Preliminary Analysis of Tag and Recapture Data of the Greater Amberjack, *Seriola dumerili,* in the Southeastern United States

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ABSTRACT

Greater amberjack, *Seriola dumerili,* tag and recapture data are summarized for 1959-1995 from five historic marine tagging programs. 13,856 fish have been tagged during this period and 10.3% (1,456) were recaptured. Recapture averages are 1.9 years at liberty (84% of returns), with a high of 14 years occurring. 48% of all fish showed no net movement. Results indicate that a spring movement of Atlantic Ocean stock occurs from the Carolinas to southeast Florida. There is a 1.3% exchange between Atlantic and Gulf of Mexico fish (1.6% exchange between the Gulf of Mexico to the Atlantic). These movements may be spawning related.

KEY WORDS: Greater amberjack, movement, migration, *Seriola dumerili,* tag and release, stock

INTRODUCTION

Greater amberjack, *Seriola dumerili*, have always been an important by-catch in reef fish fisheries and are now frequently the primary species targeted by recreational and commercial fishermen along the southeast coasts of the United States. They are widely distributed from Virginia to Florida on the U.S. Atlantic coast, from Florida through Texas in the Gulf of Mexico, into the Caribbean, and into waters off Central and South America to Brazil. However, definitive information on the stock structure is not available in the literature. Anecdotal references to the occasional occurrence in a particular region or fishery during certain seasons are available, although accounts of movement patterns have been limited to only a few scientific studies.

As more desirable species became unavailable, commercial landings of this species rose explosively during the 1980s. Landings in the Gulf of Mexico rose from 10,000 pounds in 1962 to a high of 2,858,000 pounds in 1988 and since then have dropped dramatically (McClellan and Cummings, 1996). In the Atlantic Ocean, landings rose from about 6,000 pounds in 1962 to 2,300,000

Amberjack, and Dolphin program (MML CAD) included the greater amberjack in its migration studies, with fish primarily tagged along the southwest Florida coast. Greater amberjack have also been tagged extensively along the South Carolina coast by the Marine Gamefish Tagging Program of the South Carolina Department of Natural Resources (SCDNR) since 1991. Returns from the American Littoral Society and the Gulf Coast Conservation Association of Louisiana (LAGCCA) programs were also used in this study.

Data from these programs were grouped into eight subareas to determine patterns in temporal and spatial movements (Figure 1). Subareas were selected for maximum spatial resolution to account for general knowledge of greater amberjack migrations. Several data sets represented specific geographical regions, relative to a tagging site or fishing area, that suggested maintaining these areas separate in the study.

Four subareas were defined for the Atlantic Ocean region. The spawning activity and fishing activity known to occur south of Cape Canaveral, Florida through the Florida Keys suggested the SEFL subarea. NEFL is the area between the Georgia state line and Cape Canaveral, Florida. The waters off Georgia and the Carolinas extending to Cape Hatteras, NC was defined as the SAB area since this was an area of tagging activity by the SCDNR. Known concentrations off Virginia suggested the NCH area.

In the Gulf of Mexico, four subareas were also defined based on the above criteria. Louisiana and Texas became the WG for the area west of the Mississippi River. Directed tagging by fishermen east of the Mississippi to the Florida State line suggested the NEG subarea, and intense fishing off the Panhandle of Florida and the Middle Grounds off Tampa, Florida suggested the NWFL subarea. Tampa to the Dry Tortugas became the SWFL subarea.

Temporal movement was obtained by grouping returns into 12 month year classes, where 0 – 365 days equal year 1 class , 366 – 730 days equal year 2 , etc.. The distribution of recaptures by month and year was computed for each release subarea to evaluate the timing of amberjack returning to a specific subarea.

Spatial movements were evaluated by partitioning the recapture observations by release subarea to allow for long distance movements. Minimum distance traveled was computed for each recapture and all movements were considered to be net movement in a straight line and could not take into account any circular or random movements. Fish were considered to have moved if the distance between release and recapture was greater than one degree or 60 nautical miles.

Relative direction of greater amberjack movement was calculated to address movement between subareas by grouping the observations into 90 degree spatial unit blocks according to release and recapture information.

RESULTS

Complete data on the date and location of tagged greater amberjack were reported for 13,792 of 13,856 fish tagged and 1,423 of 1,456 fish recaptured between 1959 and 1995 (Table 1) from the five programs combined. Burch (1979) estimated 82% of the species composition was greater amberjack in the recreational fishery off southeast Florida. Two/thirds of all releases were made in the Atlantic with SEFL contributing 43% of these (Table 2). Spring-summer releases were made in (SAB, NCH, NEFL) the northern subareas of the Atlantic while releases in SEFL were made in Winter-spring. Gulf of Mexico releases were primarily in the summer months. Release times are a function of the fishing pressure at these times (Figure 2).

Tag recapture rates varied by tagging program, release year and area, and were not adjusted for possible biases due to mortality, tag shedding, non-reporting, or fishing effort. The average annual rate of amberjack recaptures ranged from 1% to 29%, return rates by program varied from 1 to 11%, and averaged 10.3% overall (Table 2).

Atlantic Ocean recaptures time at large ranged from 0 to 14 years and were at average 1.9 years. 41% of recaptures were made within 90 days, 69% within one year and 85% within 2 years (Figure 3a). Relative to direction, 48% of the fish recaptured showed zero net movement, 33% within 25 nm (Figure 3b). Low positive correlation existed between distance moved and time at large with mean migration distance increasing during the first 120 days (Figure 4a). Displacement rate averaged 1.25 nm/day for the 462 recaptures showing movement and a negative relationship occurred with the highest with fish at large for a short period of time (Figure 4b). Returns to the different subareas occurred at varying rates, most within three years (Figure 5).

Gulf of Mexico recapture rates averaged 13% annually with a range from 0.6% to 66.7%, and recaptures time at large ranged from 1 to 6 years , 1.2 years on average (Figure 6a). 37% of recaptures were made within 90 days, 84% within one year and 98% within 2 years. Relative to direction, 30% of the fish recaptured showed zero net movement, 58% within 25 nm (Figure 6b)and the maximum movement was 3600 nm. Low positive correlation existed between distance moved and time at large with mean migration distance increasing during the first 120 days (Figure 7a). Displacement rate averaged 3.7 nm/day for the 376 recaptures showing movement and a negative relationship occurred with the highest with fish at large for a short period of time (Figure 7b). As with the Atlantic region, greater amberjack were at large in the different subareas at

iv) 9 recaptures from Gulf of Mexico to Atlantic (1.6%).

DISCUSSION

The ability to successfully tag greater amberjack was demonstrated by reasonably high recapture rates, 10.3%, over the 36 year period. This study corrobated temporal and spatial patterns of movement reported previously (Burch, 1979; Sutherland and Scott, 1989; Burns and Neidig, 1992; Davy, 1994). Greater amberjack are recaptured within a relatively short period of 90 days, 41 and 31 percent of recaptures, for Atlantic Ocean and Gulf of Mexico, respectively. The time period is more variable for the Atlantic (1 – 4 years) than the Gulf of Mexico (1 – 6 years). Whether the differences in recapture rates is because of fishing pressure, tagging effort, reporting rates, tag loss, natural mortality, or other factors, is unknown.

This study showed the variability in temporal movement is in part related to the area of release. Greater amberjack released in the NCH subarea were reported recaptured during the fall there but also in the spring in the SEFL. Releases in the SAB also showed up in the spring in the SEFL. These support the hypothesis of a southerly migration down the Atlantic east coast and a subsequent northerly migration. Because of large concentrations spawning annually off SEFL in the spring, this migration may be spawning related. A resident stock of amberjack off the east coast of Florida is suggested because of the lack of movement of fish tagged in SEFL and NEFL, and has also been suggested by previous investigators.

Most greater amberjack made limited movements, with about 64.4% for the Atlantic Ocean and 54.0% for the Gulf of Mexico of all recaptures made within 25 nm of the release site. Distance moved and time at large had low positive correlation. Fish from the Gulf of Mexico were at liberty for shorter time periods, and recaptures were closer to tagging sites than the Atlantic Ocean, which suggests Atlantic fish participate in longer migrations. In the Atlantic, 72.9% of all fish were recaptured within 100 miles, while 92.7% of GOM fish traveled less than 100 miles.

Directionally, Atlantic Ocean fish moved predominantly in a south/southwest direction and Gulf of Mexico fish showed no trend. Some fish in the WFL subarea showed a tendency to migrate into the SEFL. The two recaptures from NEFL to the Bahamas suggest movement across the Gulf Stream. Movement between the two regions is rare, but does occur 1.3% of the time from Atlantic to Gulf of Mexico and 1.6% vice versa. Movement of fish from the Atlantic to the Caribbean was reported seven times over the 36 years.

Table 2. Summary of greater amberjack releases, recaptures, and percentage recapture by subarea of release between 1959 and 1995 for the Atlantic Ocean region, Gulf of Mexico region, and Other regions. Codes for subareas are as follows: NCH = north of Cape Hatteras; SAB = south Atlantic Bight; NEFL = northeast Florida; SEFL = southeast Florida; WFL = west Florida; NWFL = northwest Florida; NEG = northeast Gulf; and WG = western Gulf.

	Released	Recaptured	Percent
Atlantic Ocean			
NCH	1767	87	4.9%
SAB	1599	50	3.1%
NEFL	1914	123	6.4%
SEFL	3908	568	14.5%
TOTAL	9188	828	9.0%
Gulf of Mexico			
WFL	770	66	8.6%
NWFL	2913	422	14.5%
NEG	468	56	12.0%
WG	194	25	12.9%
TOTAL	4345	569	13.1%
Other Regions			
Bahamas	174	13	7.5%
Other	56	3	5.4%
Unknown	29	10	34.5%
Total	259	26	10.0%
All Combined			
Total	13792	1423	10.3%

Table 4. Posterior probability values for membership in the a.) Atlantic Ocean or Gulf of Mexico region or b.) subarea management units of greater amberjack based on a measure of generalized square distance. Number of recaptures are in parenthesis.

a.

RELEASE REGION	RELEASE REGION		
RELEASE REGION	Atlantic Ocean	Gulf of Mexico	Affinity Value
Atlantic Ocean	99.1 (616)	0.9 (7)	99.1
Gulf of Mexico	3.2 (16)	96.8 (482)	96.8
Total	632	489	1321

b.

RELEASE SUBAREA	RELEASE SUBAREA								
RELEASE SUBAREA	Atlantic Ocean Region				Gulf of Mexico Region				Affinity Value
	NCH	SAB	NEFL	SEFL	WFL	NWFL	NEG	WG	
Atlantic Ocean									
NCH	90.7 (78)	5.8 (5)	3.5 (3)						100.0
SAB	10.0 (5)	38.0 (19)	48.0 (24)	2.0 (1)			2.0 (1)		98.0
NEFL	2.5 (3)	12.3 (15)	54.9 (67)	28.7 (35)		1.6 (2)			98.4
SEFL	0.4 (2)	3.2 (18)	5.0 (28)	90.8 (513)	0.5 (3)	0.2 (1)			99.3
Gulf of Mexico									
WFL		3.4 (1)		13.8 (4)	79.3 (23)	3.4 (1)			82.7
NWFL		1.8 (7)	1.0 (4)			69.7 (271)	27.5 (107)		97.2
NEG		5.4 (30	1.8 (1)			10.7 (6)	82.1 (46)		92.8
WG						4.2 (1)	12.5 (3)	83.3 (20)	100.0
Total	88	68	127	553	26	282	157	20	1321

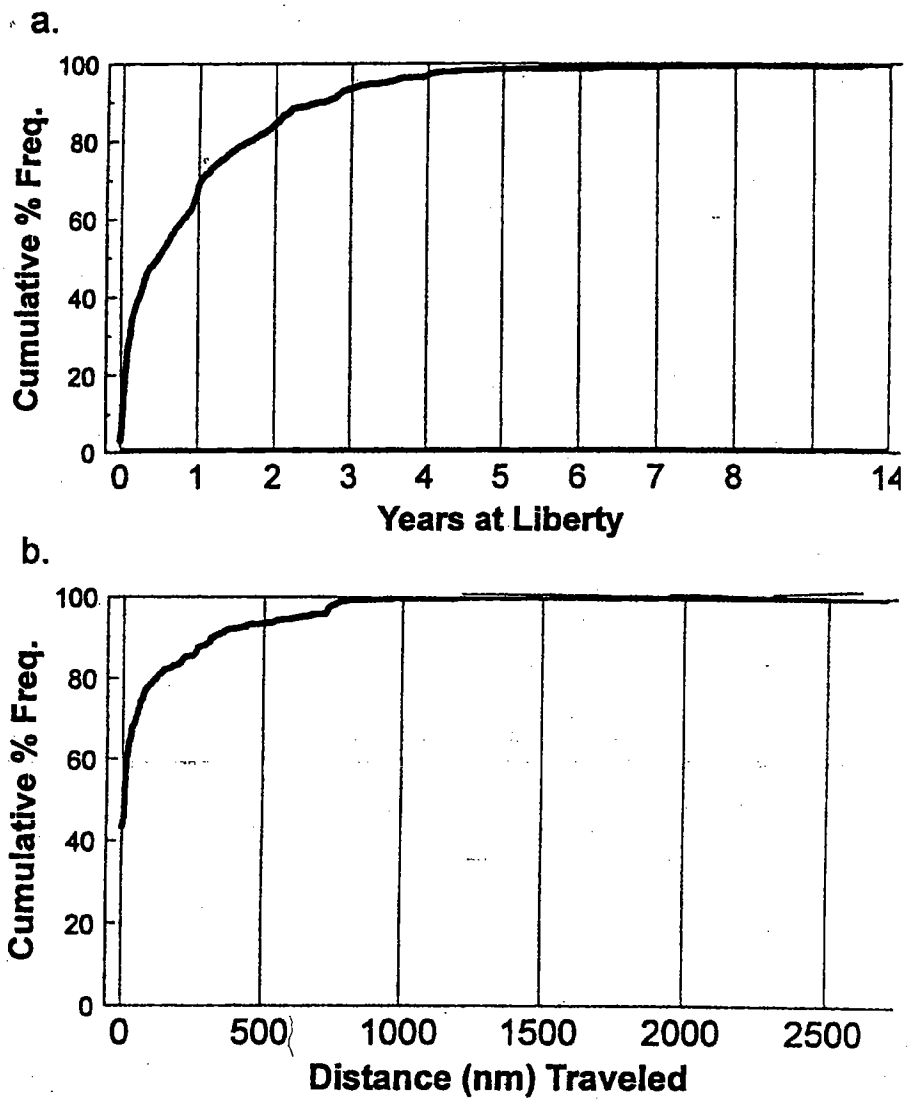

Figure 2. Atlantic Ocean recaptures as a cumulative percentage of total number of recaptures for greater amberjack released from the Atlantic Ocean for a). the time at large from the day of release and b.) the straight- line distance traveled from the point of release. Not all recaptures were used in the analyses because of incomplete data.

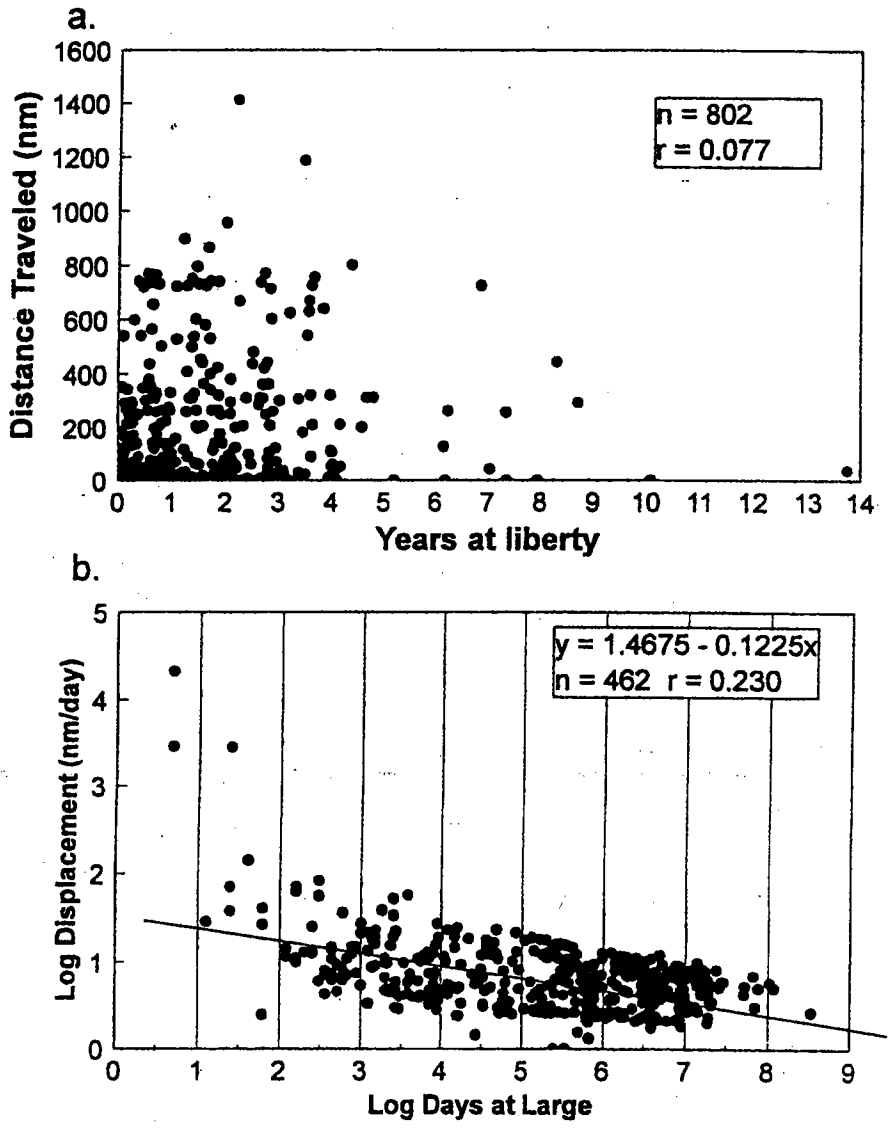

Figure 4. Greater amberjack relationships in the Atlantic Ocean region showing (a) the correlation between distance moved and years at liberty, and (b) the relationship between the log displacement rate (nautical miles per day) and log days at liberty. Not all recaptures were used in the analyses because of incomplete data.

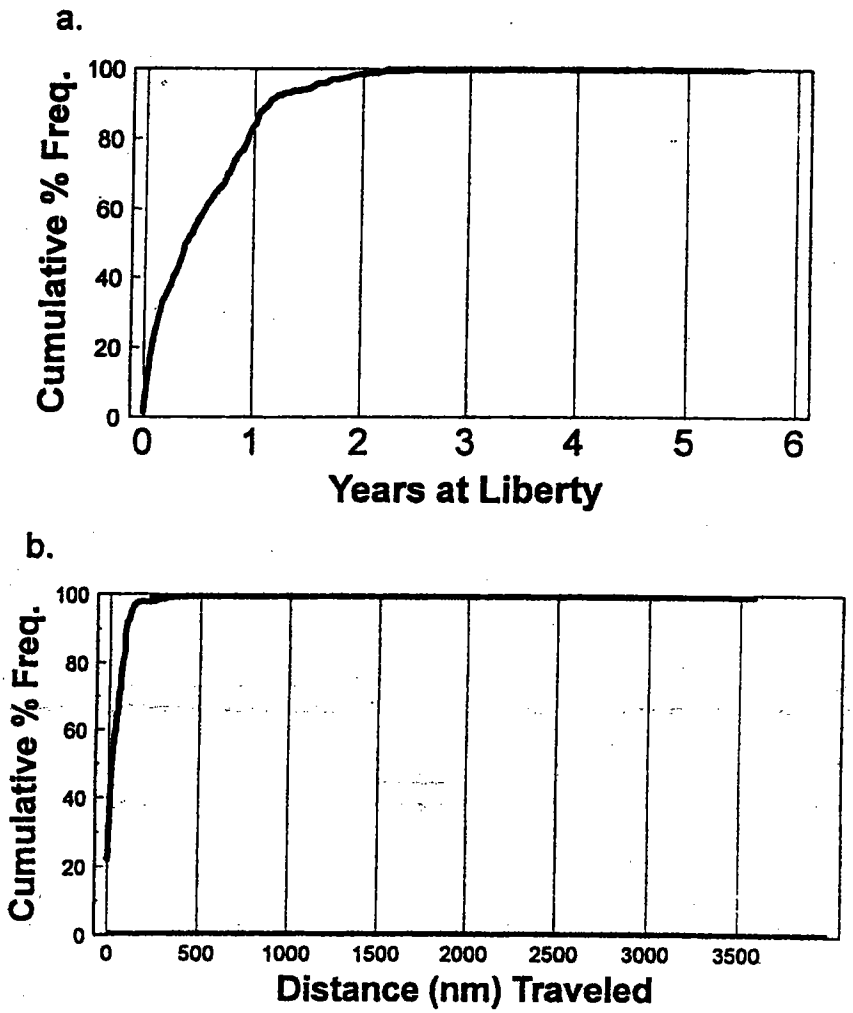

Figure 6. Gulf of Mexico recaptures as a cumulative percentage of total number of recaptures for greater amberjack released from the Gulf of Mexico for a.) the time at large from the day of release and b). the straight- line distance traveled from the point of release. Not all recaptures were used in the analyses because of incomplete data.

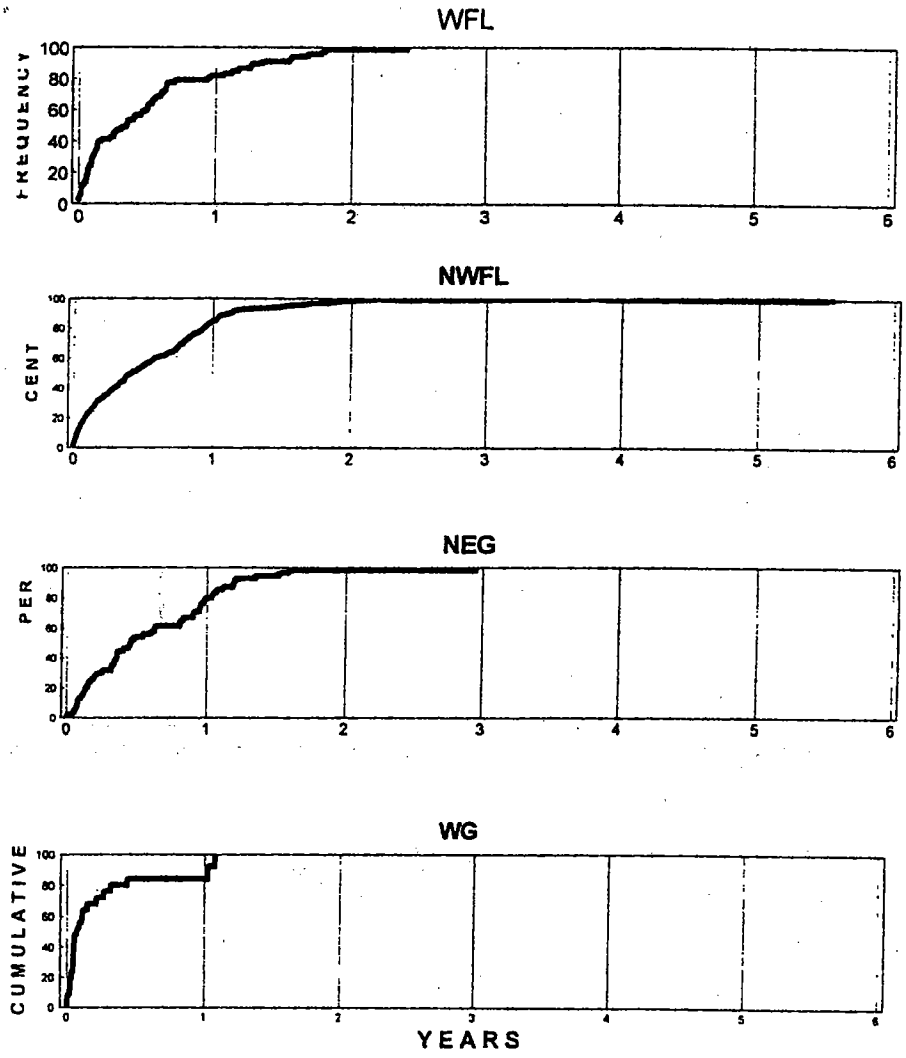

Figure 8. Time at liberty for greater amberjack released in the Gulf of Mexico region for each release subarea of (a) west Florida (WFL), (b) northwest Florida (NWFL), (c) northeast Gulf (NEG), and (d) western Gulf (WG), as cumulative percentage of total number of recaptures. Not all recaptures were used in the analyses because of incomplete data.

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