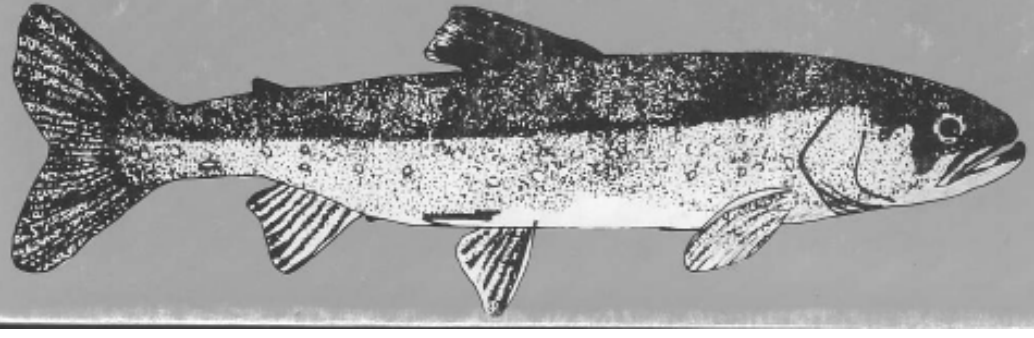


Biology of the Arctic Charr:

Proceedings of the International Symposium on Arctic Charr

Edited by Lionel Johnson and Bonnie Burns





Migration Of Anadromous Dolly Varden Charr In Southeastern Alaska — A Manager's Nightmare

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ARMSTRONG, R.H. 1984. Migration of anadromous Dolly Varden charr in southeastern Alaska — a manager's nightmare, p. 559–570. *In* L. Johnson and B.L. Burns [eds.] Biology of the Arctic charr, Proceedings of the International Symposium on Arctic Charr, Winnipeg, Manitoba, May 1981. Univ. Manitoba Press, Winnipeg.

Anadromous Dolly Varden charr *Salvelinus malma* of southeastern Alaska have complex and varying migratory patterns. These patterns differ between those charr originating from a lake system and those originating from a nonlake stream system.

Charr originating from a lake system conduct relatively simple annual migrations to and from the sea. They leave the lake in the spring and return throughout the summer and fall. These migrations consist of smolts, nonspawners (not going to spawn that year) and spawners (will spawn in the fall). The charr spend from a few days to several months feeding at sea before returning to the lake system for the winter. Some of the smolts and nonspawners will enter and leave other nearby freshwater systems.

Charr originating from a nonlake system conduct much more complex migrations than those originating from a lake system. Their migration patterns vary between first year migrants (smolts) and subsequent migrations of the nonspawners and spawners. Smolts leave nonlake streams in the spring and fall; once at sea, these charr enter and leave other nonlake streams until one with a lake is found. After spending the winter in the lake, those charr that are not going to spawn migrate to sea in spring and randomly enter other stream systems; these nonspawners return to sea and migrate to a lake system before winter. Spawners that originated from nonlake streams also migrate to sea in the spring from their lake wintering area. Once at sea, these charr migrate directly to their home stream without entering other streams enroute. After spawning, the survivors return directly to the lake system before winter.

These migration patterns create a manager's nightmare because individual stocks are difficult to recognize. Streams and lakes contain mixed stocks of charr originating from streams over a vast area. Successful management is dependent on recognition of these complex migration patterns.

INTRODUCTION

The migratory habits of anadromous Dolly Varden (*Salvelinus malma*) in southeastern Alaska are complicated and difficult to describe. This poster paper

is an attempt, through diagrams, to make these migratory patterns more easily understood. Although the results of studies on the charr's migratory habits have been published (Armstrong 1965, 1970, 1974; Armstrong and Morrow 1980) I felt, because a clear understanding was so important to their management, that a poster paper on the subject was appropriate for this symposium.

MATERIALS AND METHODS

Migrating Dolly Varden have been counted, sampled and marked as they passed upstream and downstream at weirs built across several streams in southeastern Alaska (Figs. 1-3). Throughout this ten year study 328,263 charr have been fin-clipped and measured, approximately 50,000 have been tagged with dart or internal anchor tags and 7,414 have been sampled for age, maturity and stomach content.

RESULTS

The migration patterns in anadromous Dolly Varden vary between smolt, nonspawner and spawner and between those fish originating from nonlake and lake (wintering)[1] systems. The results are presented as theories in diagramatic

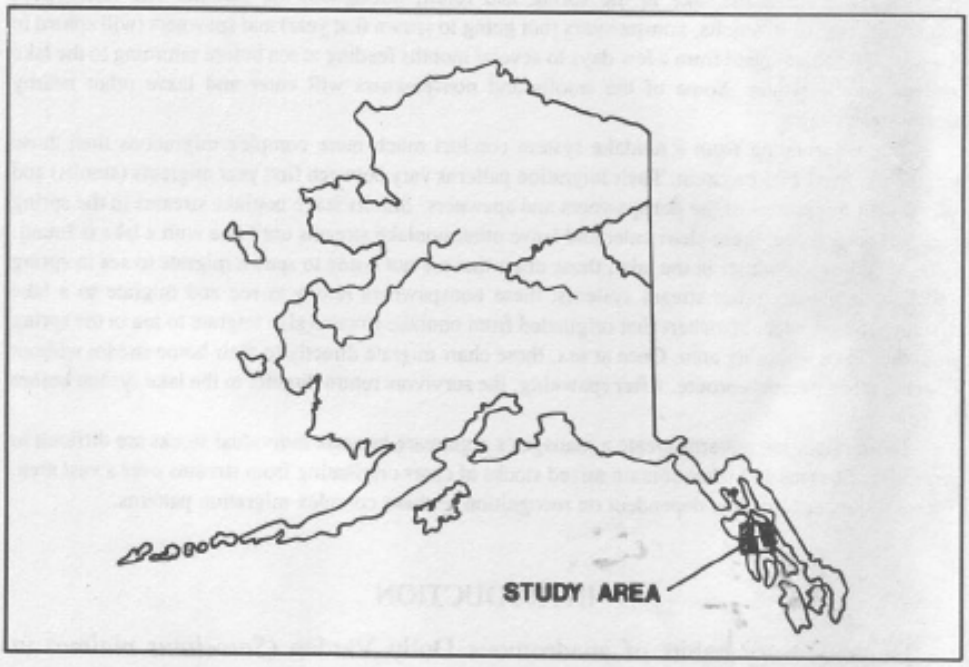


FIG. 1 Study area, Admiralty and Baranof Islands, southeastern Alaska.

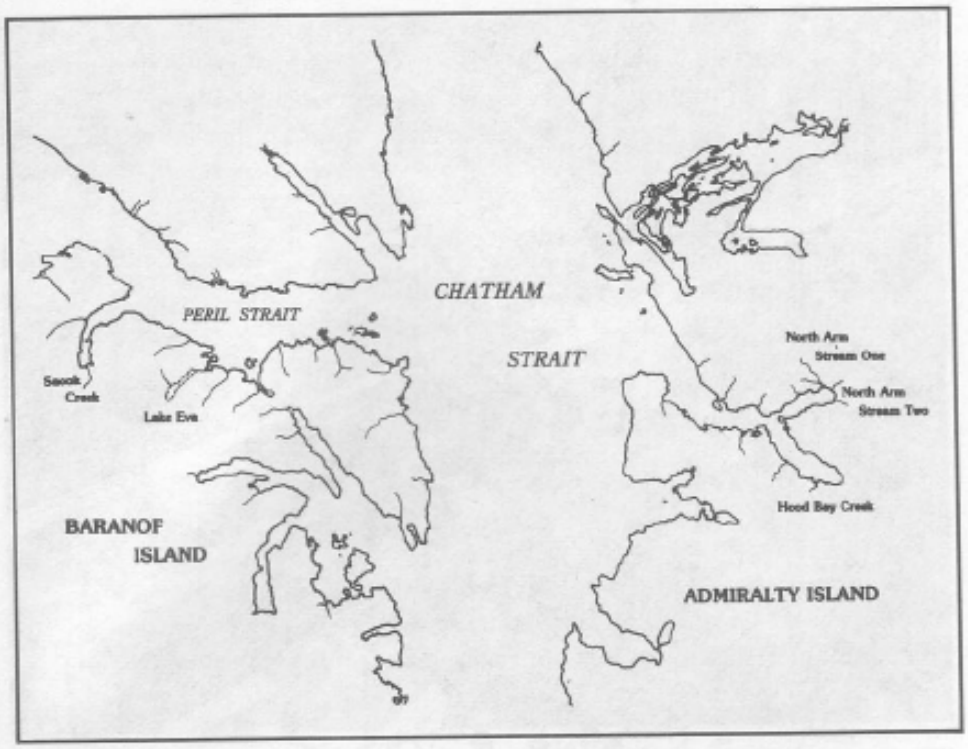


FIG. 2 Locations of the five streams weired for the migration study.

form (Figs. 4-11). The evidence used to develop these theories is briefly presented with each diagram.

MANAGEMENT SUGGESTIONS

1) Recognize the complex nature of the migration patterns in management decisions. Land-use activities that harm one stream or overharvest one stream may affect populations of charr in other systems.
2) Pay particular attention to the protection and preservation of major charr wintering areas.
3) Marking studies should concentrate on smolt, presmolt or spawning charr. For management, identification of individual stocks and the harvest rates imposed on these stocks is extremely important. Marking nonspawning charr or charr in their wintering areas can lead to confusing and erroneous conclusions.

[1] Although not common, there are some larger rivers in southeastern Alaska in which Dolly Varden charr overwinter. However, for ease of discussion, the wintering areas will be referred to as lakes.

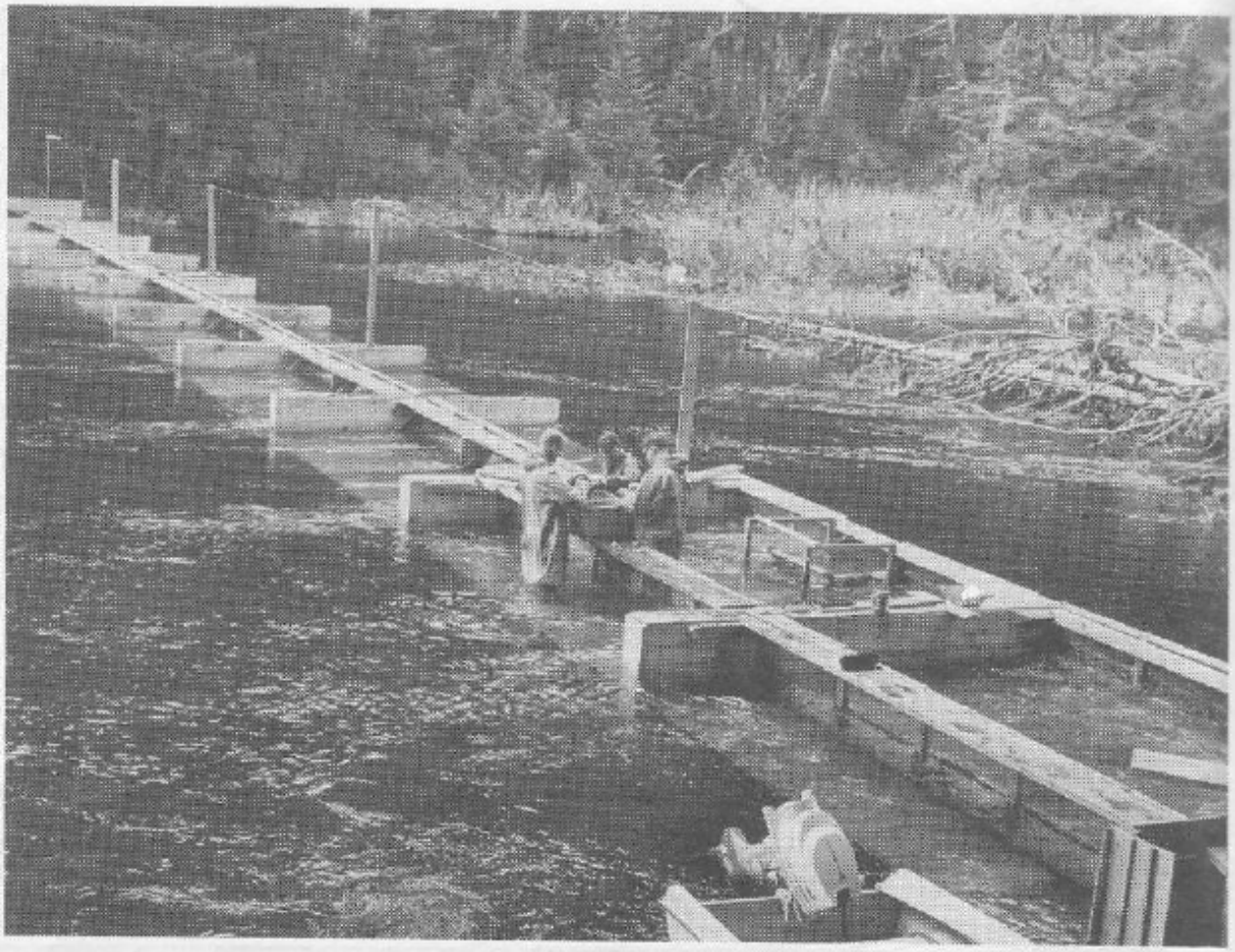


FIG. 3 Eva Creek — weir operated 3 years — estimated number of immigrant charr per year = 82,940 - 101, 814 — estimated number of spawning females in one year = 1,104 — estimated number of spawning males in one year = 1,029.

Other streams that were weired and the number of Dolly Varden charr captured or estimated were:

Saook Creek — weir operated 1 year — used for sampling purposes only — weir operated 3 days per week — total immigrant charr captured = 3,898.

Hood Bay Creek — weir operated 4 years — estimated number of immigrant charr per year = 5,007 - 7,904 — spawning females per year = 933 - 1,115 — spawning males per year = 334 - 1,165.

North Arm Stream One — weir operated 1 year — estimated number of immigrant charr = 8,285 — spawning females = 533 — spawning males = 512.

North Arm Stream Two — weir operated 1 year — estimated number of immigrant charr = 4,653 — spawning females = 435 — spawning males = 303.

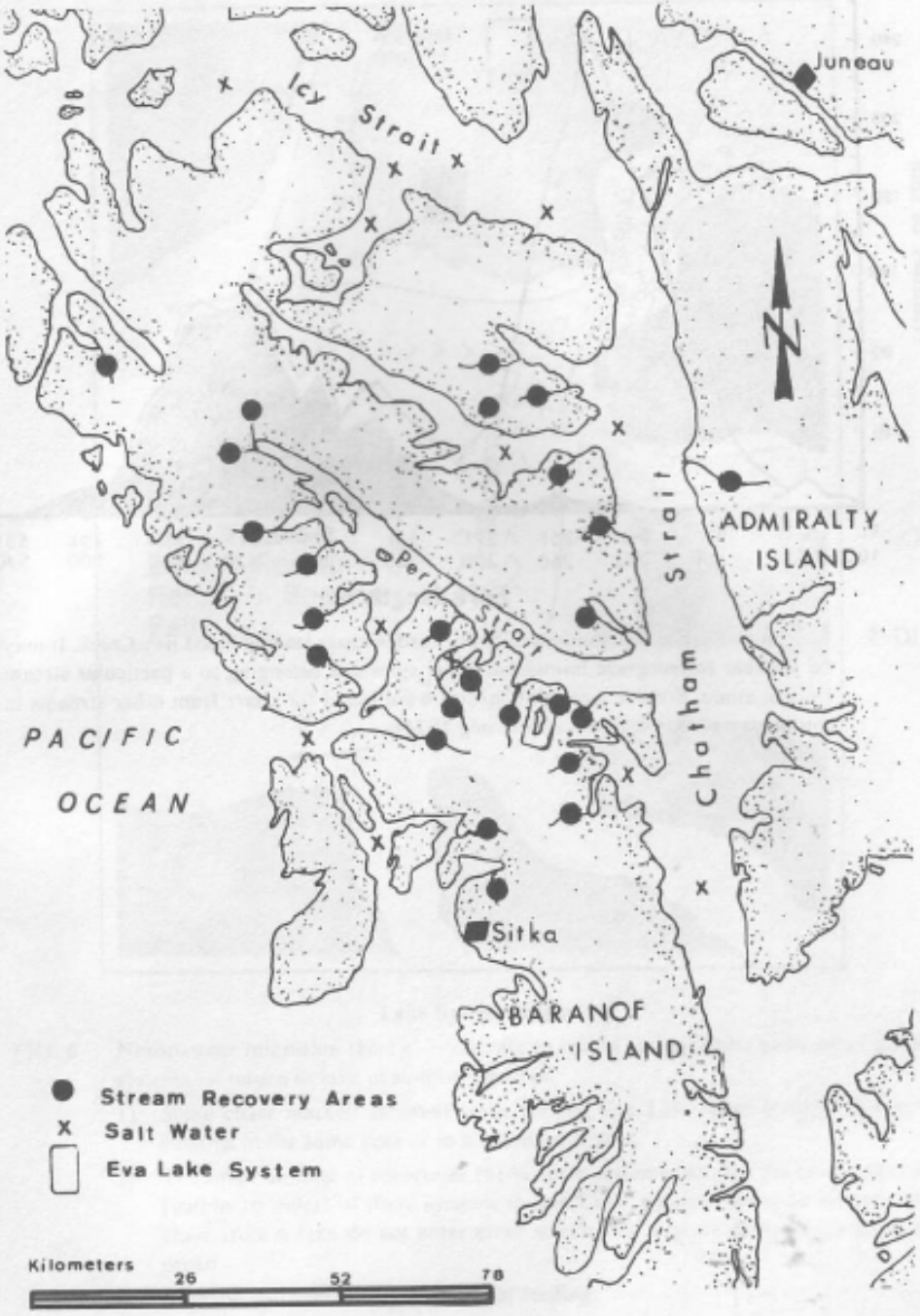


FIG. 4 Recovery areas for anadromous Dolly Varden charr marked while leaving Eva Lake on Baranof Island in southeastern Alaska (from Armstrong 1965).

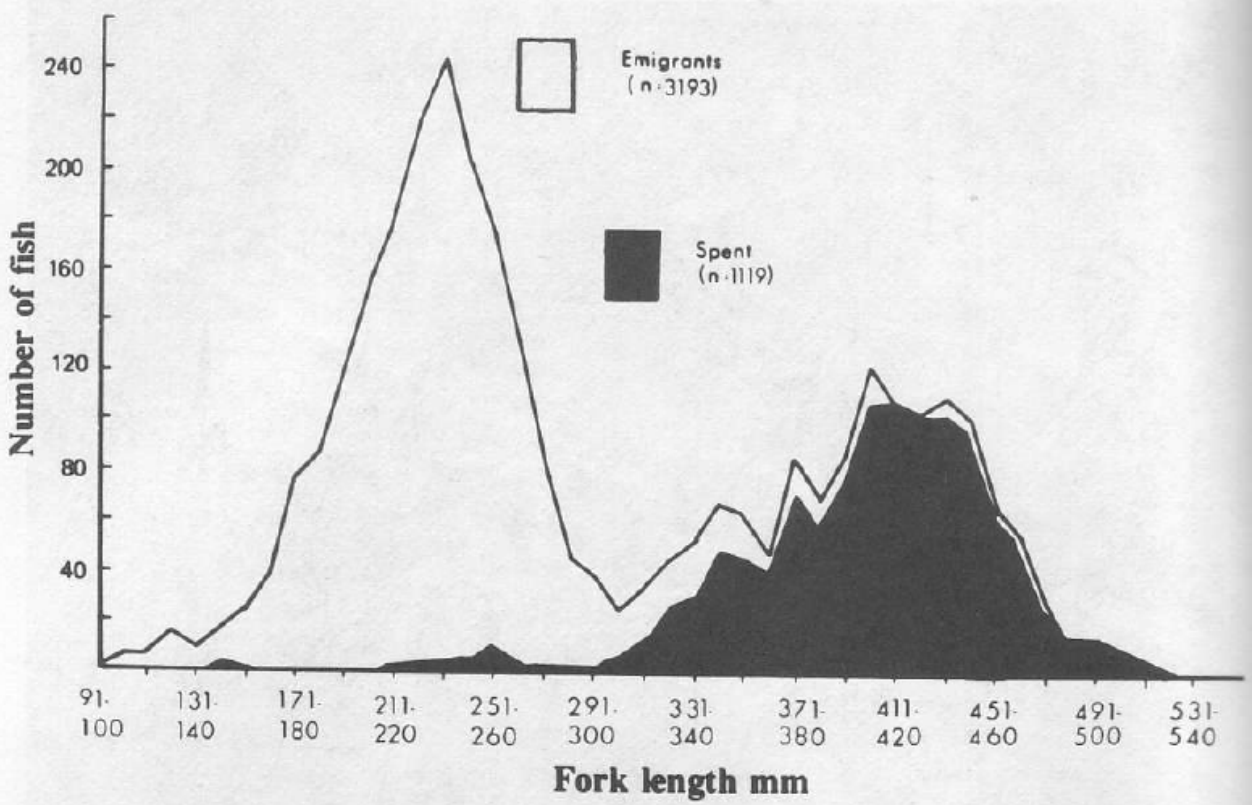
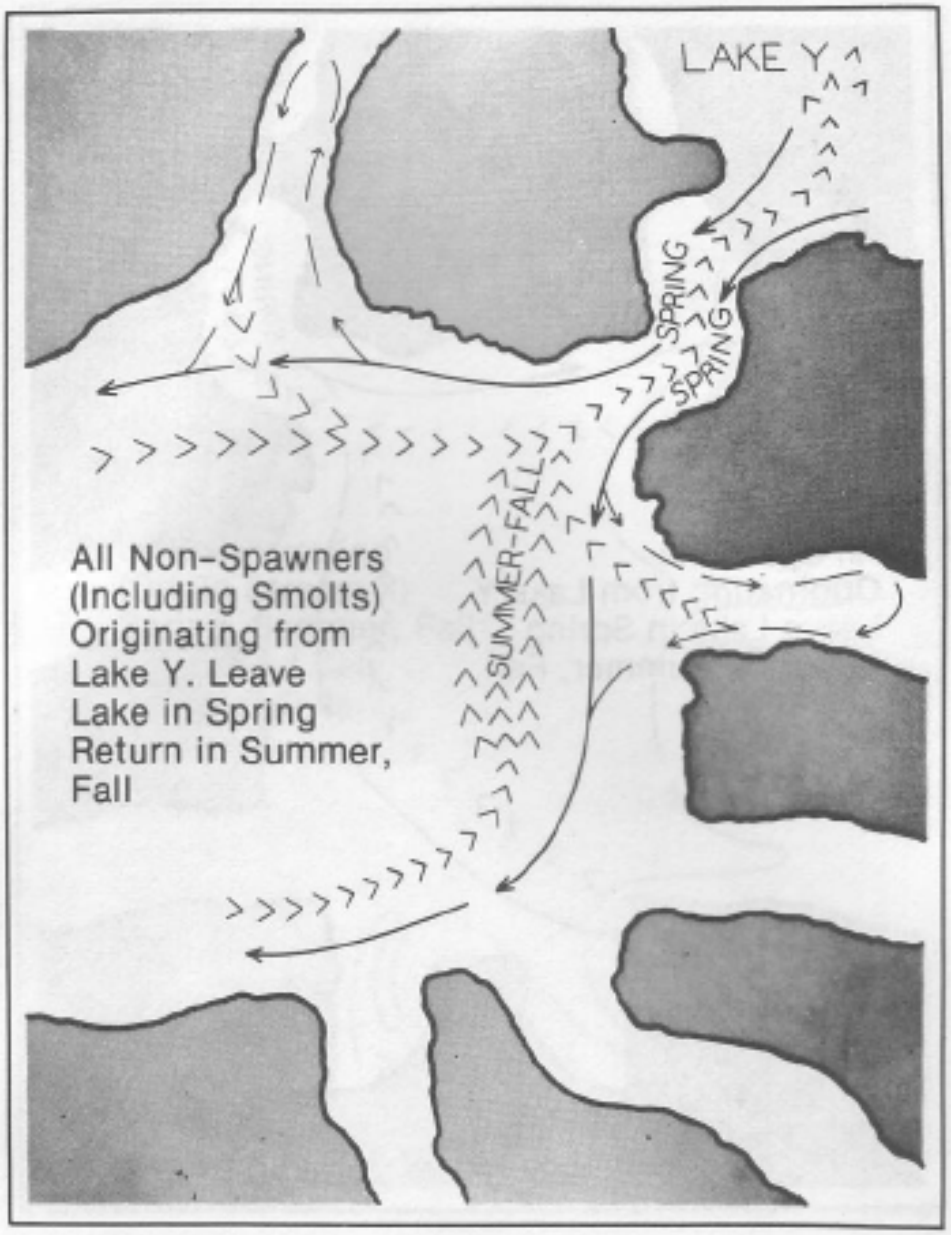


FIG. 5 Length frequency distributions of Dolly Varden charr leaving Hood Bay Creek. It may be possible to recognize immigrant charr spawners belonging to a particular stream by size alone. Similar size relationships were found for charr from other streams in southeastern Alaska (from Armstrong 1974).



Lake System Origin

G. 6 Nonspawner migration theory — migrate to sea in spring, some enter other stream systems — return to lake in summer and fall.

1) Some charr marked as smolt while leaving Eva Lake were recovered in other streams in the same year or in a subsequent year.

2) The small number of recoveries (8) in other systems (4) plus the close proximity (within 10 miles) of these systems to Eva Lake suggest that most nonspawning charr from a lake do not enter other streams or migrate great distances in the ocean.

3) Probable purpose of migration is for feeding.

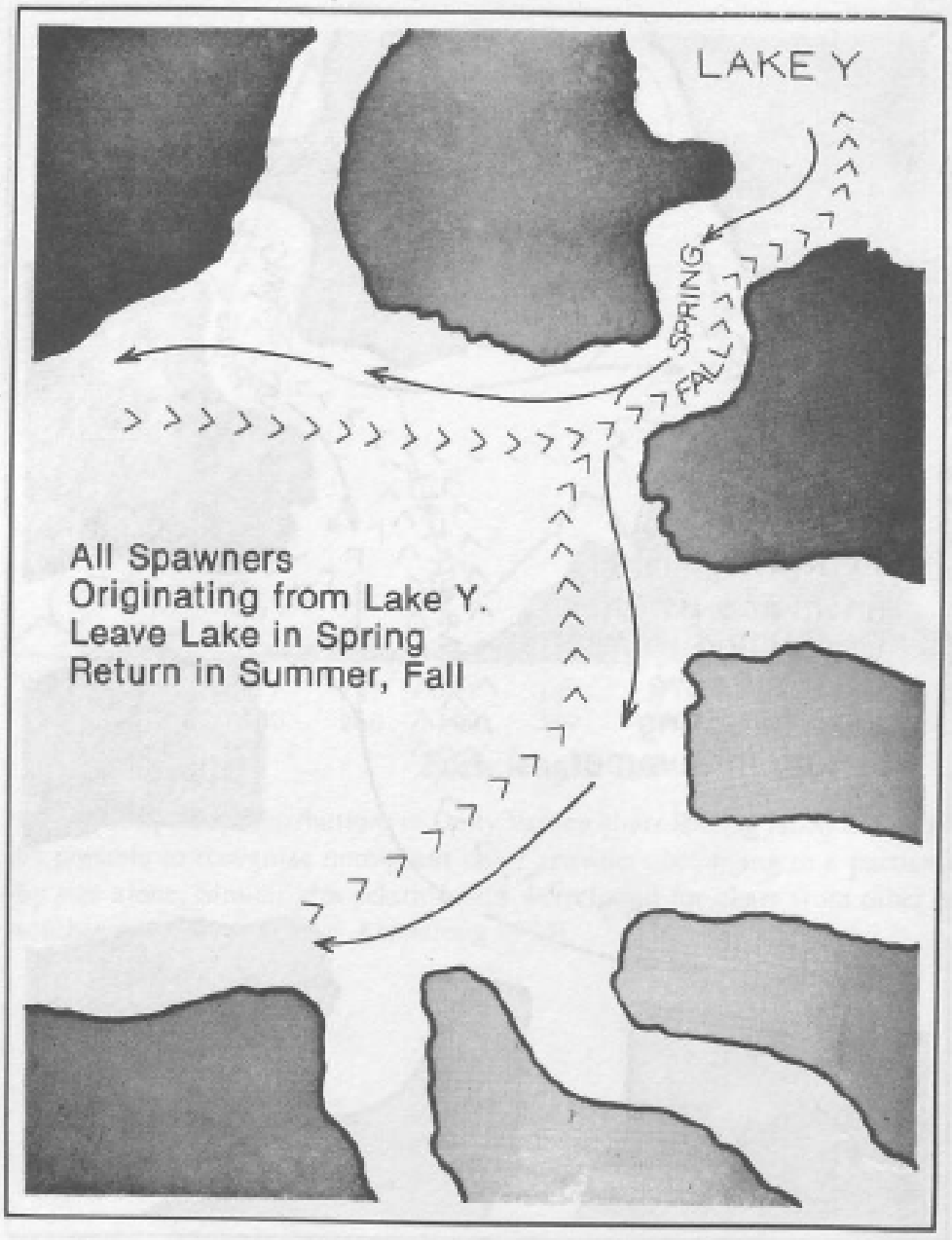
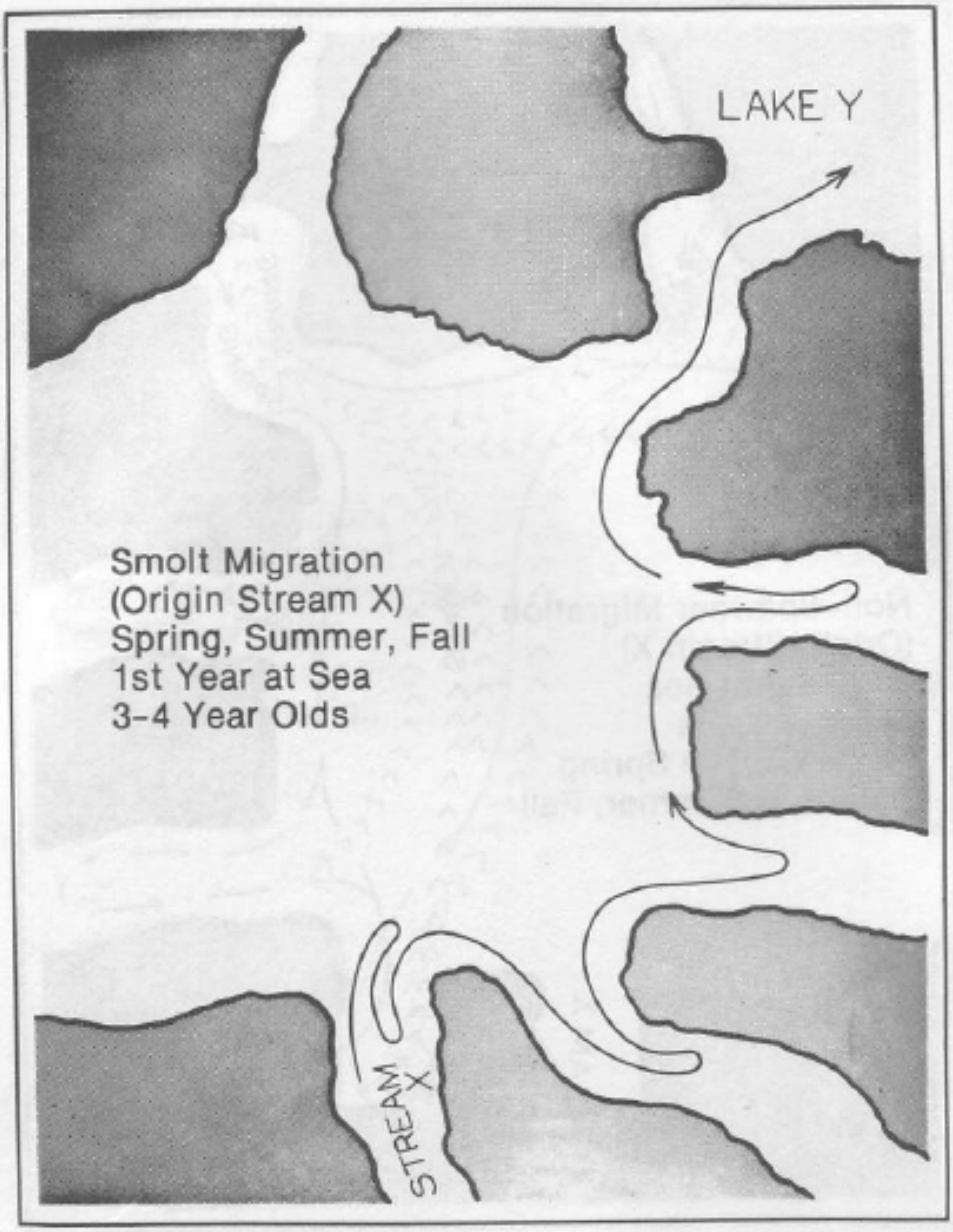


FIG. 7 Spawner migration theory — migrate to sea in spring, do not enter other stream systems — return to lake in summer and fall.

1) No spawners have been found leaving nonlake streams prior to spawning, hence it is unlikely that spawners from lakes are entering these systems.
2) Probable purpose of migration is for feeding.



Nonlake System Origin

IG. 8 Smolt migration theory — smolts move from one freshwater system to another until one with a lake is found.

1) Many (670) smolts marked while leaving Hood Bay Creek were captured entering adjacent study streams.
2) Despite marking all smolts for 3 years, approximately 80 percent of the smolt-sized charr entering Hood Bay Creek were unmarked — hence had originated elsewhere.
3) Most nonspawners leave streams within 10 days of entry.
4) Possible reason for migration — the smolt must search to find a lake in which to overwinter.

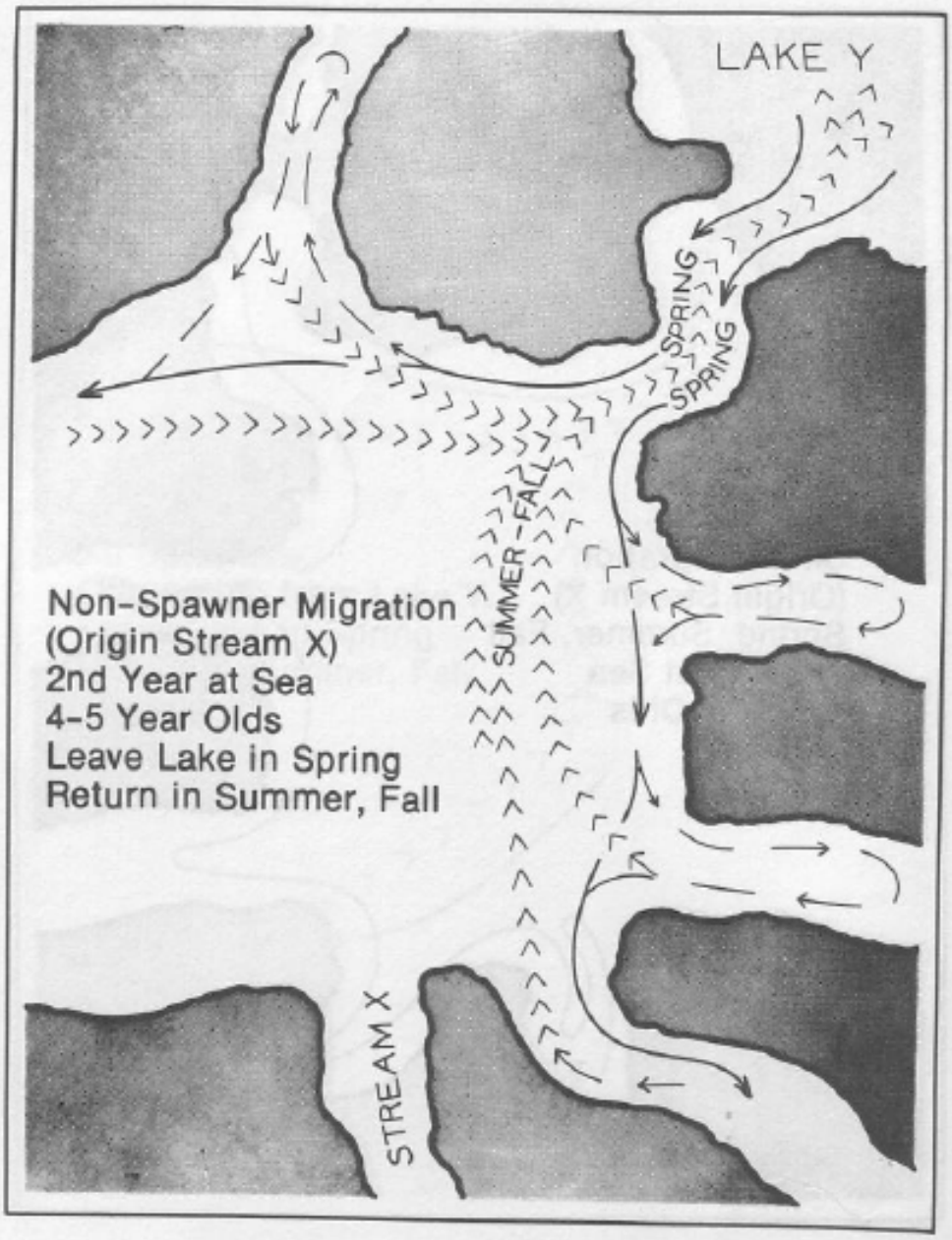


FIG. 9 Nonspawners migration theory — after wintering in lakes, nonspawning charr migrate to sea, enter other stream systems at random and return to the lake system before winter.

1) Nonspawning charr marked while leaving Eva Lake were found in 25 different stream systems up to 226 km from the lake.
2) Of 2,436 Dolly Varden charr marked while leaving Eva Lake and captured while entering Saook Creek, 62 percent returned to Eva Lake before winter (most of these fish were nonspawners).
3) Most nonspawning charr entering Hood Bay Creek had not originated from that system.
4) Probable reason is for feeding — they feed heavily on the eggs of pink and chum salmon.

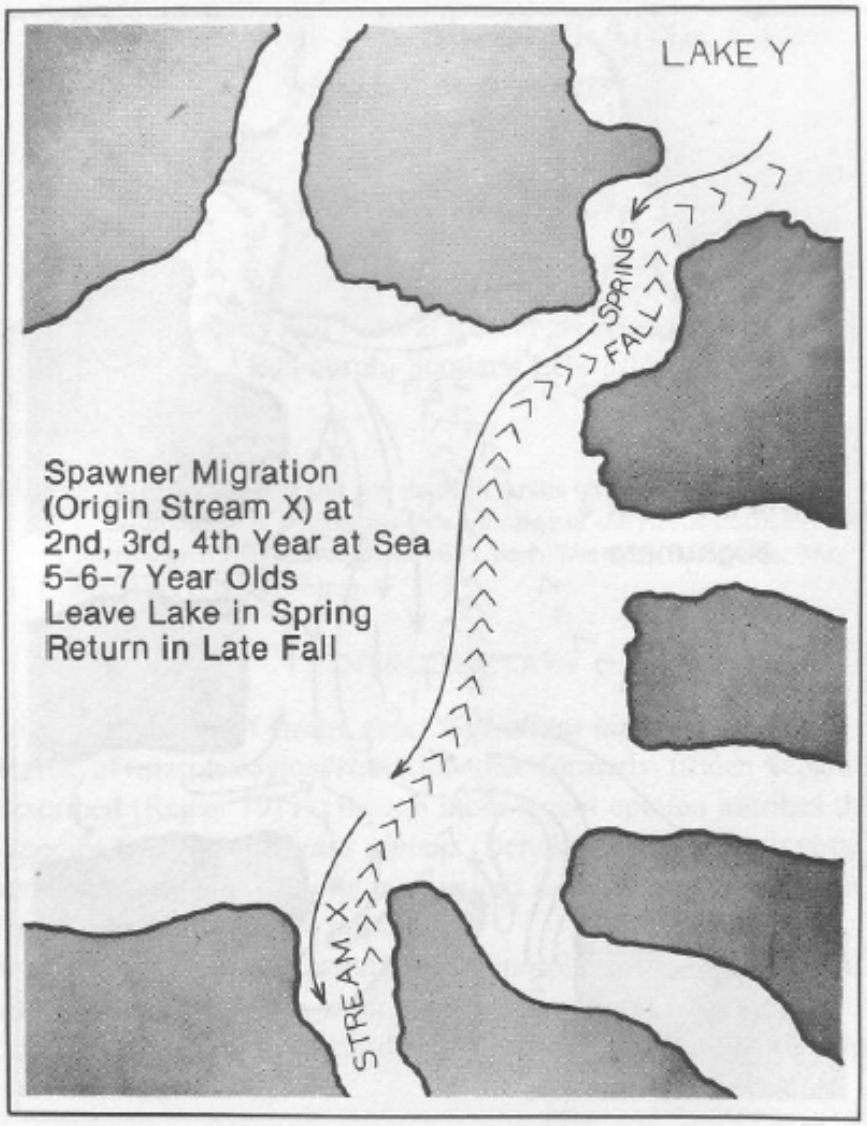


FIG. 10 Spawner migration theory — after wintering in lakes spawners leave in the spring, migrate directly to their home stream, remain until spawning is completed then return directly to the lake system before winter.

1) Homing tendencies strong because:
   a) No straying of charr marked as smolt was observed between adjacent study streams.
   b) All charr spawning in Hood Bay Creek could be accounted as originating from the creek.
   c) Spawning charr displaced from a stream to saltwater returned to the system they were displaced from.
2) No spawning charr left the study streams in Hood Bay before spawning. This indicated a direct movement between the lake and nonlake streams.
3) No spawned-out charr entered any of the nonlake systems studied yet many (2,900) entered the lake system before winter. This indicates a direct migration from the nonlake system to a lake system after spawning.

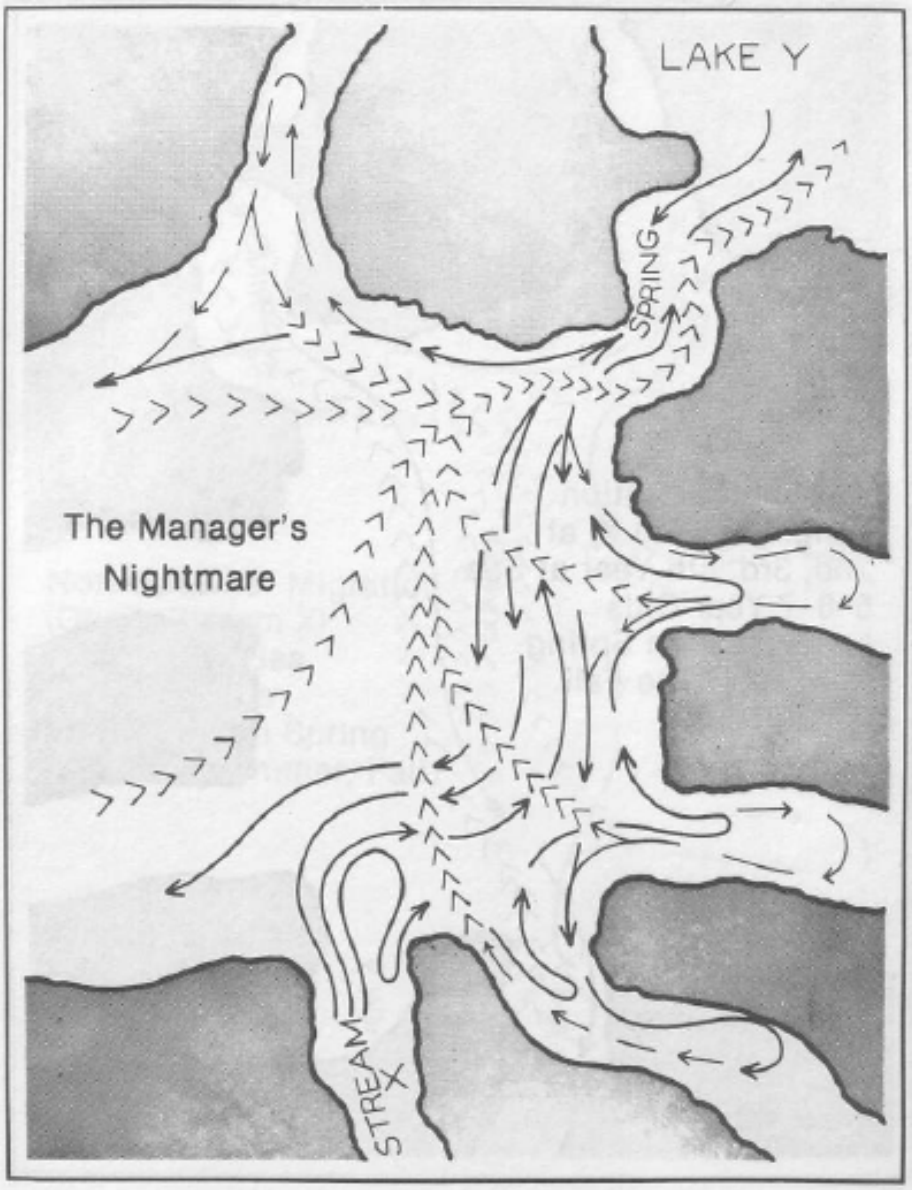


FIG. 11 The managers' nightmare — each stream and lake contains mixed stocks of charr. The same fish may be available for harvest in several nonlake streams, saltwater and a lake system.

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