Review of the early life history of vermilion snapper, *Rhomboplites aurorubens*, with a summary of data from SEAMAP plankton surveys in the Gulf of Mexico: 1982-2002

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EARLY LIFE HISTORY

Information on the early life history of *Rhomboplites aurorubens* is limited. Vermilion snapper are oviparous and spawn pelagic eggs during the warmer months of the year. Larvae are planktonic and were first identified and described from field collected specimens by Laroche (1977). Despite this initial description and the additional morphological characteristics described since (Lyczkowski-Shultz and Comyns 1992; Comyns and Lyczkowski-Shultz 1993; Drass et al. 2000; and Lindeman et al. 2005), vermilion snapper larvae cannot be consistently distinguished from the larvae of other snappers at sizes < 3.5 mm in length. Size at settlement is presumably ~20 mm (Lindemann et al. 2005).

Vertical stratification, distribution, diet, growth and mortality rates of vermilion snapper larvae in coastal and shelf waters of the northcentral Gulf of Mexico from east Louisiana to northwest Florida during the period 1983-1993 were described in MARFIN reports by Lyczkowski-Shultz and Comyns (1992), Comyns and Lyczkowski-Shultz (1993), and Comyns (1995). Snapper larvae (all taxa) were, in general, captured more frequently and in greater numbers at depths of 5 and 11 m than at 1 m. Small snapper larvae, too undeveloped to be identified, were present in April samples from this area. Vermilion snapper larvae were first positively identified in May samples. Frequency of occurrence and station abundances were higher in July than in May and remained at similar levels in August. Values of percent occurrence and abundance in September were nearly twice as high as in previous months. Highest abundances were observed between 18 and 37 m water depth and in the central and eastern region of the survey area (Comyns 1997). Diet analyses were inconclusive due to the high incidence of empty guts even among snapper larvae captured in daytime collections.

Growth increments observed on sectioned otoliths of vermilion snapper larvae were similar in appearance to validated daily growth marks on the otoliths of red snapper larvae. Growth rate of vermilion snapper larvae (presuming their otolith growth increments are also daily) was found to be related to water temperature and capture location (Comyns 1995). Significant seasonal differences in larval growth rates were observed. Larvae captured in May were growing at 0.3 mm/day at water temperatures of 24-25° C, while larvae captured in August were growing at 0.5 mm/day at water temperatures ranging from 29-30° C. Larvae captured in May samples attained a length of 8 mm in 22 days while in August larvae reached 8 mm in 16 days. Comyns (1995) noted that vermilion snapper larvae captured in July tend to be longer at age than red snapper larvae in the same collections (over the size range of ~2.5-6.5 mm) but their growth rates as derived from age/length relationships were not significantly different. Significant within-cruise (among station) differences in growth among larvae captured in September were observed that were unrelated to temperature differences (Comyns 1997; Comyns et al. 2003). Small-scale variability in larval growth rates was assumed to have

been caused by variability in as yet undetermined conditions effecting larval growth. Cruise estimates of mortality coefficients for larval vermilion snapper ranged from 0.19 and 0.29 during three September cruises.

Distribution and abundance of vermilion snapper larvae were described in a recent summary of SEAMAP ichthyoplankton data from an area of the northeastern Gulf of Mexico between ~ 88.5° and 84.5° N latitude and from the shoreline to ~1000 m contour (Lyczkowski-Shultz et al. 2004). Vermilion snapper larvae were the second most frequently taken and abundant among snapper taxa identified in NEGOM area samples. Although more total specimens were collected in neuston samples, two-thirds of all occurrences resulted from bongo net samples with all but four occurrences, and 97 % of specimens being taken during fall plankton surveys. Vermilion snapper larvae were widely distributed through the northeastern Gulf but were taken more consistently at localities at or east of 87º W longitude. Larvae were taken relatively more frequently in this region than Gulfwide.

SEAMAP SURVEYS, METHODS AND MATERIALS

Since 1982 the Southeast Area Monitoring and Assessment Program (SEAMAP) has supported collection and analysis of ichthyoplankton samples during fishery-independent, resource surveys in the Gulf of Mexico (GOM) with the goal of producing a long-term database on the early life stages of fishes (Rester et al. 2000). Surveys are conducted by the National Marine Fisheries Service in cooperation with the states of Florida, Alabama, Mississippi, and Louisiana. The original plan for SEAMAP plankton surveys was to sample both the open (shelf edge to U.S. EEZ) and continental shelf (10 to 200 m) portions of the Gulf in their entirety at least once during each season. This ambitious goal has not been achieved because survey data relevant to fisheries-related issues must encompass the entire geographic extent of spawning which, for most species, includes either the entire open Gulf or continental shelf regions. Furthermore, once established, these surveys must be conducted on an annual basis in order to build a historical database from which population trends can be assessed.

Due to these constraints SEAMAP ichthyoplankton data are collected primarily during four survey periods: spring (April and May, 1982 to present), summer (June and July, 1982 to present), late summer /early fall (typically in September, 1986 to present) and fall (October and November, 1982 to present). The spring survey covers only open U.S. GOM waters, while the summer and fall surveys encompass only continental shelf waters from south Texas to Mobile Bay; and the late summer/early fall survey from south Texas to south Florida. There have been three, winter plankton surveys in open Gulf waters during the SEAMAP time series (in 1983, 1984 and 1996). Samples used in annual estimates of larval fish abundance are collected on both state and federal cruises. Since 1982 the number of samples taken each year during SEAMAP summer and fall shrimp/bottomfish trawl surveys has typically ranged from 30 to 76 samples. In 1998 only 10 samples were collected during the summer trawl survey due to vessel breakdowns and severe weather. The summer and fall trawl survey area includes the continental shelf and coastal waters west of 88° W longitude; although in the earliest years of the time series (1982 to 1988) sampling was conducted further east off northwest

Florida. Samples from mid August to mid-October are taken during the SEAMAP fall plankton survey which only became a Gulfwide survey of continental shelf and coastal waters between Brownsville, Texas and south Florida in 1986. This survey has produced from 81 to 150 samples per year since 1986. In 1998 only 35 samples were collected during this timeframe due to vessel breakdowns and tropical storms.

Over the years, plankton sampling has been conducted using standard SEAMAP gear at SEAMAP designated stations that were not part of designated SEAMAP surveys. Data and observations from these sampling efforts are used to better define spawning times and intensity but are not used to estimate annual indices of larval fish occurrence and mean abundance.

The sampling gear and methodology used during SEAMAP surveys (Rester et al. (2000) are similar to those recommended by Kramer et al. (1972), Smith and Richardson (1977) and Posgay and Marak (1980). A 60 cm bongo net fitted with 0.333 (0.335)[1] mm mesh netting is fished in an oblique tow path from a maximum depth of 200 m or to 2-5 m off the bottom at depths less than 200 m. A mechanical flowmeter is mounted off-center in the mouth of each bongo net to record the volume of water filtered. Volume filtered ranges from ~20 to 600 m^3 but is typically 30 to 40 m^3 at the shallowest stations and 300 to 400 m^3 at the deepest stations. A single or double 2x1 m pipe frame neuston net fitted with 0.947 (0.950)[1] mm mesh netting is towed at the surface with the frame half-submerged for 10 minutes. Non-standard gear used to collect plankton samples from smaller vessels operated by the states are coded as such in the database and are not used to calculate larval indices.

Catches of larvae from bongo nets are standardized to account for sampling effort and expressed as number of larvae under 10 m^2 of sea surface. This is accomplished by dividing the number of larvae of each taxon caught in a sample by the volume of water filtered during the tow; and than multiplying the resultant by the maximum depth of the tow in meters and the factor 10. Catches of larvae from neuston nets are standardized to account for sampling effort and expressed as number of larvae per 10 min tow.

Most but not all SEAMAP, standard plankton stations are located at 30 mile or ½ degree (~56 km) intervals in a fixed, systematic grid across the GOM, although, only every other N-S transect of stations is sampled during spring surveys and during fall plankton surveys in 1988-1991. Occasionally during surveys, samples are taken at non-standard locations or stations are moved to avoid navigational hazards. Samples are taken upon arrival on station regardless of time of day. At each station either a bongo and/or neuston tow are made depending on the specific survey.

Initial processing of SEAMAP plankton samples is carried out at the Sea Fisheries Institute, Plankton Sorting and Identification Center (ZSIOP), in Szczecin, Poland and the Louisiana Department of Wildlife and Fisheries. Vials of eggs and identified larvae, plankton displacement volumes, total egg counts, and counts and length measurements of

[1] Mesh size change in database does not represent an actual change in gear but only a change in the accuracy at which plankton mesh aperture size can be measured by the manufacturer.

identified larvae are sent to the SEAMAP Archive at the Florida Marine Research Institute in St. Petersburg, FL. There data are entered into the SEAMAP database and specimens are curated and loaned to interested scientists. Data files containing specimen identifications and lengths are sent to the NMFS Mississippi Laboratories where these data are combined with field collection data and edited according to established SEAMAP editing routines. SEAMAP survey data are currently maintained in dBase file structures but conversion to an Oracle based system is underway.

All specimens of snapper larvae used in these analyses were re-examined by ichthyoplankton specialists at the Southeast Fisheries Science Center, Mississippi Laboratories. A strict identification protocol was followed to assure the accuracy and consistency of vermilion snapper identifications over the time series.

RESULTS

General Description of Occurrence and Abundance from SEAMAP surveys in the Gulf of Mexico:

Use of ichthyoplankton survey data in assessment analyses for snapper species (family Lutjanidae) has proven difficult due to the inability to distinguish the larvae of closely related species at the smallest sizes found in samples. Over 11,000 specimens of snapper larvae collected in bongo and neuston net samples during SEAMAP surveys, 1982-2002 were examined and identified to the lowest taxon possible using recent descriptions of snapper larvae (Drass et al. 2000; Lindeman et al. 2005).

The larvae of vermilion snapper were collected in plankton samples from 138 of over 240 cruises in the NMFS/Mississippi Labs database through the 2002 field season (Table 1). Larvae first appeared in samples from April and were present in samples through November (Table 2). Months of highest occurrence and abundance were August, September and October when vermilion larvae occurred in 17 % and 9%, 25% and 12%, and 15% and 9% of bongo and neuston samples, respectively. Mean abundance in those months was 2.98, 2.87 and 1.87 larvae per 10 m^2 for bongo samples and 1.15, 0.75 and 0.54 larvae per 10 min for neuston samples. By November per cent occurrence was $\leq$ 2 % and mean abundance was <0.2 larvae in samples from either gear.

Mean abundance and occurrence of vermilion snapper larvae by month and survey (including non-SEAMAP sampling effort) indicated that the SEAMAP Fall Plankton survey accounts for the majority of captures (Tables 3 and 4). This survey comprises samples collected within the timeframe, 15 August to 15 October. Summed abundances of vermilion snapper larvae during the only other established, long-term surveys; namely spring plankton and summer and fall shrimp/bottomfish surveys, were an order of magnitude less than summed abundance during the fall plankton survey. The explanation for this difference is that sampling during spring surveys takes place primarily in open Gulf waters, i.e. outside vermilion snapper spawning grounds. Sampling during summer and fall shrimp/ bottomfish surveys apparently misses peak spawning production.

Size frequency distributions (catch curves) of vermilion snapper larvae captured during the three, long-term SEAMAP surveys in shelf waters are shown in Figures 1 and 2. The overall range in body length (BL) of vermilion snapper larvae was 1.5 to 41.0 mm BL

(mean = 4.39, median = 4.10) in bongo net samples and 2.0 to 29.8 mm BL (mean = 3.97, median = 3.80) in neuston net samples. Over 99% of larvae in bongo net samples were ≤ 8.5 mm BL and larvae in neuston net samples were ≤ 6 mm BL (Tables 5 & 6).

Maps showing distribution and relative abundance of larvae in bongo and neuston samples from the SEAMAP August 1984 plankton survey and SEAMAP Fall Plankton surveys, 1986 to 2002 are presented in Figures 3-20. Vermilion snapper were taken over the entire east-west extent of the survey area but, over the time series, most occurrences were observed at stations on the mid and outer continental shelf between the 50 and 100 m isobaths. In some years larvae occurred at more inshore locations off east Texas and west Louisiana, and southwest Florida. Larvae consistently occurred beyond the 100 m isobath off southwest Florida and at nearshore stations off Alabama and northwest Florida near the northern rim of the De Soto Canyon (~ 87° W longitude and 50-60 m water depth). The region of highest station abundances was observed off central and southwest Florida. Distribution of larvae during other surveys did not markedly differ from the pattern observed during the fall plankton survey.

Larval Index:

We recommend that the vermilion snapper index of larval abundance be based on bongo net samples from the SEAMAP Fall Plankton survey (Table 7). The time series for this index begins with the 1986 season when the fall plankton survey became Gulfwide, and subsequently, it has been conducted each year from mid August to mid October. Too few samples were taken during the 1998 field season on which to base an estimate of larval abundance due to tropical storms and hurricanes that severely curtailed field work that year. It is evident from a comparison of mean annual abundances, coefficients of variation of mean abundance (CV), and annual per cent occurrence between both gear types that vermilion snapper larvae are taken more consistently in bongo than in neuston samples (Tables 8 & 9). CV's over the time series for bongo net catches are lower and relatively more stable than for neuston net catches. Larvae occurred less frequently and in lower numbers during the summer and fall shrimp/bottomfish surveys than during the fall plankton survey. Geographic coverage during the fall plankton survey includes the west Florida shelf where vermilion snapper larvae are present in moderate to high abundances. Plankton sampling during the summer and fall shrimp/bottomfish surveys does not extend east of Mobile Bay, Alabama and, therefore, does not adequately sample a large portion of the vermilion snapper spawning stock in the Gulf.

The final vermilion snapper larval index of abundance will be based on a single size/age class using a 'trimmed' data set, i.e. utilizing only data from stations consistently sampled at a selected threshold level over the time series see Hanisko et al. SEDAR7-RW 7.

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Table 1: Surveys where vermilion snapper larvae were caught in plankton samples. SP=SEAMAP Spring survey; SG=SEAMAP Summer Shrimp/Bottomfish survey; FG=Fall Shrimp/Bottomfish survey; FP=SEAMAP Fall Plankton survey; SQ=Squid/ Butterfish survey; AF=Alabama Fall SEAMAP survey; AS=Alabama Summer SEAMAP; * donotes sampling outside established SEAMAP surveys

CRUISE	VESSEL	Survey Type	No. of Samples NEUSTON	No. of Samples BONGO	Cruise Begin Date	Cruise End Date
126	04	SP	128	127	4/15/1982	5/25/1982
821	30	SP	0	8	4/27/1982	4/28/1982
821	09	SP	7	7	5/19/1982	5/16/1982
127	04	SG	60	66	6/2/1982	7/13/1982
134	04	SP	108	110	4/22/1983	5/23/1983
135	04	SG	46	47	6/1/1983	7/13/1983
831	09	*	8	16	6/26/1983	6/29/1983
832	09	*	0	19	7/12/1983	7/14/1983
138	04	FG	23	36	10/12/1983	10/31/1983
143	04	SP	88	141	4/21/1984	5/16/1984
145	04	SG	59	60	6/8/1984	7/22/1984
841	17	SG	10	10	6/8/1984	6/10/1984
146	04	FP	161	156	8/2/1984	8/27/1984
841	30	FP	20	20	8/25/1984	8/29/1984
148	04	FG	0	29	10/10/1984	11/10/1984
851	30	*	34	34	6/5/1985	6/14/1985
153	04	SG	36	38	6/11/1985	7/15/1985
853	35	SG	20	24	7/22/1985	7/25/1985
154	04	SQ	46	47	7/30/1985	8/26/1985
852	17	SQ	20	20	8/2/1985	8/13/1985
854	17	SQ	5	5	8/22/1985	8/24/1985
156	04	FG	1	1	10/19/1985	11/2/1985
159	04	SP	69	69	4/22/1986	5/21/1986
160	04	SG	43	43	6/10/1986	7/6/1986
862	17	SG	6	6	6/11/1986	6/12/1986
161	04	FP	48	48	9/4/1986	9/12/1986
862	36	FP	29	29	9/6/1986	9/13/1986
864	17	FP	9	9	9/8/1986	9/10/1986
865	28	FP	56	55	9/13/1986	9/22/1986
862	23	AF	10	6	9/22/1986	9/18/1986
163	04	FG	62	63	10/23/1986	11/22/1986
864	36		28	28	11/15/1986	11/21/1986
873	36	SP	16	18	5/1/1987	5/9/1987
167	04	SG	43	44	6/12/1987	7/14/1987
872	35	SG	11	22	7/7/1987	7/11/1987
875	36	FP	35	35	9/1/1987	9/8/1987
169	04	FP	91	91	9/12/1987	9/27/1987
171	04	FG	20	24	10/23/1987	11/14/1987

Table 1 cont.

173	04	SP	4	73	4/20/1988	5/26/1988
881	17	SG	5	6	6/13/1988	7/10/1988
882	36	FP	36	36	8/26/1988	9/2/1988
176	04	FP	80	39	9/7/1988	9/28/1988
892	49	SP	121	61	4/26/1989	5/19/1989
891	36	SP	24	25	5/11/1989	5/16/1989
891	17	SG	7	7	6/10/1989	7/11/1989
180	04	SG	21	21	6/19/1989	7/13/1989
892	28	*	30	0	6/24/1989	6/28/1989
183	04	FP	75	37	9/13/1989	9/29/1989
892	17	FP	5	5	9/17/1989	9/19/1989
892	36	FP	34	35	10/4/1989	10/11/1989
184	04	FG	39	38	10/20/1989	11/19/1989
187	04	SP	138	65	4/20/1990	5/24/1990
901	36	SP	4	21	5/24/1990	5/30/1990
904	28	SP	129	64	5/30/1990	6/30/1990
901	17	SG	3	4	6/9/1990	7/28/1990
189	04	SG	0	19	6/18/1990	7/7/1990
190	04	FP	100	52	9/2/1990	9/28/1990
902	36	FP	30	30	10/13/1990	10/18/1990
191	04	FG	39	39	10/16/1990	11/17/1990
194	04	SP	141	48	4/17/1991	5/22/1991
911	36	SP	13	13	5/7/1991	5/9/1991
911	17	SG	2	2	6/15/1991	6/16/1991
195	04	SG	37	37	6/18/1991	7/13/1991
912	36	FP	22	23	8/21/1991	8/25/1991
914	28	FP	95	49	9/6/1991	9/26/1991
197	04	FG	40	40	10/14/1991	11/18/1991
199	04	SP	146	72	4/22/1992	5/23/1992
921	26	SP	14	20	5/17/1992	5/21/1992
200	04	SG	40	41	6/13/1992	7/13/1992
922	35	SG	7	7	7/6/1992	7/9/1992
925	28	FP	72	73	8/30/1992	9/20/1992
201	04	FP	25	27	9/24/1992	9/27/1992
922	26	FP	13	12	10/12/1992	10/19/1992
202	04	FG	30	30	10/18/1992	11/10/1992
204	04	SP	120	64	5/19/1993	6/15/1993
936	28	FP	72	72	9/10/1993	9/29/1993
207	04	FP	10	10	10/5/1993	10/6/1993
932	26	FP	36	36	10/11/1993	10/18/1993
208	04	FG	36	30	10/15/1993	11/14/1993
935	17	FG	2	2	10/29/1993	11/2/1993
209	04	SP	88	67	4/28/1994	6/9/1994
944	28	SP	60	27	5/20/1994	5/31/1994
941	36	SP	5	5	5/20/1994	5/22/1994

Table 1 cont.

210	04	SG	42	41	6/16/1994	7/17/1994
946	28	FP	88	88	9/11/1994	9/29/1994
942	36	FP	29	29	9/28/1994	10/8/1994
214	04	FG	48	48	10/14/1994	11/20/1994
216	04	SP	264	127	4/19/1995	6/7/1995
951	26	SP	15	15	4/20/1995	4/28/1995
951	17	SG	2	2	6/10/1995	6/11/1995
955	28	FP	88	87	9/9/1995	9/26/1995
952	17	FP	5	5	9/16/1995	9/18/1995
952	26	FP	24	25	9/24/1995	9/28/1995
220	04	SP	171	79	4/17/1996	5/24/1996
961	26	SP	18	18	5/20/1996	5/25/1996
221	04	SG	22	22	6/14/1996	7/16/1996
965	28	FP	92	92	9/5/1996	9/25/1996
962	26	FP	19	19	9/11/1996	9/14/1996
224	04	FG	43	43	10/11/1996	11/21/1996
963	17	FG	2	2	10/24/1996	10/24/1996
225	04	SP	186	95	4/17/1997	6/9/1997
971	17	SG	2	2	6/7/1997	6/7/1997
226	04	SG	47	47	6/13/1997	7/16/1997
975	28	FP	93	93	9/7/1997	9/27/1997
972	17	FP	4	4	9/20/1997	9/22/1997
972	26	FP	19	19	10/2/1997	10/6/1997
973	17	FG	2	2	11/10/1997	11/11/1997
984	28	SP	156	71	4/19/1998	5/30/1998
981	26	SP	17	17	6/21/1998	6/23/1998
981	63	FP	25	27	9/7/1998	9/24/1998
232	04	FG	15	14	10/12/1998	10/15/1998
234	04	SP	179	88	4/23/1999	5/31/1999
991	17	SG	2	2	6/12/1999	6/13/1999
235	04	SG	35	35	6/15/1999	7/20/1999
992	63	FP	116	117	9/3/1999	9/29/1999
993	17	FP	9	9	9/9/1999	9/10/1999
991	26	FP	12	10	9/25/1999	9/29/1999
237	04	FG	45	43	10/16/1999	11/20/1999
002	63	SP	166	85	4/20/2000	5/26/2000
240	04	SG	45	45	6/13/2000	7/19/2000
001	17	SG	2	2	6/24/2000	6/25/2000
242	04	FP	104	111	9/7/2000	10/1/2000
001	26	FP	13	14	9/26/2000	9/29/2000
002	17	FP	11	11	10/13/2000	10/15/2000
243	04	FG	46	45	10/14/2000	11/17/2000
012	63	SP	180	96	4/18/2001	5/29/2001
246	04	SG	28	29	6/12/2001	7/24/2001

Table 1 cont.

013	17	SG	12	11	7/3/2001	7/10/2001
015	63	FP	131	127	8/31/2001	9/26/2001
011	26	FP	12	12	10/11/2001	10/14/2001
248	04	FG	5	5	10/15/2001	11/6/2001
016	63	FG	42	42	10/15/2001	11/13/2001
014	17	FG	2	2	10/19/2001	10/20/2001
022	63	SP	160	90	4/18/2002	5/28/2002
250	04	SG	51	50	6/12/2002	7/16/2002
021	35	SG	7	7	7/9/2002	7/12/2002
025	63	FP	86	88	8/30/2002	9/20/2002
252	04	FG	46	44	10/13/2002	11/15/2002

Table 2: Summary of larval vermilion snapper catches by month based on all surveys in the Gulf of Mexico, 1982-2002. CV=coefficient of variation of mean abundance.

A. Bongo samples

Month	No. Samples	No. Occurrences	No. Larvae	% Occurrence	Mean Abundance	Std	SE	Lower 95%CI	Upper 95%CI	Minimum Abundance	Maximum Abundance	Summed Abundance	CV
1	72	0											
2	35	0											
3	185	0											
4	607	7	13	1.15	0.11	1.317	0.053	0.007	0.218	0	26.53	68.28	47.54
5	1361	34	43	2.50	0.17	1.216	0.033	0.107	0.236	0	21.61	233.84	19.18
6	684	64	119	9.36	0.71	3.399	0.130	0.459	0.969	0	44.15	488.55	18.19
7	590	51	79	8.64	0.55	2.305	0.095	0.367	0.740	0	30.00	326.36	17.16
8	329	57	224	17.33	2.98	10.018	0.552	1.892	4.065	0	69.88	980.02	18.54
9	1615	401	1258	24.83	2.87	8.594	0.214	2.454	3.293	0	127.07	4641.05	7.44
10	684	105	380	15.35	1.87	7.097	0.271	1.335	2.401	0	92.57	1277.90	14.53
11	472	10	11	2.12	0.12	0.914	0.042	0.041	0.206	0	9.84	58.40	33.99
12	236	0											

B. Neuston samples

Month	No. Samples	No. Occurrences	No. Larvae	% Occurrence	Mean Abundance	Std	SE	Lower 95%CI	Upper 95%CI	Minimum Abundance	Maximum Abundance	Summed Abundance	CV
1	76	0											
2	33	0											
3	50	0											
4	890	4	4	0.45	0.00	0.067	0.002	0.000	0.009	0	1.00	3.99	49.92
5	2039	55	250	2.70	0.12	2.023	0.045	0.034	0.210	0	82.00	249.24	36.66
6	768	20	55	2.60	0.08	0.657	0.024	0.032	0.125	0	10.00	60.45	30.10
7	536	11	35	2.05	0.06	0.667	0.029	0.003	0.116	0	13.08	31.79	48.54
8	331	29	381	8.76	1.15	7.368	0.405	0.355	1.948	0	83.00	381.26	35.16
9	1878	232	1408	12.35	0.75	4.010	0.093	0.568	0.931	0	65.22	1406.82	12.35
10	658	61	356	9.27	0.54	3.497	0.136	0.269	0.805	0	48.84	353.39	25.39
11	403	7	9	1.74	0.02	0.191	0.010	0.003	0.041	0	3.00	8.94	42.94
12	188	0											

Table 3: Summary of larval vermilion snapper catches in bongo net samples by month and survey type based on all surveys in the Gulf of Mexico, 1982-2002. CV=coefficient of variation of mean abundance. * donotes sampling outside established SEAMAP surveys

Month	Survey Type	No. Samples	No. Occurrences	No. Larvae	% Occurrence	Mean Abundance	Std	SE	Lower 95%CI	Upper 95%CI	Minimum Abundance	Maximum Abundance	Summed Abundance	CV
1	*	72	0											
2	*	35	0											
3	*	137	0											
6	*	50	18	41	36.00	3.14	6.755	0.955	1.221	5.061	0	39.53	157.06	30.41
7	*	22	6	7	27.27	1.32	2.435	0.519	0.241	2.401	0	8.77	29.07	39.30
8	*	13	0	0	0.00	0.00	0.000	0.000			0	0.00	0.00	
11	*	31	1	1	3.23	0.14	0.789	0.142	-0.148	0.431	0	4.40	4.40	100.00
12	*	225	0		0.00	0.00	0.000	0.000			0	0.00	0.00	
3	SP	48	0		0.00	0.00	0.000	0.000			0	0.00	0.00	
4	SP	607	7	13	1.15	0.11	1.317	0.053	0.007	0.218	0	26.53	68.28	47.54
5	SP	1345	34	43	2.53	0.17	1.223	0.033	0.108	0.239	0	21.61	233.84	19.18
6	SP	147	9	10	6.12	0.40	1.675	0.138	0.130	0.676	0	12.31	59.30	34.25
6	AS	2	0		0.00	0.00	0.000	0.000			0	0.00	0.00	
6	SG	485	37	68	7.63	0.56	3.189	0.145	0.277	0.846	0	44.15	272.19	25.80
7	SG	565	43	63	7.61	0.46	1.919	0.081	0.302	0.619	0	24.30	260.10	17.53
5	SQ	16	0		0.00	0.00	0.000	0.000			0	0.00	0.00	
7	SQ	3	2	9	66.67	12.40	15.663	9.043	-26.513	51.306	0	30.00	37.19	72.95
8	SQ	69	8	10	11.59	0.79	2.403	0.289	0.215	1.370	0	13.16	54.67	36.51
9	AF	6	0		0.00	0.00	0.000	0.000			0	0.00	0.00	
8	FP	247	49	214	19.84	3.75	11.394	0.725	2.318	5.174	0	69.88	925.35	19.35
9	FP	1609	401	1258	24.92	2.88	8.608	0.215	2.463	3.305	0	127.07	4641.05	7.44
10	FP	269	73	290	27.14	3.73	10.200	0.622	2.504	4.953	0	92.57	1002.98	16.68
10	FG	415	32	90	7.71	0.66	3.472	0.170	0.327	0.997	0	44.78	274.92	25.72
11	FG	441	9	10	2.04	0.12	0.923	0.044	0.036	0.209	0	9.84	54.01	35.88
12	FG	11	0											

Table 4: Summary of larval vermilion snapper catches in neuston net samples by month and survey type based on all surveys in the Gulf of Mexico, 1982-2002. CV=coefficient of variation of mean abundance. * donotes sampling outside established SEAMAP surveys

Month	Survey Type	No. Samples	No. Occurrences	No. Larvae	% Occurrence	Mean Abundance	Std	SE	Lower 95%CI	Upper 95%CI	Minimum Abundance	Maximum Abundance	Summed Abundance	CV
1	*	76	0											
2	*	33	0											
3	*	13	0											
4	*	5	0											
5	*	84	0											
6	*	72	5	10	6.94	0.21	1.217	0.143	-0.071	0.501	0	10.00	15.47	66.75
7	*	3	0											
8	*	13	0											
11	*	31	3	5	9.68	0.16	0.583	0.105	-0.053	0.375	0	3.00	5.00	64.91
12	*	180	0											
3	SP	37	0											
4	SP	885	4	4	0.45	0.00	0.067	0.002	0.000	0.009	0	1.00	3.99	49.92
5	SP	1941	55	250	2.83	0.13	2.074	0.047	0.036	0.221	0	82.00	249.24	36.65
6	SP	249	7	29	2.81	0.12	0.802	0.051	0.016	0.217	0	9.00	29.00	43.65
6	AS	4	0											
6	SG	443	8	16	1.81	0.04	0.379	0.018	0.001	0.071	0	7.00	15.98	49.89
7	SG	530	10	28	1.89	0.05	0.598	0.026	-0.004	0.098	0	13.08	24.79	55.57
5	SQ	14	0											
7	SQ	3	1	7	33.33	2.33	4.041	2.333	-7.706	12.373	0	7.00	7.00	100.00
8	SQ	68	7	10	10.29	0.14	0.457	0.055	0.031	0.252	0	2.00	9.63	39.18
9	AF	125	1	1	0.80	0.01	0.079	0.007	-0.007	0.021	0	0.88	0.88	100.00
10	AF	18	0											
8	FP	250	22	371	8.80	1.49	8.451	0.534	0.434	2.539	0	83.00	371.63	35.96
9	FP	1753	231	1407	13.18	0.80	4.146	0.099	0.608	0.996	0	65.22	1405.93	12.35
10	FP	258	40	312	15.50	1.20	5.472	0.341	0.529	1.871	0	48.84	309.69	28.38
10	FG	382	21	44	5.50	0.11	0.634	0.032	0.051	0.178	0	7.00	43.70	28.37
11	FG	372	4	4	1.08	0.01	0.102	0.005	0.000	0.021	0	1.04	3.94	49.86
12	FG	8	0											

Figure 1: Overall size frequency distribution of vermilion snapper larvae (0.5 mm size classes) captured in bongo net samples during SEAMAP surveys, 1982-2002. FG=Fall Shrimp/Bottomfish survey; SG= Summer Shrimp/Bottomfish survey; FP=Fall Plankton survey.

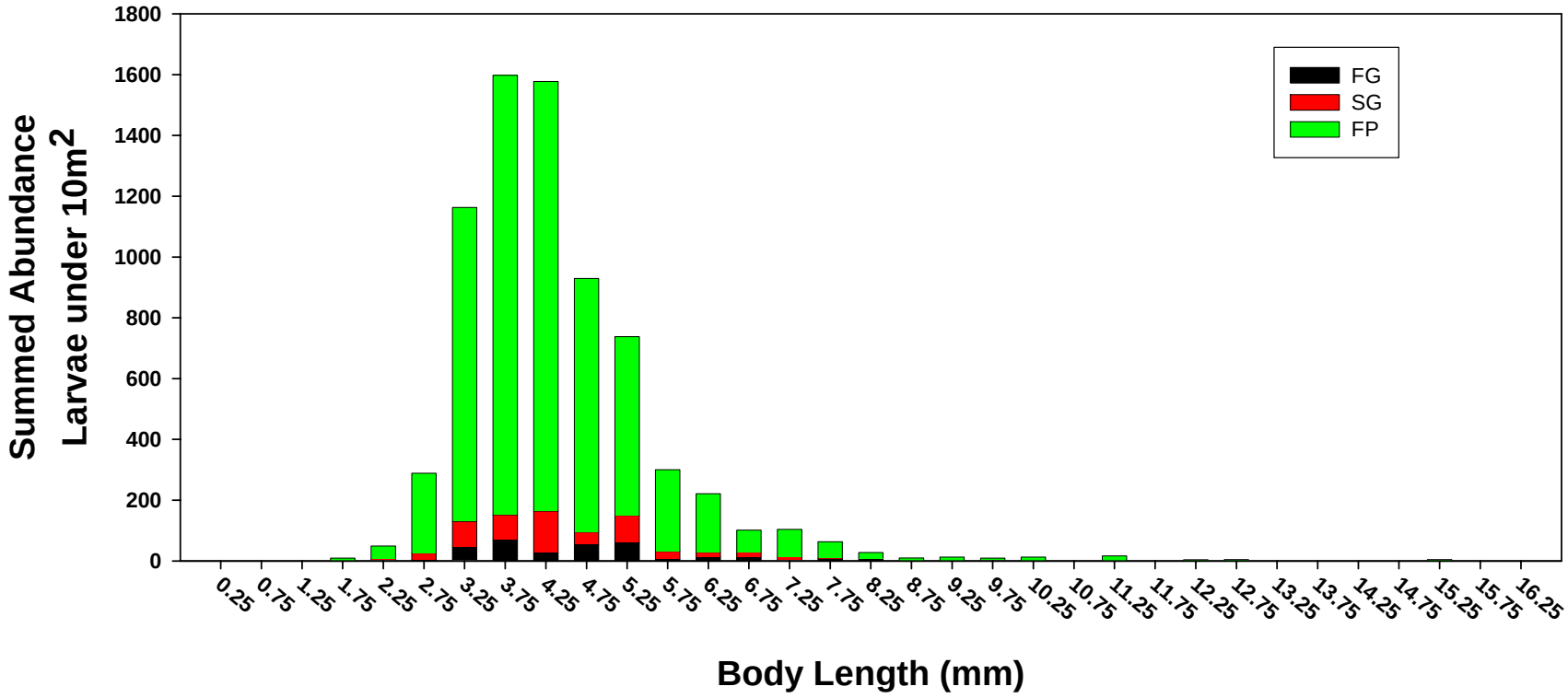

Figure 2: Overall size frequency distribution of vermilion snapper larvae (0.5 mm size classes) captured in neuston net samples during SEAMAP surveys, 1982-2002. FG=Fall Shrimp/Bottomfish survey; SG= Summer Shrimp/Bottomfish survey; FP=Fall Plankton survey.

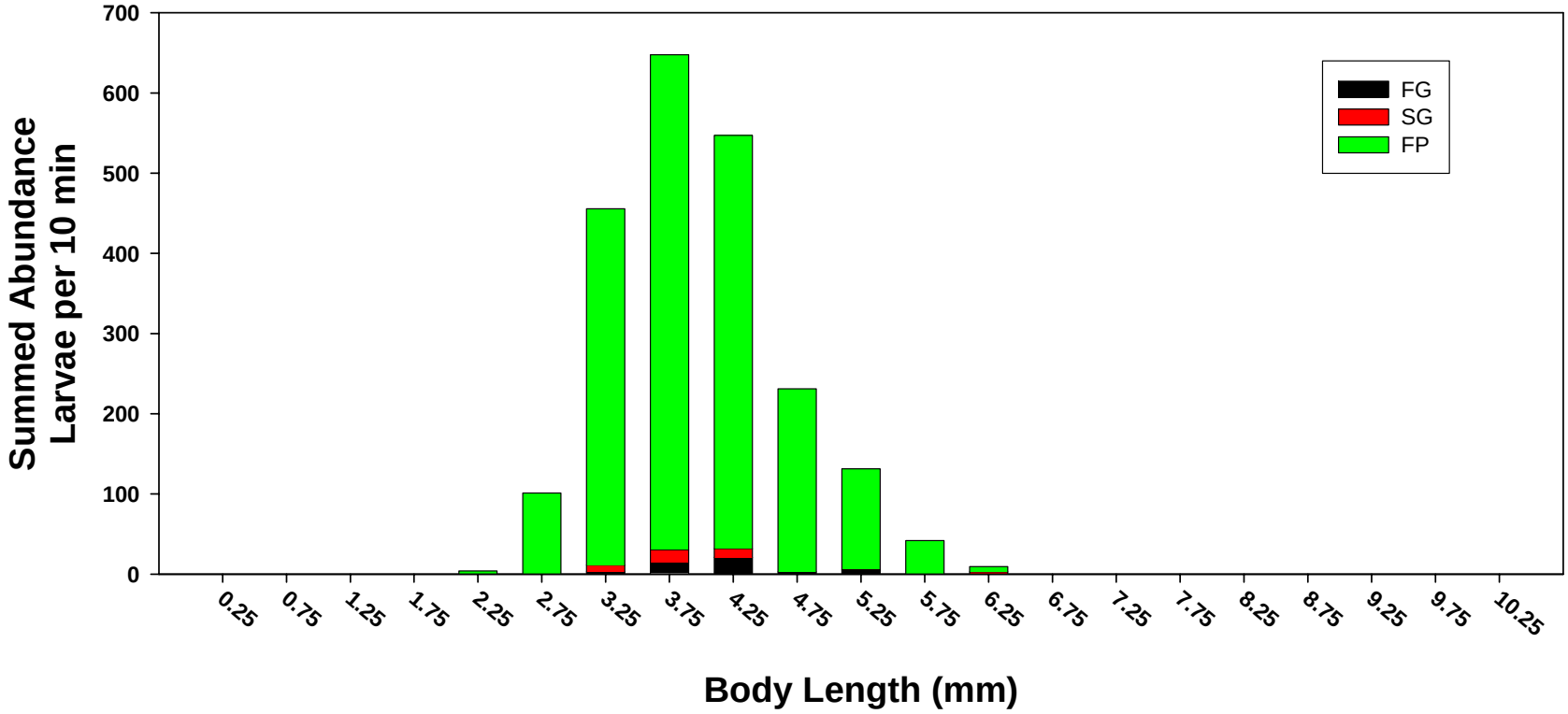

Table 5: Per cent cumulative frequency of vermilion snapper larvae in 0.5 mm size classes caught in bongo net samples during SEAMAP surveys, 1982-2002.

Size class (BL mm)	Number of Larvae	Adjusted Total Number of Larvae	Adjusted Number of Larvae under $10m^2$	% Cumulative Frequency
0.25	0	0.00	0.00	0.00
0.75	0	0.00	0.00	0.00
1.25	0	0.00	0.00	0.00
1.75	2	2.00	9.35	0.13
2.25	11	11.00	48.92	0.80
2.75	76	77.00	288.33	4.78
3.25	304	306.56	1163.15	20.81
3.75	421	433.01	1597.70	42.84
4.25	428	432.40	1577.56	64.59
4.75	254	257.49	929.60	77.40
5.25	191	195.40	737.62	87.57
5.75	76	79.33	300.12	91.71
6.25	54	57.98	220.91	94.75
6.75	21	22.60	100.82	96.14
7.25	24	25.12	103.76	97.57
7.75	17	17.70	63.40	98.45
8.25	7	7.70	27.36	98.82
8.75	4	4.00	9.70	98.96
9.25	4	4.00	12.32	99.13
9.75	2	2.00	9.24	99.25
10.25	4	4.00	12.51	99.43
10.75	1	1.00	1.31	99.44
11.25	4	4.00	16.33	99.67
11.75	0	0.00	0.00	99.67
12.25	1	1.00	4.07	99.73
12.75	1	1.00	4.73	99.79
13.25	0	0.00	0.00	99.79
13.75	0	0.00	0.00	99.79
14.25	0	0.00	0.00	99.79
14.75	0	0.00	0.00	99.79
15.25	1	1.00	4.51	99.85
15.75	0	0.00	0.00	99.85
16.25	0	0.00	0.00	99.85
16.75	0	0.00	0.00	99.85
17.25	0	0.00	0.00	99.85
17.75	0	0.00	0.00	99.85
18.25	0	0.00	0.00	99.85
18.75	0	0.00	0.00	99.85
19.25	0	0.00	0.00	99.85
19.75	0	0.00	0.00	99.85
20.25	1	1.00	3.28	99.90
20.75	1	1.00	4.73	99.96

Table 5 cont.

21.25	0	0.00	0.00	99.96
21.75	0	0.00	0.00	99.96
22.25	0	0.00	0.00	99.96
22.75	0	0.00	0.00	99.96
23.25	0	0.00	0.00	99.96
23.75	0	0.00	0.00	99.96
24.25	0	0.00	0.00	99.96
24.75	0	0.00	0.00	99.96
25.25	0	0.00	0.00	99.96
25.75	0	0.00	0.00	99.96
26.25	0	0.00	0.00	99.96
26.75	0	0.00	0.00	99.96
27.25	0	0.00	0.00	99.96
27.75	0	0.00	0.00	99.96
28.25	0	0.00	0.00	99.96
28.75	0	0.00	0.00	99.96
29.25	0	0.00	0.00	99.96
29.75	0	0.00	0.00	99.96
30.25	0	0.00	0.00	99.96
30.75	0	0.00	0.00	99.96
31.25	0	0.00	0.00	99.96
31.75	0	0.00	0.00	99.96
32.25	0	0.00	0.00	99.96
32.75	0	0.00	0.00	99.96
33.25	0	0.00	0.00	99.96
33.75	0	0.00	0.00	99.96
34.25	0	0.00	0.00	99.96
34.75	0	0.00	0.00	99.96
35.25	0	0.00	0.00	99.96
35.75	0	0.00	0.00	99.96
36.25	0	0.00	0.00	99.96
36.75	0	0.00	0.00	99.96
37.25	0	0.00	0.00	99.96
37.75	0	0.00	0.00	99.96
38.25	0	0.00	0.00	99.96
38.75	0	0.00	0.00	99.96
39.25	0	0.00	0.00	99.96
39.75	0	0.00	0.00	99.96
40.25	0	0.00	0.00	99.96
40.75	0	0.00	0.00	99.96
41.25	1	1.00	2.63	100.00

Table 6: Per cent cumulative frequency of vermilion snapper larvae in 0.5 mm size classes caught in neuston net samples during SEAMAP surveys, 1982-2002.

Size class (BL mm)	Number of Larvae	Adjusted Number of Larvae	Adjusted Number of Larvae/10min Tow	% Cumulative Frequency
0.25	0	0.00	0.00	0.00
0.75	0	0.00	0.00	0.00
1.25	0	0.00	0.00	0.00
1.75	0	0.00	0.00	0.00
2.25	4	4.00	3.98	0.18
2.75	86	99.67	101.08	4.83
3.25	393	455.95	455.56	25.77
3.75	511	652.88	647.44	55.53
4.25	409	548.88	547.13	80.67
4.75	154	230.58	231.09	91.30
5.25	86	131.92	131.20	97.33
5.75	22	41.73	41.95	99.25
6.25	9	9.40	9.32	99.68
6.75	0	0.00	0.00	99.68
7.25	0	0.00	0.00	99.68
7.75	0	0.00	0.00	99.68
8.25	0	0.00	0.00	99.68
8.75	0	0.00	0.00	99.68
9.25	1	1.00	0.91	99.72
9.75	1	1.00	1.00	99.77
10.25	0	0.00	0.00	99.77
10.75	0	0.00	0.00	99.77
11.25	0	0.00	0.00	99.77
11.75	0	0.00	0.00	99.77
12.25	0	0.00	0.00	99.77
12.75	0	0.00	0.00	99.77
13.25	0	0.00	0.00	99.77
13.75	0	0.00	0.00	99.77
14.25	0	0.00	0.00	99.77
14.75	0	0.00	0.00	99.77
15.25	0	0.00	0.00	99.77
15.75	0	0.00	0.00	99.77
16.25	0	0.00	0.00	99.77
16.75	0	0.00	0.00	99.77
17.25	0	0.00	0.00	99.77
17.75	1	1.00	1.00	99.82
18.25	0	0.00	0.00	99.82
18.75	1	1.00	1.00	99.86
19.25	0	0.00	0.00	99.86
19.75	0	0.00	0.00	99.86

Table 6 cont.

20.25	0	0.00	0.00	99.86
20.75	0	0.00	0.00	99.86
21.25	0	0.00	0.00	99.86
21.75	0	0.00	0.00	99.86
22.25	0	0.00	0.00	99.86
22.75	0	0.00	0.00	99.86
23.25	0	0.00	0.00	99.86
23.75	0	0.00	0.00	99.86
24.25	0	0.00	0.00	99.86
24.75	0	0.00	0.00	99.86
25.25	0	0.00	0.00	99.86
25.75	0	0.00	0.00	99.86
26.25	1	1.00	1.00	99.91
26.75	0	0.00	0.00	99.91
27.25	0	0.00	0.00	99.91
27.75	0	0.00	0.00	99.91
28.25	1	1.00	1.00	99.95
28.75	0	0.00	0.00	99.95
29.25	0	0.00	0.00	99.95
29.75	1	1.00	1.00	100.00

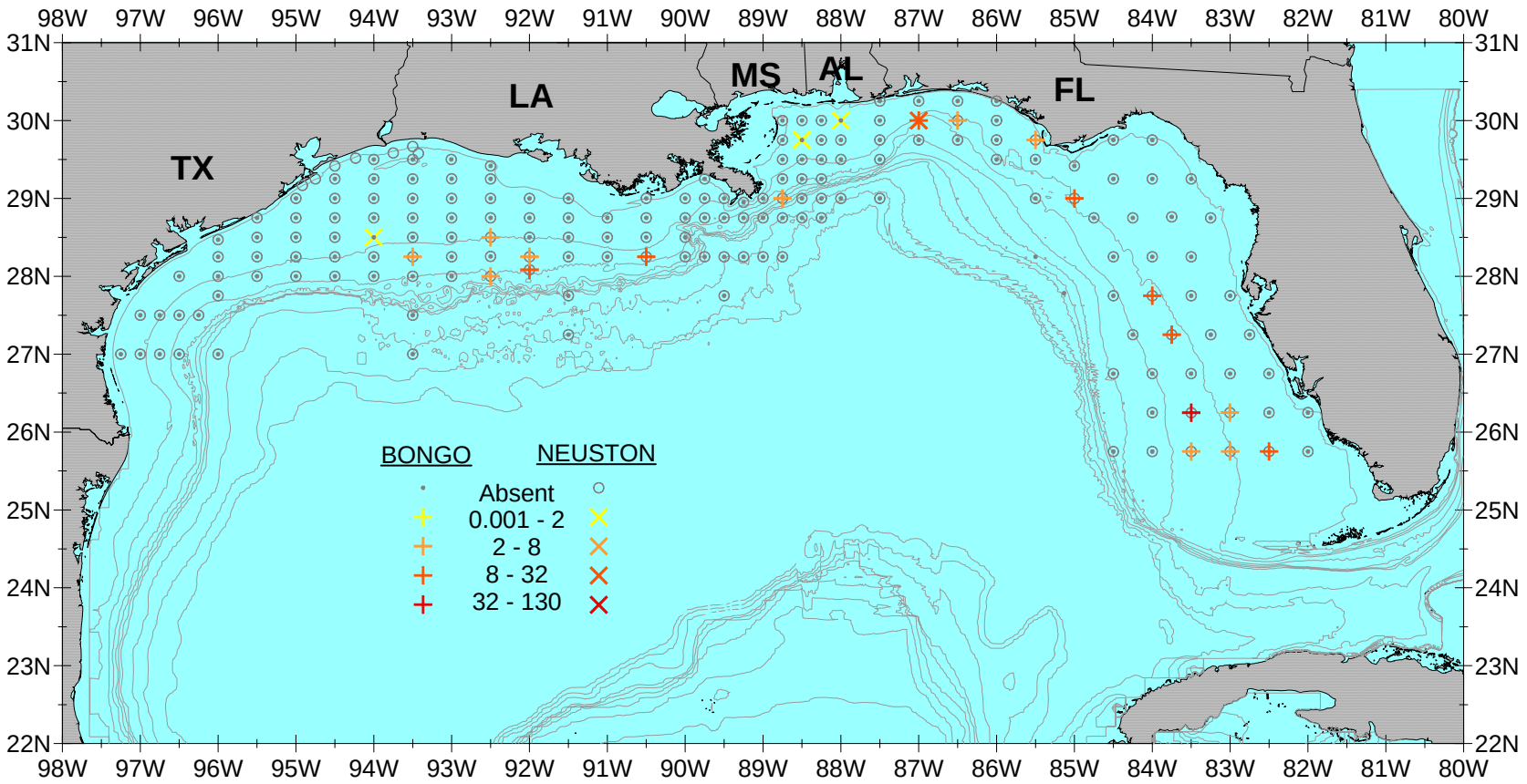

Figure 3. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae during the August 1984 SEAMAP plankton survey, Oregon II cruise 146. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

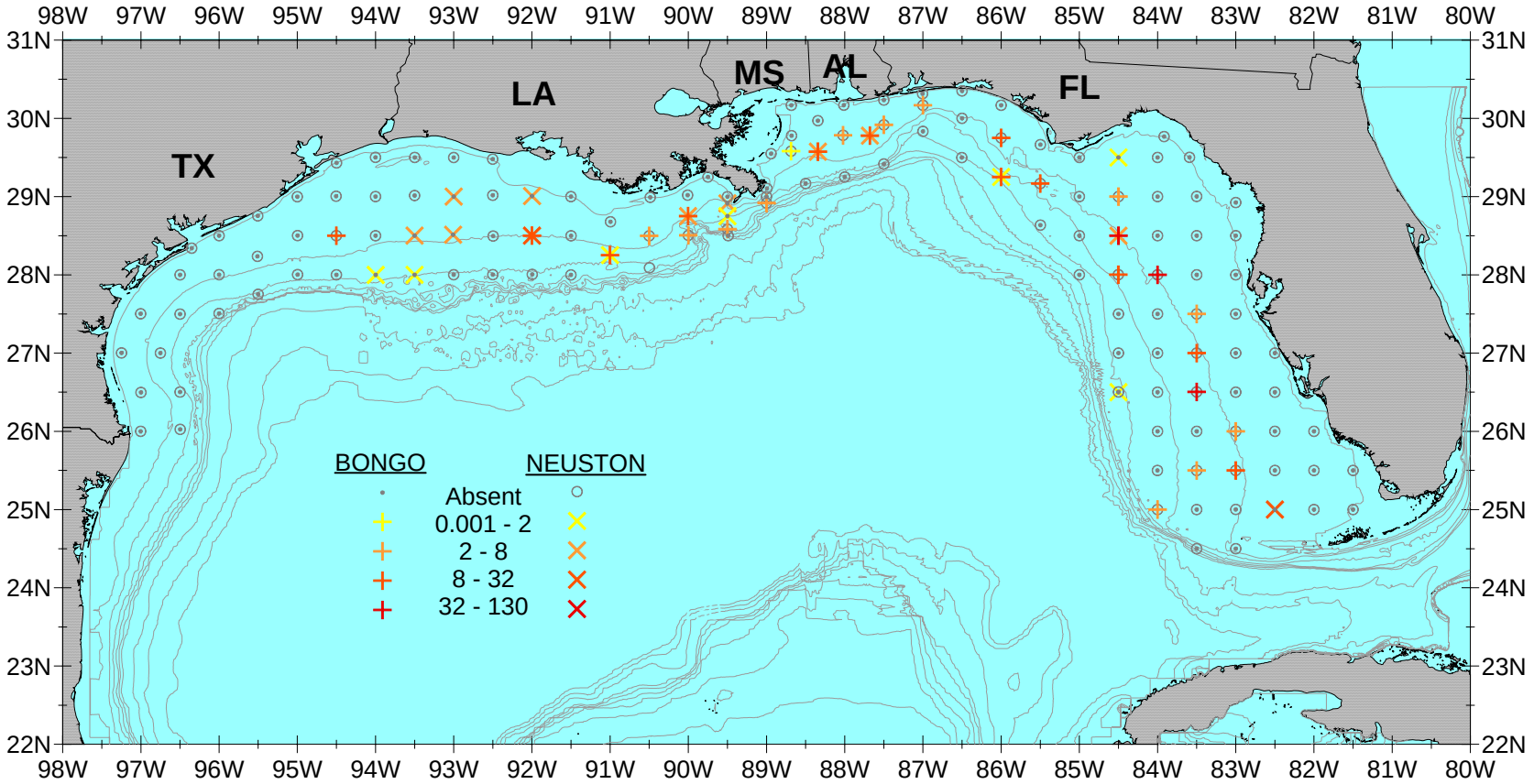

Figure 4. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1986. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

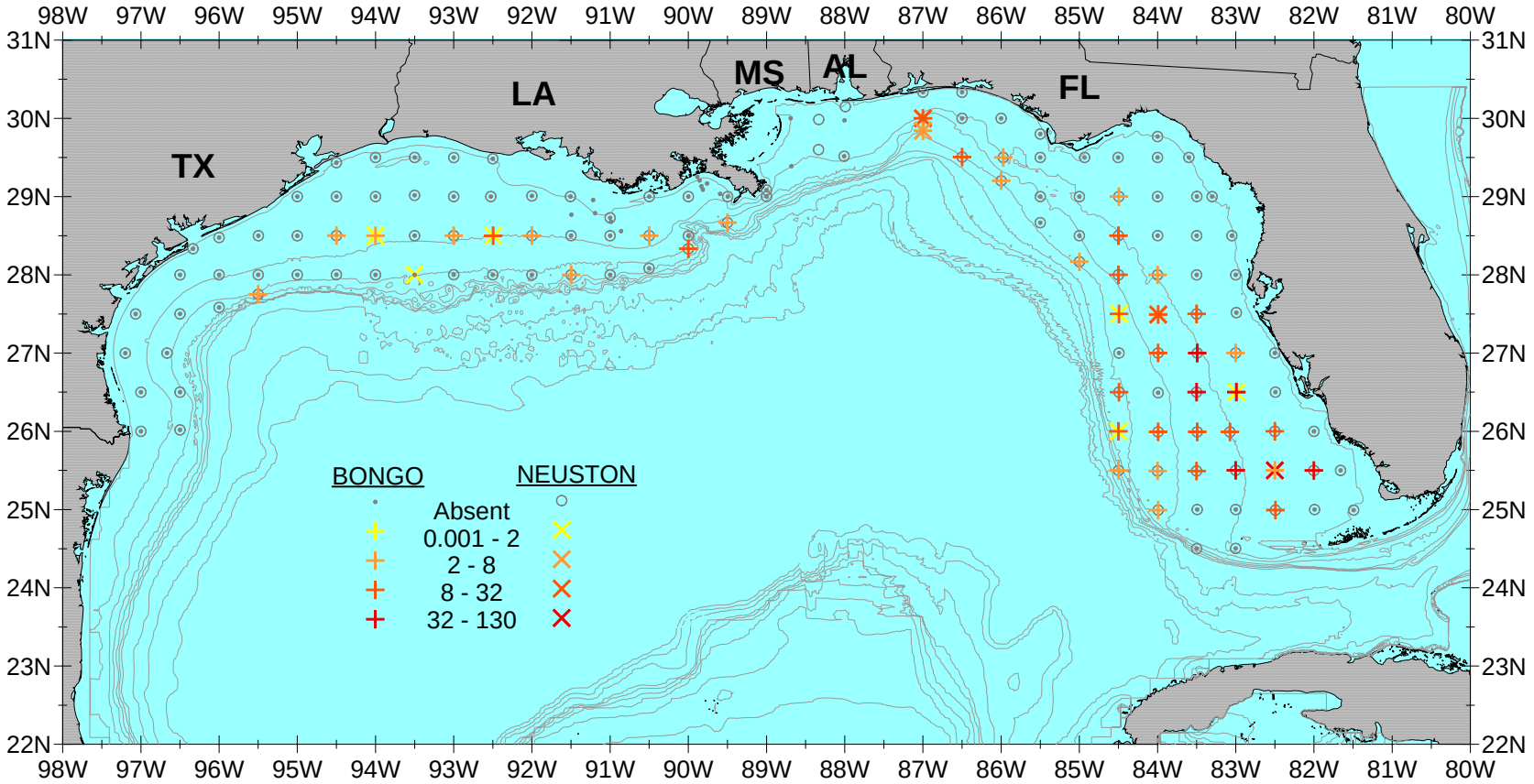

Figure 5. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1987. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

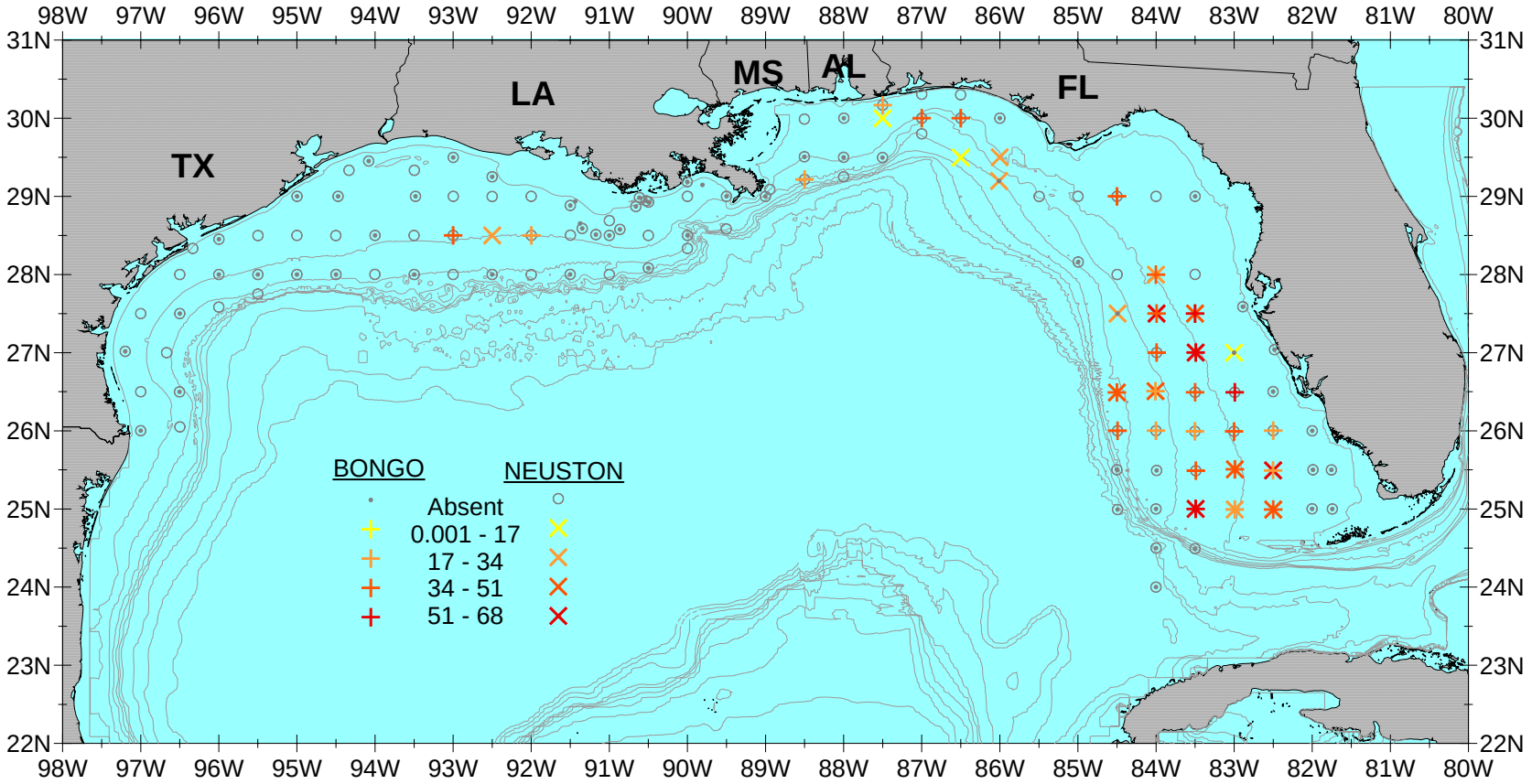

Figure 6. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1988. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

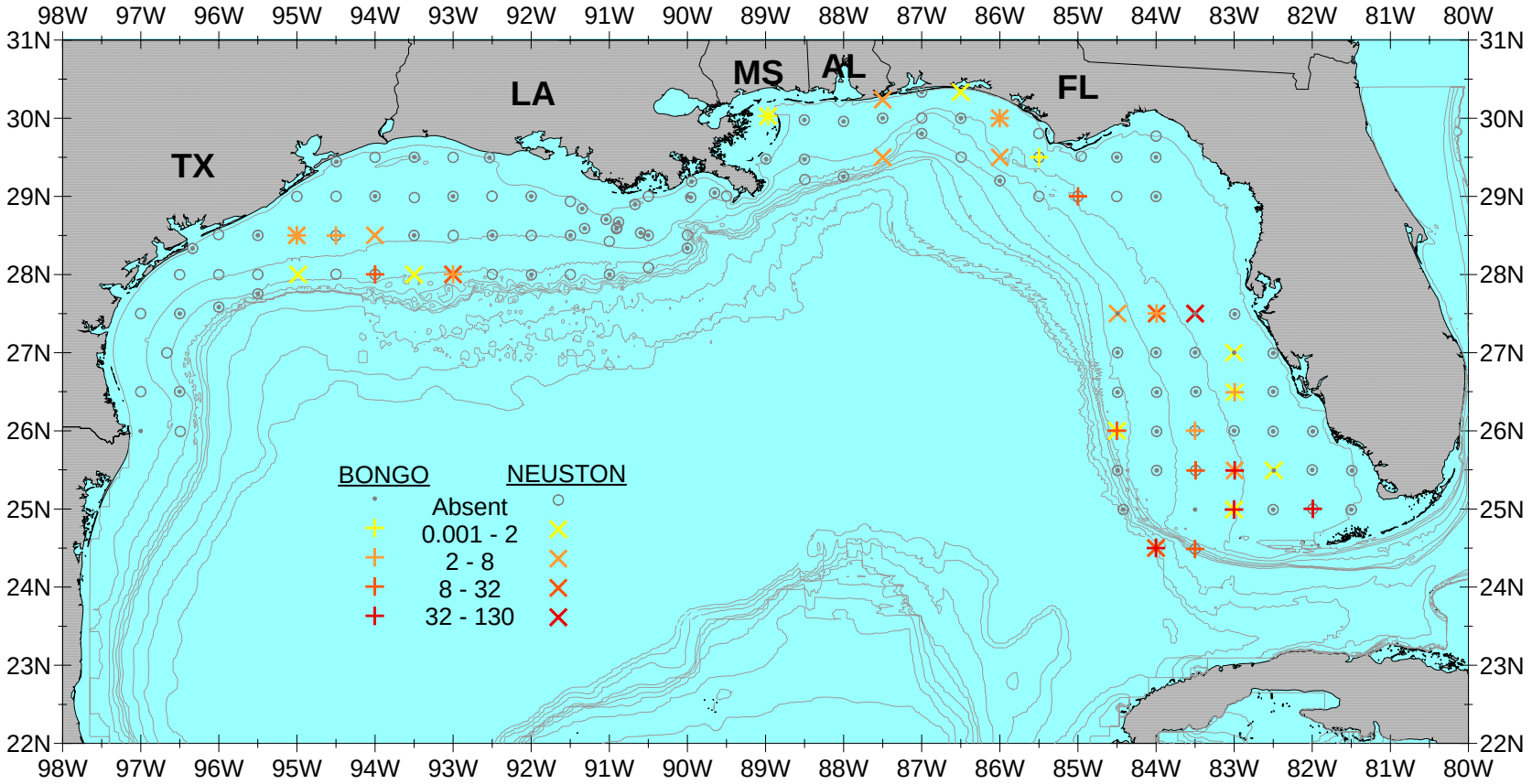

Figure 7. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1989. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

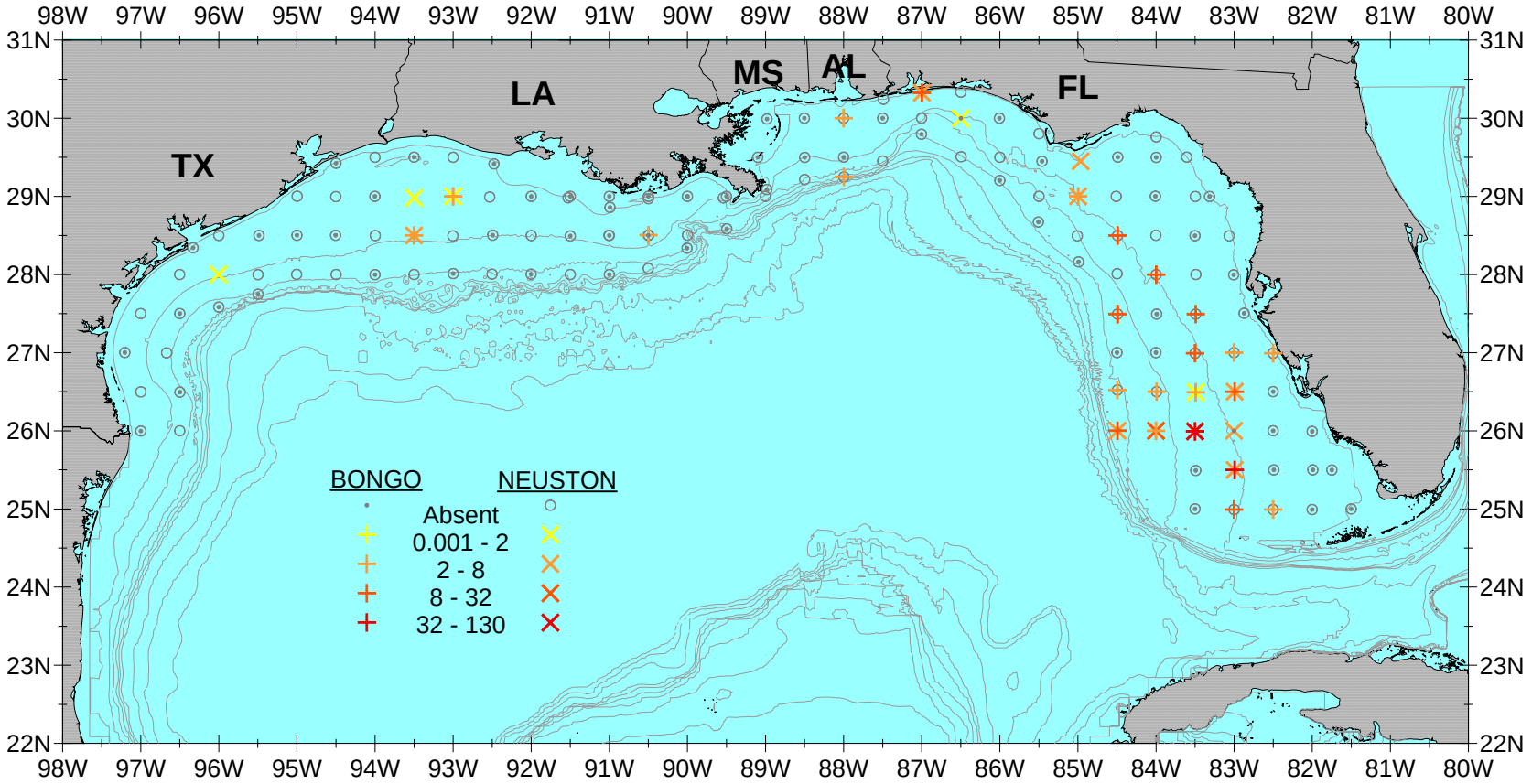

Figure 8. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1990. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

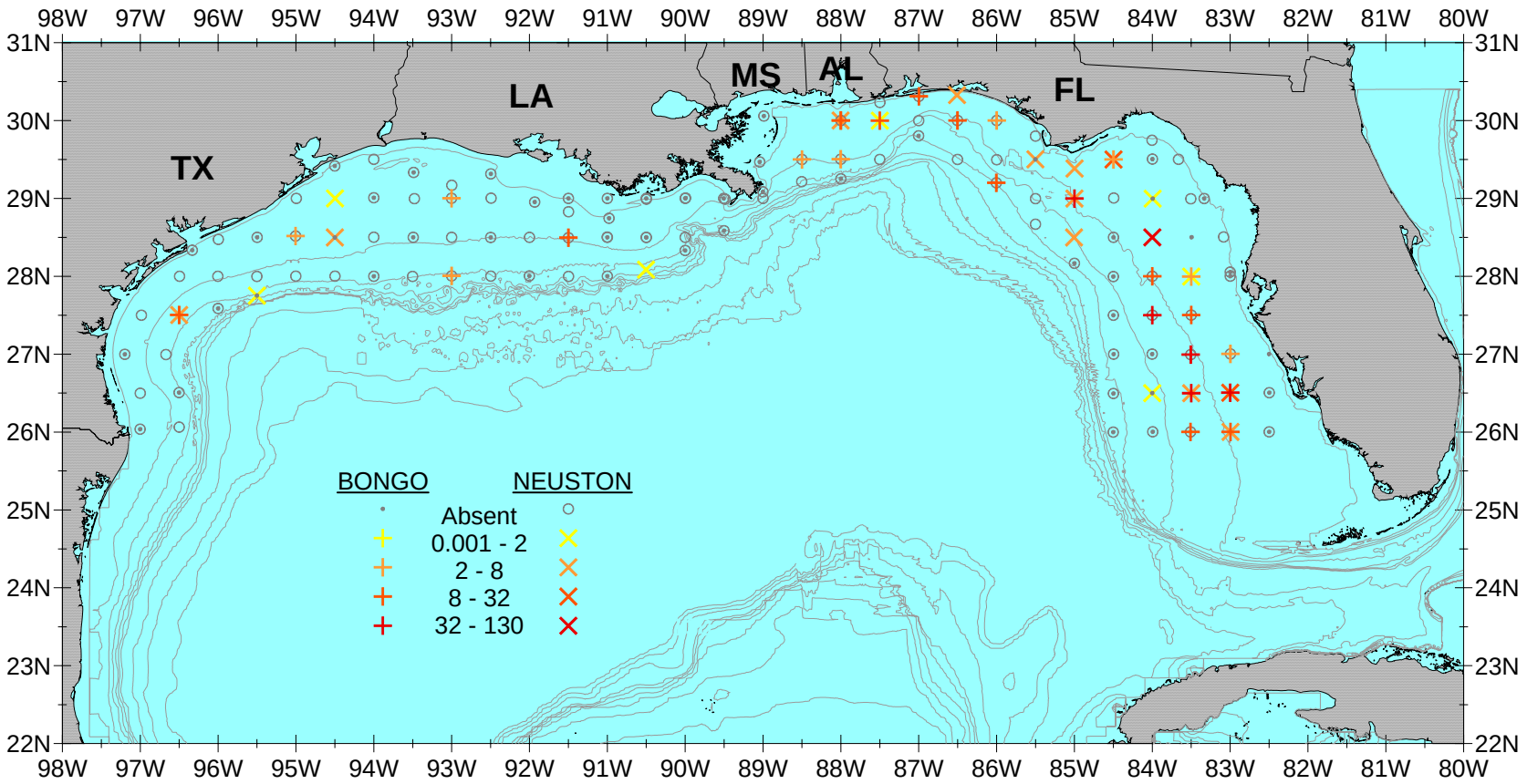

Figure 9. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1991. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

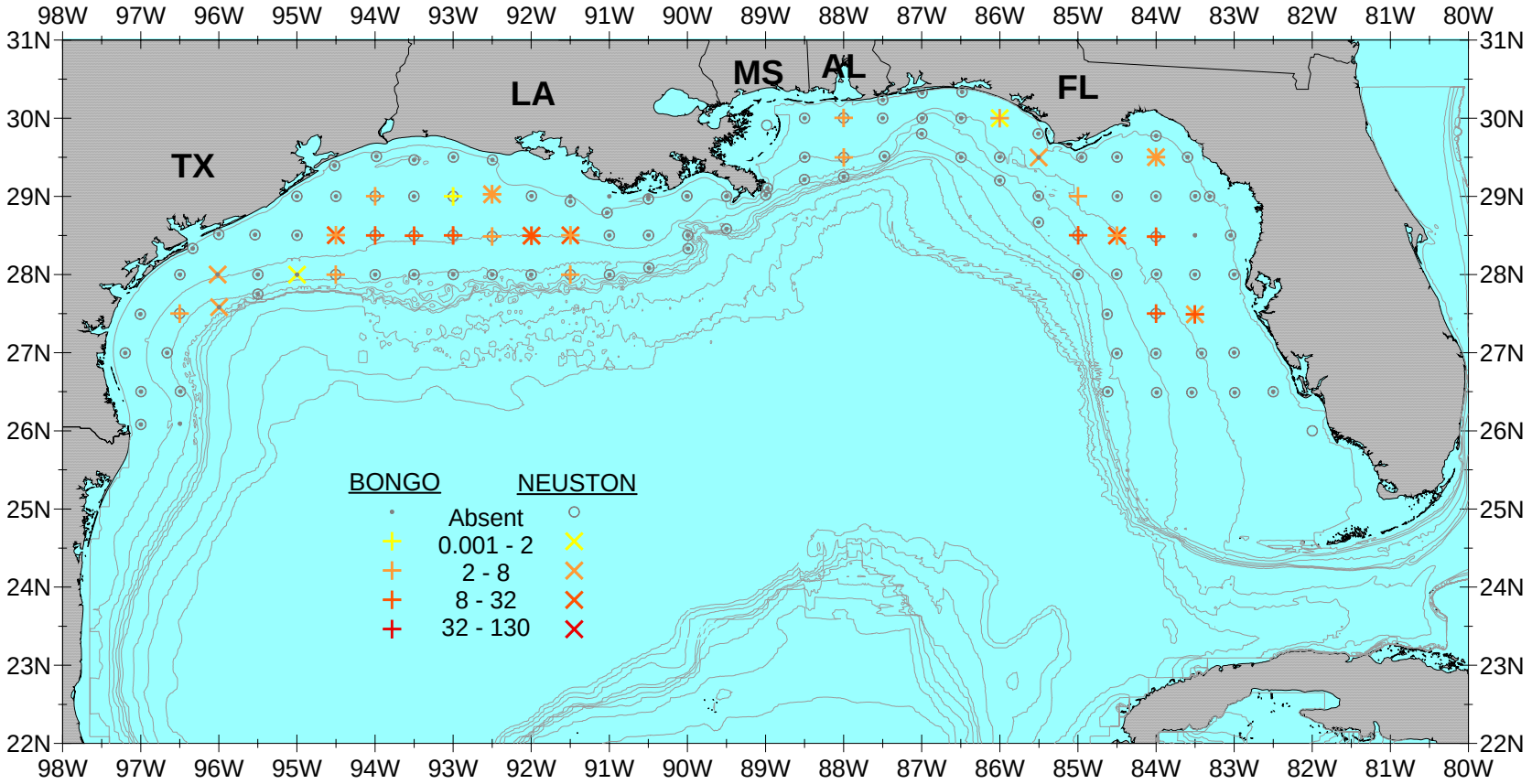

Figure 10. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1992. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

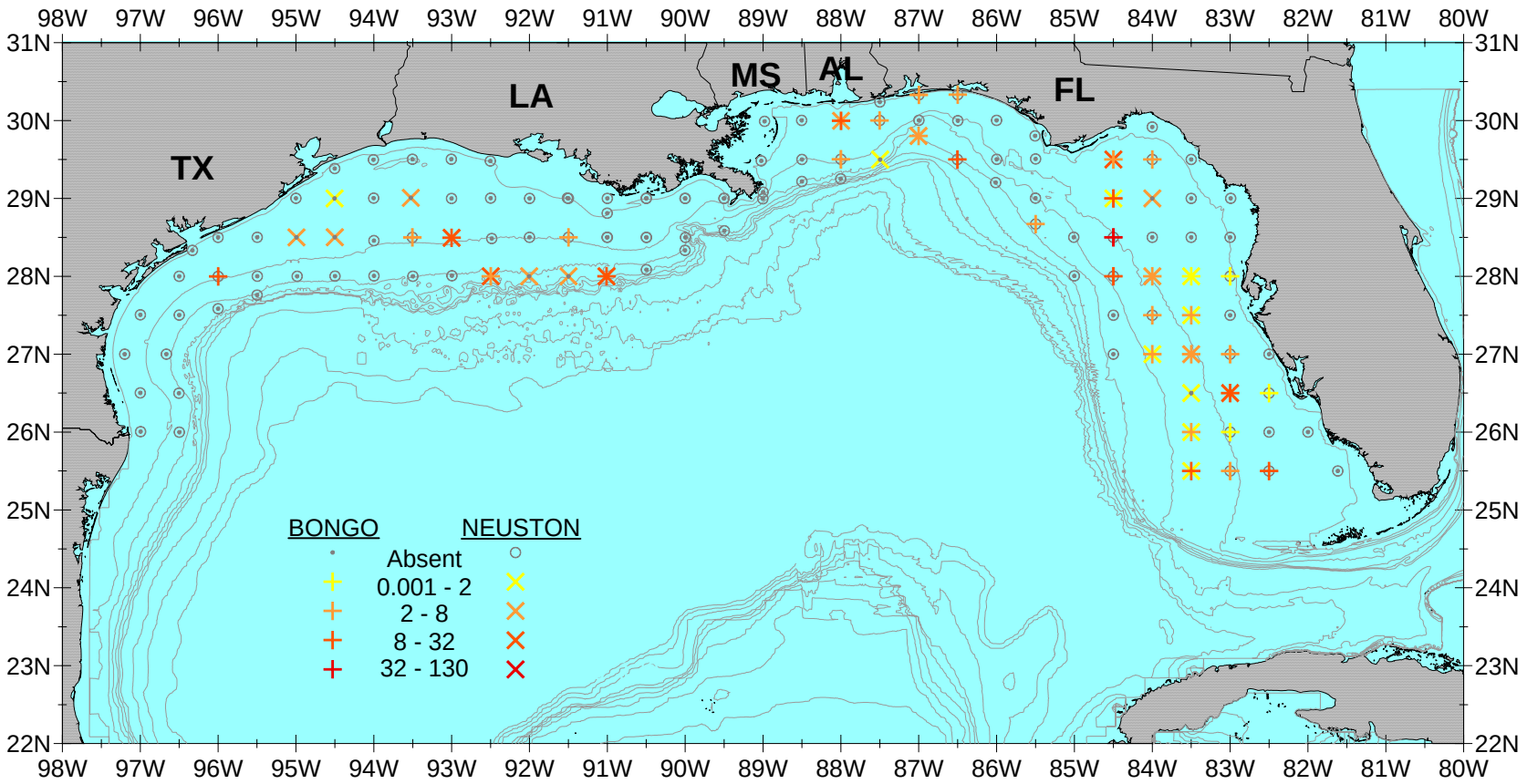

Figure 11. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1993. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

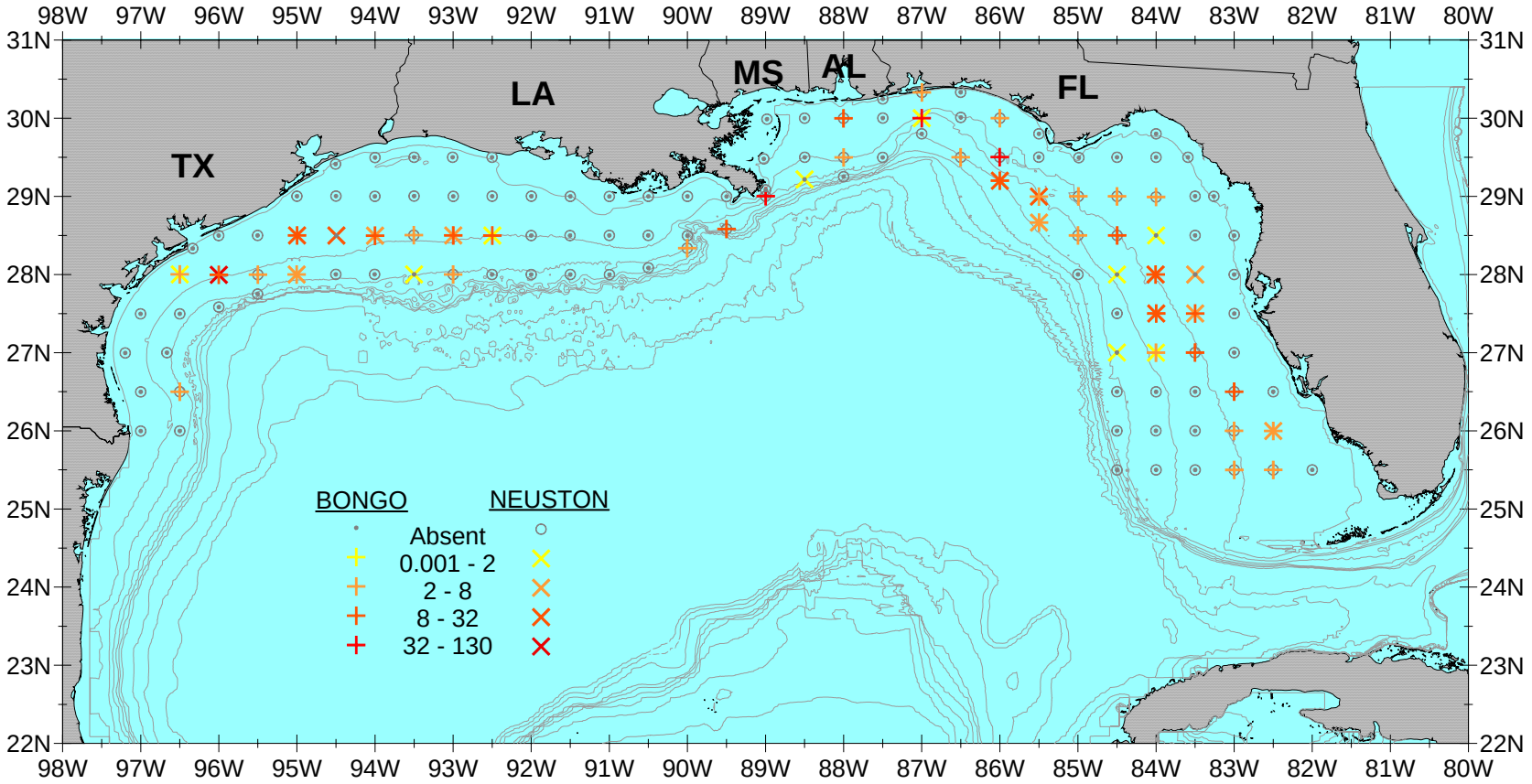

Figure 12. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1994. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

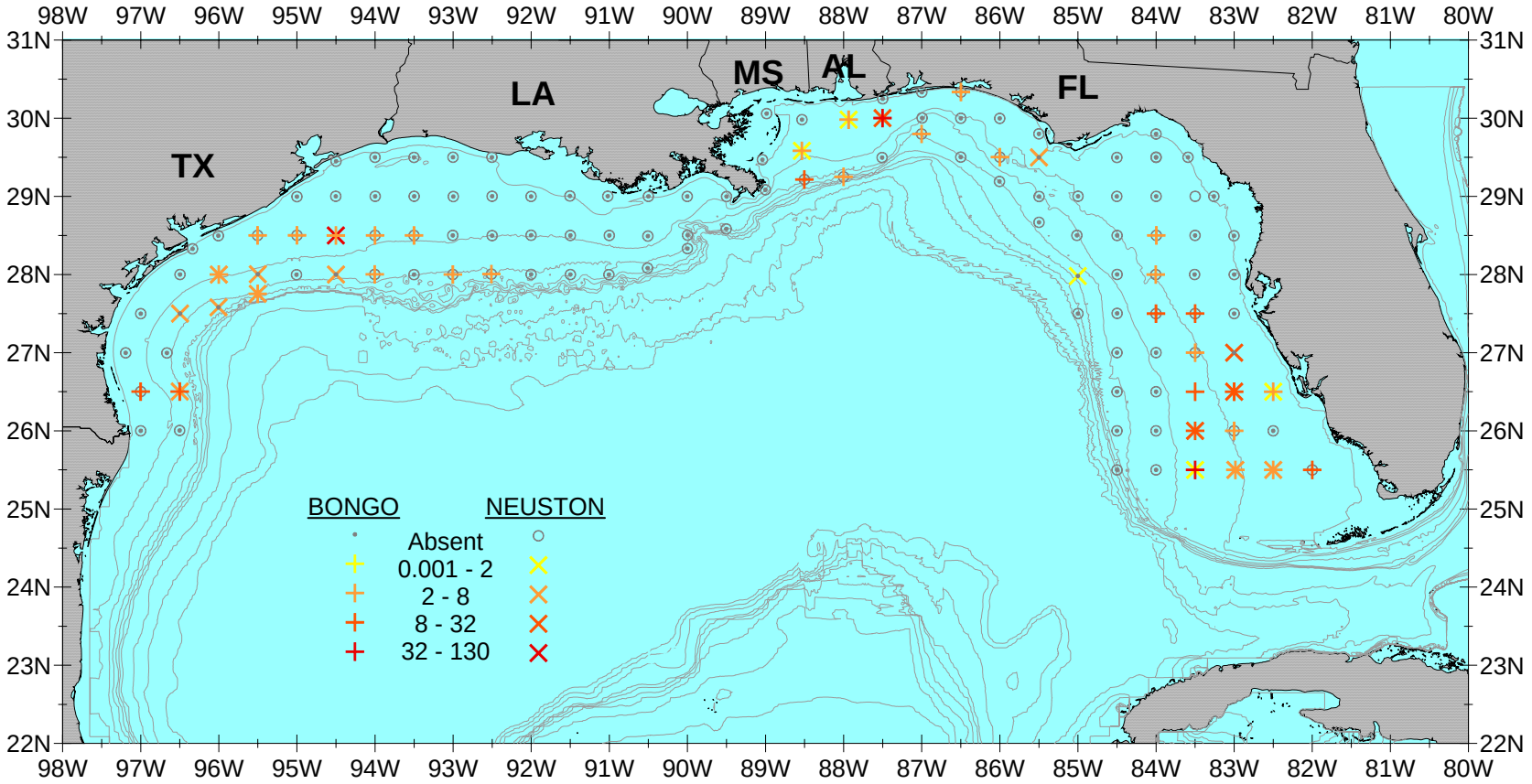

Figure 13. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1995. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

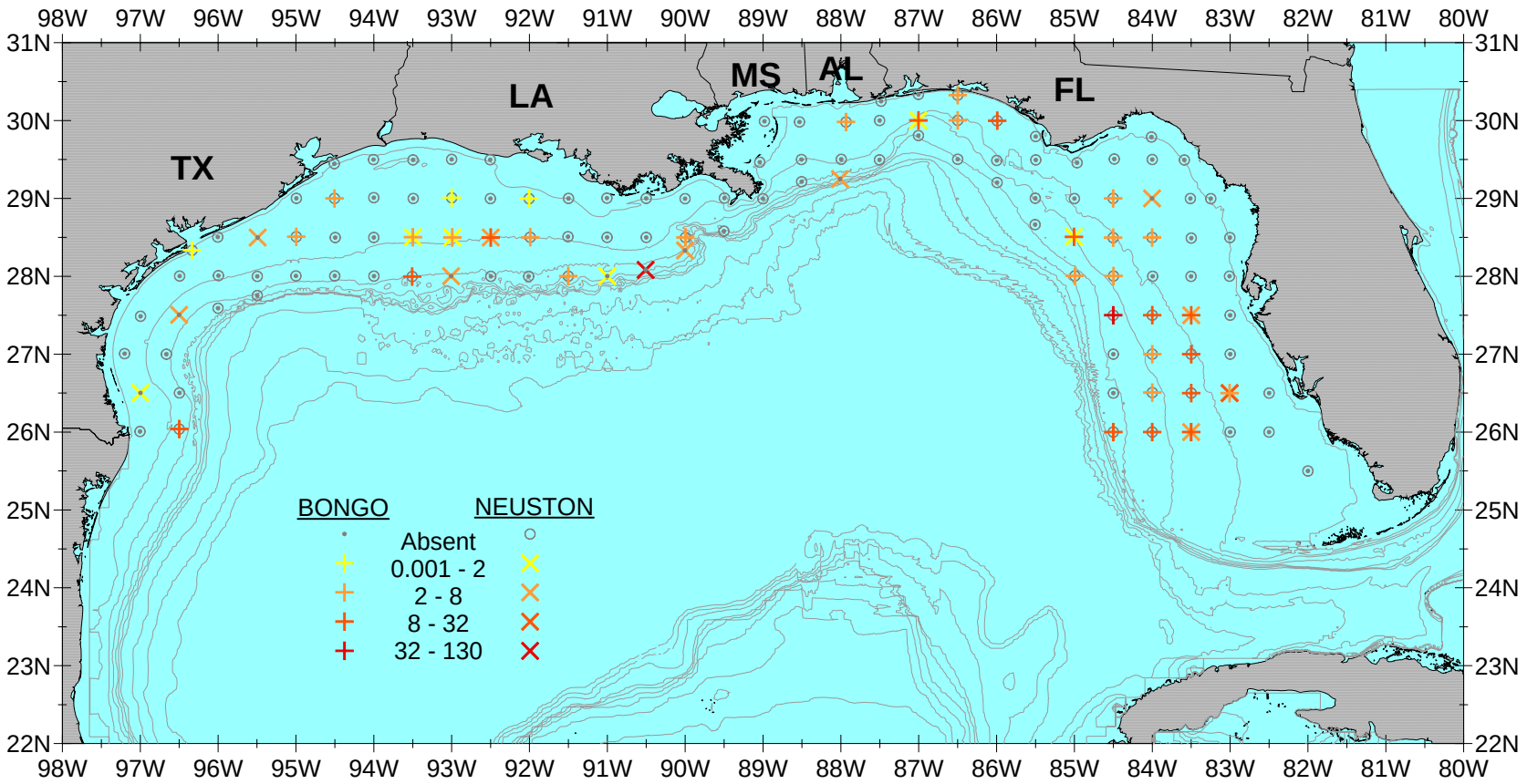

Figure 14. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1996. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

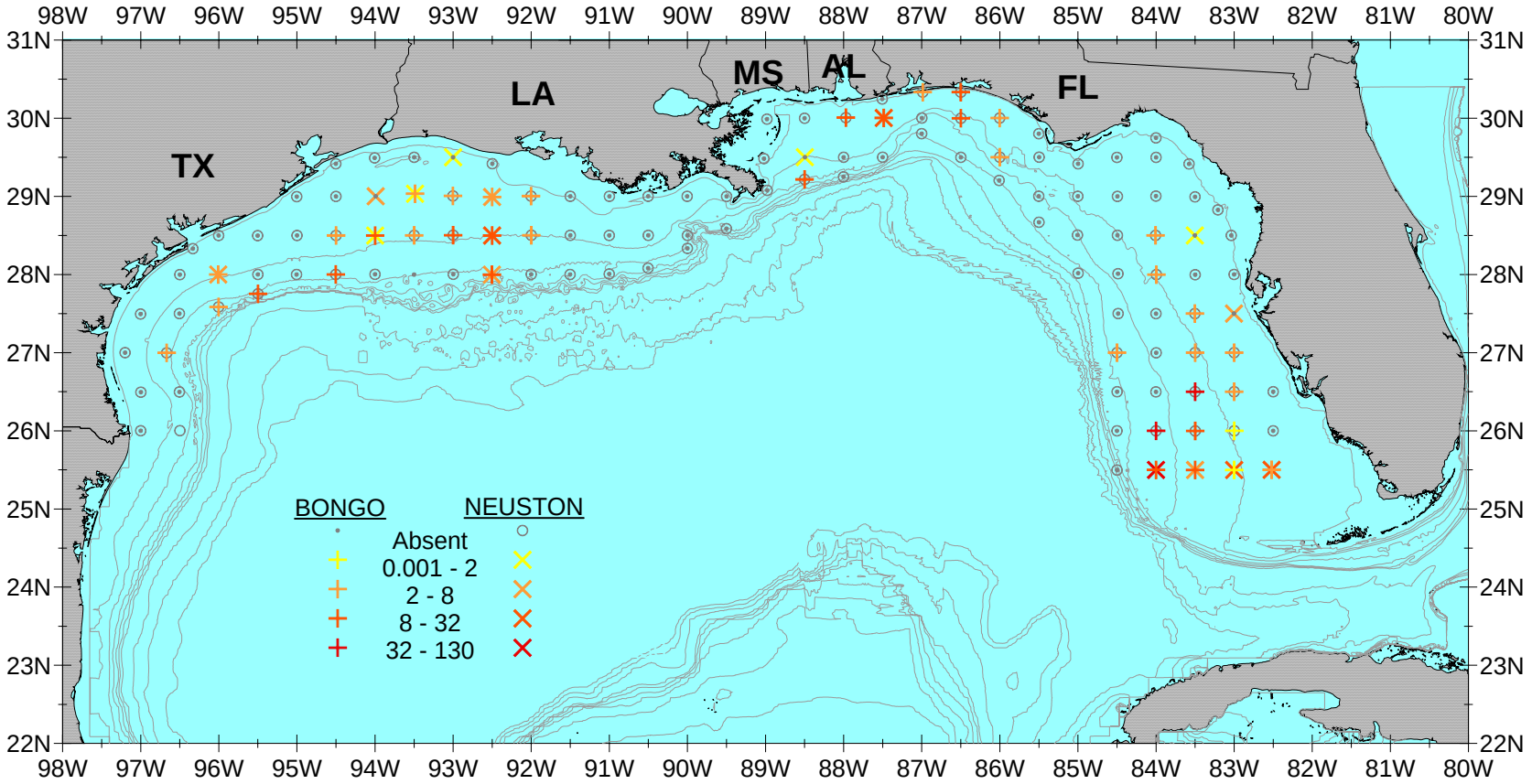

Figure 15. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1997. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

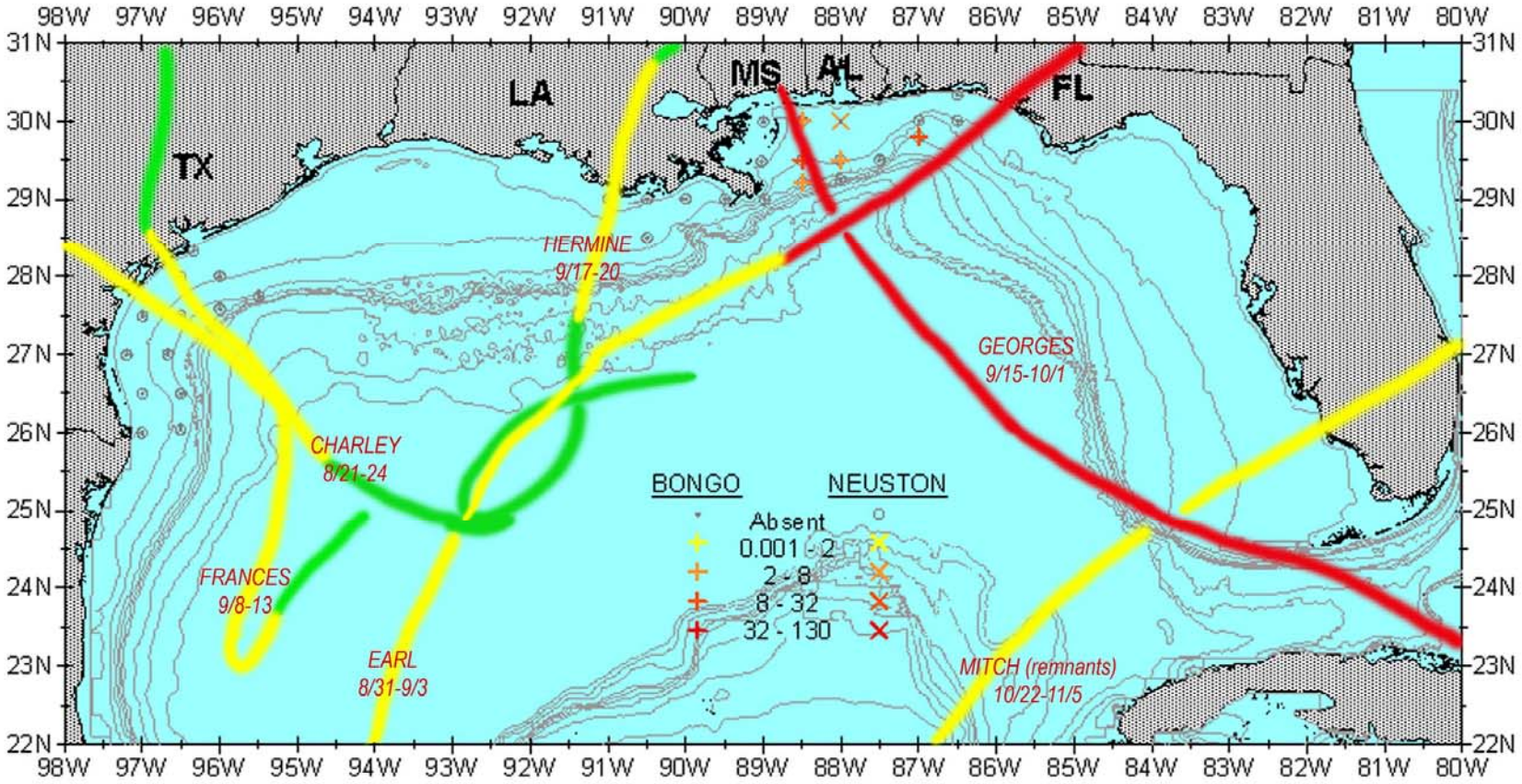

Figure 16. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1998. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min. Green line = Tropical Depression; Yellow line = Tropical Storm; Red line = Hurricane.

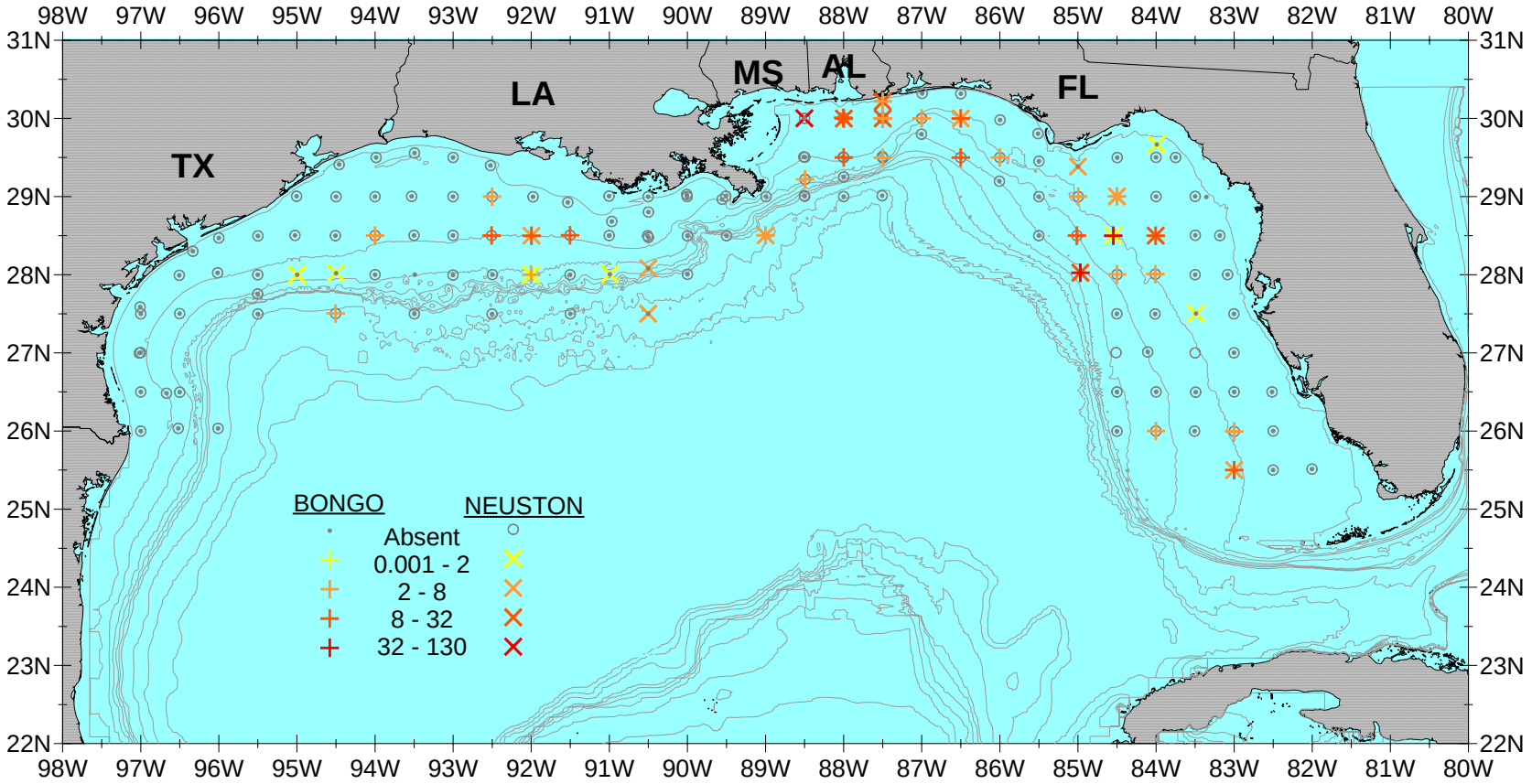

Figure 17. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 1999. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

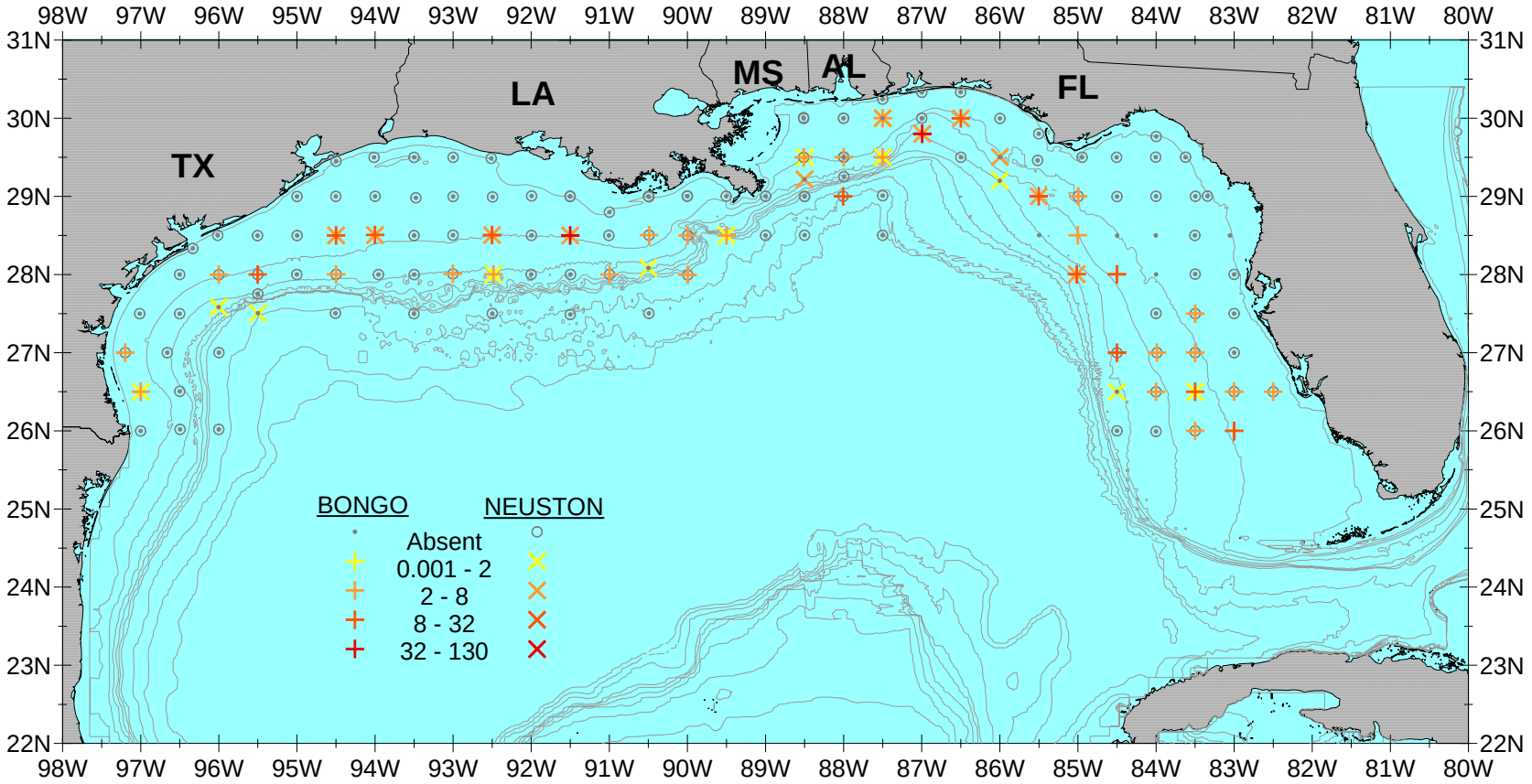

Figure 18. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 2000. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

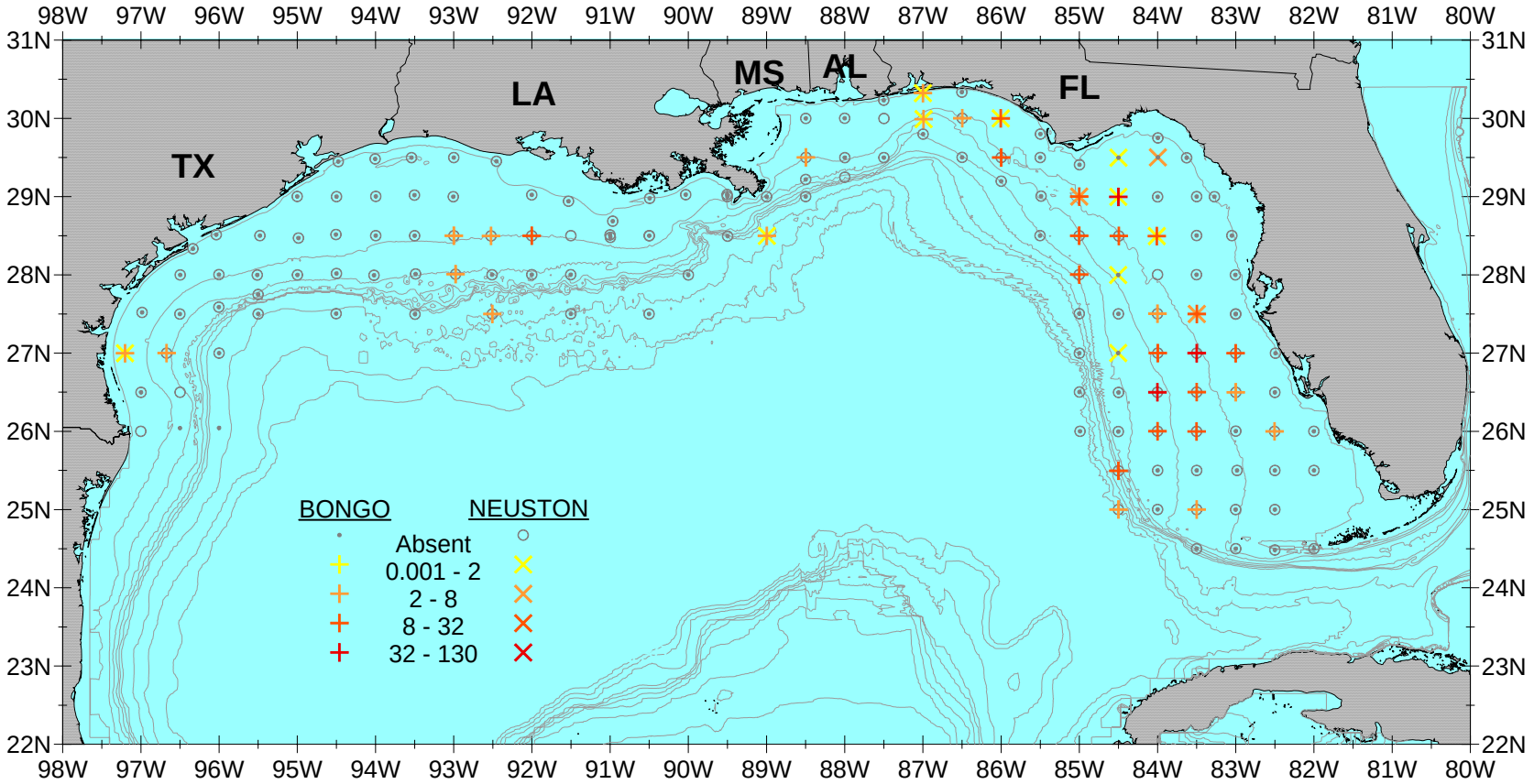

Figure 19. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 2001. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

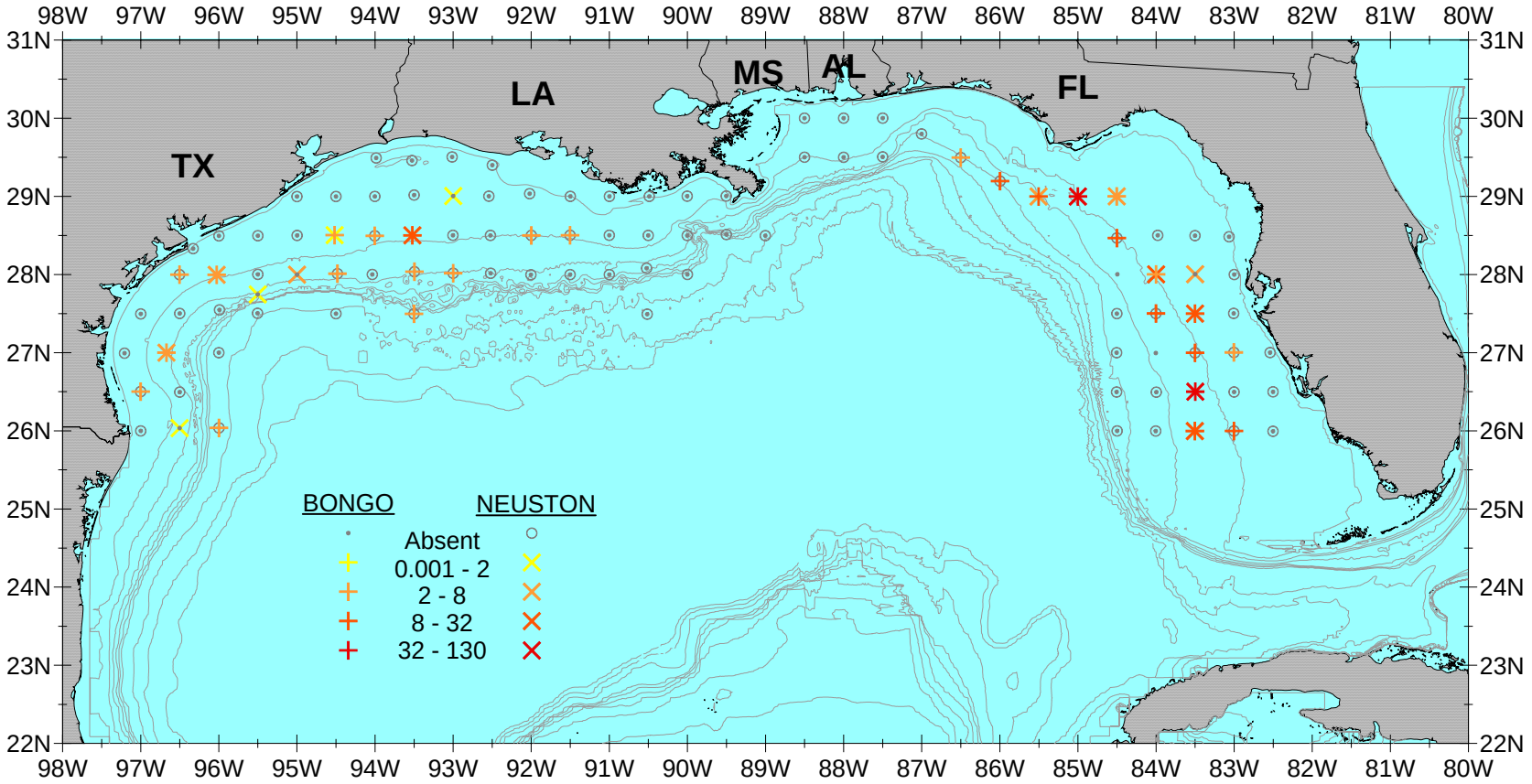

Figure 20. Occurrence and abundance of vermilion snapper, *Rhomboplites aurorubens*, larvae at SEAMAP stations during the fall plankton survey in 2002. Abundance in bongo net samples = Larvae / 10 m^2. Abundance in neuston net samples = Larvae / 10 min.

Table 7: Summary of cruises and sampling effort during SEAMAP Fall Plankton surveys, 1986-1999 and 2000-2002.

CRUISE	VESSEL	Survey Type	No. NEUSTON Samples	No. BONGO Samples	Cruise Begin Date	Cruise End Date	Vermilion snapper present
161	04	FP	48	48	9/4/1986	9/12/1986	*
862	36	FP	29	29	9/6/1986	9/13/1986	*
864	17	FP	9	9	9/8/1986	9/10/1986	*
865	28	FP	56	55	9/13/1986	9/22/1986	*
875	36	FP	35	35	9/1/1987	9/8/1987	*
169	04	FP	91	91	9/12/1987	9/27/1987	*
873	17	FP	4	4	9/15/1987	9/17/1987	
874	35	FP	0	11	9/29/1987	10/1/1987	
882	36	FP	36	36	8/26/1988	9/2/1988	*
176	04	FP	80	39	9/7/1988	9/28/1988	*
882	17	FP	4	3	10/1/1988	9/30/1988	
884	35	FP	7	10	10/3/1988	10/12/1988	
183	04	FP	75	37	9/13/1989	9/29/1989	*
892	17	FP	5	5	9/17/1989	9/19/1989	
894	35	FP	11	11	10/2/1989	10/5/1989	
892	36	FP	34	35	10/4/1989	10/11/1989	
190	04	FP	100	52	9/2/1990	9/28/1990	*
902	17	FP	2	2	9/16/1990	9/16/1990	
904	35	FP	6	7	10/1/1990	10/4/1990	
902	36	FP	30	30	10/13/1990	10/18/1990	
912	36	FP	22	23	8/21/1991	8/25/1991	*
914	28	FP	95	49	9/6/1991	9/26/1991	*
912	17	FP	2	2	9/23/1991	9/23/1991	
914	35	FP	7	7	9/30/1991	10/4/1991	*
925	28	FP	72	73	8/30/1992	9/20/1992	*
201	04	FP	25	27	9/24/1992	9/27/1992	
923	35	FP	0	5	9/28/1992	10/1/1992	
923	17	FP	1	0	9/29/1992	9/29/1992	
922	26	FP	13	12	10/12/1992	10/19/1992	
936	28	FP	72	72	9/10/1993	9/29/1993	*
934	17	FP	2	2	9/20/1993	9/21/1993	
933	35	FP	7	7	10/4/1993	10/7/1993	
207	04	FP	10	10	10/5/1993	10/6/1993	*
932	26	FP	36	36	10/11/1993	10/18/1993	

Table 7 cont.

943	17	FP	2	2	9/10/1994	9/11/1994	
946	28	FP	88	88	9/11/1994	9/29/1994	*
943	35	FP	7	7	9/26/1994	9/29/1994	
942	36	FP	29	29	9/28/1994	10/8/1994	
955	28	FP	88	87	9/9/1995	9/26/1995	*
952	17	FP	5	5	9/16/1995	9/18/1995	
952	26	FP	24	25	9/24/1995	9/28/1995	*
953	35	FP	7	7	9/25/1995	9/29/1995	
965	28	FP	92	92	9/5/1996	9/25/1996	*
962	26	FP	19	19	9/11/1996	9/14/1996	*
962	17	FP	2	2	9/22/1996	9/23/1996	
962	35	FP	7	7	9/30/1996	10/3/1996	
975	28	FP	93	93	9/7/1997	9/27/1997	*
972	17	FP	4	4	9/20/1997	9/22/1997	
972	26	FP	19	19	10/2/1997	10/6/1997	
972	35	FP	7	7	10/4/1997	10/7/1997	
992	63	FP	116	117	9/3/1999	9/29/1999	*
993	17	FP	9	9	9/9/1999	9/10/1999	*
991	26	FP	12	10	9/25/1999	9/29/1999	
994	17	FP	5	6	10/12/1999	10/14/1999	
242	04	FP	104	111	9/7/2000	10/1/2000	*
001	26	FP	13	14	9/26/2000	9/29/2000	*
002	35	FP	3	3	10/11/2000	10/13/2000	
002	17	FP	11	11	10/13/2000	10/15/2000	
015	63	FP	131	127	8/31/2001	9/26/2001	*
012	35	FP	4	3	10/8/2001	10/21/2001	
011	26	FP	12	12	10/11/2001	10/14/2001	
025	63	FP	86	88	8/30/2002	9/20/2002	*
022	35	FP	7	7	9/16/2002	9/19/2002	
023	17	FP	6	6	10/10/2002	10/11/2002	*

Table 8: Annual per cent occurrence and mean abundance of vermilion snapper larvae caught in bongo net samples during SEAMAP Fall Plankton surveys, 1986-1997 and 1999-2002. The dataset recommended as the basis for the larval vermilion snapper index.

	No.	No.	No.	%			Lower	Upper	Mean			Lower	Upper	Abundance		Summed	
Year	Samples	Occurrences	Larvae	Occurrence	Std	SE	95%CI	95%CI	Abundance	Std	SE	95%CI	95%CI	Min.	Max.	Abundance	CV
1986	141	28	84	19.86	0.400	0.034	13.192	26.524	2.49	7.302	0.615	1.279	3.710	0	47.55	351.70	24.65
1987	141	42	220	29.79	0.459	0.039	22.146	37.429	5.04	14.164	1.193	2.678	7.395	0	123.00	710.15	23.68
1988	88	27	109	30.68	0.464	0.049	20.854	40.509	5.14	11.693	1.246	2.662	7.617	0	63.26	452.30	24.25
1989	88	18	67	20.45	0.406	0.043	11.859	29.050	3.06	9.079	0.968	1.137	4.985	0	42.00	269.37	31.62
1990	91	24	79	26.37	0.443	0.046	17.146	35.602	4.03	12.688	1.330	1.389	6.674	0	92.57	366.87	32.99
1991	81	26	178	32.10	0.470	0.052	21.711	42.486	6.78	16.742	1.860	3.082	10.486	0	96.04	549.48	27.42
1992	117	23	53	19.66	0.399	0.037	12.350	26.966	1.54	3.998	0.370	0.812	2.276	0	23.16	180.67	23.93
1993	127	34	97	26.77	0.445	0.039	18.966	34.578	2.12	5.080	0.451	1.229	3.013	0	34.11	269.32	21.26
1994	126	39	125	30.95	0.464	0.041	22.769	39.136	3.51	8.389	0.747	2.031	4.989	0	58.90	442.21	21.29
1995	124	34	96	27.42	0.448	0.040	19.457	35.381	2.59	6.410	0.576	1.450	3.728	0	43.15	321.02	22.23
1996	120	35	80	29.17	0.456	0.042	20.916	37.417	2.85	6.006	0.548	1.769	3.940	0	32.49	342.57	19.21
1997	123	39	133	31.71	0.467	0.042	23.367	40.047	3.17	6.651	0.600	1.983	4.357	0	34.94	389.91	18.92
1999	142	31	73	21.83	0.415	0.035	14.953	28.709	2.49	7.563	0.635	1.239	3.748	0	57.83	354.09	25.45
2000	139	38	82	27.34	0.447	0.038	19.836	34.840	2.82	6.781	0.575	1.680	3.955	0	43.13	391.63	20.41
2001	141	34	124	24.11	0.429	0.036	16.966	31.261	3.50	9.678	0.815	1.887	5.110	0	67.56	493.29	23.30
2002	101	28	107	27.72	0.450	0.045	18.842	36.604	4.03	14.387	1.432	1.193	6.873	0	127.07	407.32	35.50

Table 9: Annual per cent occurrence and mean abundance of vermilion snapper larvae caught in neuston net samples during SEAMAP Fall Plankton surveys, 1986-1997 and 1999-2002.

	No.	No.	No.	%			Lower	Upper	Mean			Lower	Upper	Abundance		Summed	
Year	Samples	Occurrences	Larvae	Occurrence	Std	SE	95%CI	95%CI	Abundance	Std	SE	95%CI	95%CI	Min.	Max.	Abundance	CV
1986	142	18	61	12.68	0.334	0.028	7.137	18.215	0.43	1.713	0.144	0.146	0.715	0	15.00	61.10	33.42
1987	130	10	104	7.69	0.268	0.023	3.050	12.334	0.80	5.720	0.502	0.000	1.791	0	59.00	103.84	62.81
1988	127	18	375	14.17	0.350	0.031	8.024	20.322	2.97	11.859	1.052	0.885	5.051	0	83.00	376.93	35.46
1989	125	21	111	16.80	0.375	0.034	10.155	23.445	0.89	4.175	0.373	0.149	1.628	0	39.94	111.06	42.03
1990	138	15	100	10.87	0.312	0.027	5.611	16.128	0.72	4.309	0.367	0.000	1.445	0	46.69	99.37	50.94
1991	126	20	107	15.87	0.367	0.033	9.404	22.342	0.85	3.517	0.313	0.234	1.474	0	33.00	107.62	36.69
1992	111	12	61	10.81	0.312	0.030	4.943	16.678	0.53	1.956	0.186	0.165	0.900	0	11.00	59.11	34.86
1993	127	24	141	18.90	0.393	0.035	11.996	25.800	1.10	3.811	0.338	0.428	1.766	0	27.00	139.33	30.82
1994	126	23	183	18.25	0.388	0.035	11.416	25.092	1.44	5.273	0.470	0.515	2.374	0	35.00	182.03	32.52
1995	124	20	135	16.13	0.369	0.033	9.565	22.693	1.09	4.358	0.391	0.319	1.868	0	35.00	135.58	35.79
1996	120	17	97	14.17	0.350	0.032	7.837	20.496	0.81	4.479	0.409	0.000	1.616	0	47.00	96.81	50.68
1997	123	16	144	13.01	0.338	0.030	6.979	19.037	1.17	5.377	0.485	0.207	2.126	0	48.84	143.46	41.57
1999	142	21	131	14.79	0.356	0.030	8.879	20.699	0.92	3.948	0.331	0.265	1.575	0	39.00	130.59	36.02
2000	131	24	73	18.32	0.388	0.034	11.608	25.033	0.56	1.933	0.169	0.222	0.891	0	18.00	72.88	30.36
2001	146	13	23	8.90	0.286	0.024	4.229	13.579	0.15	0.591	0.049	0.057	0.250	0	3.92	22.39	31.89
2002	99	16	225	16.16	0.370	0.037	8.783	23.541	2.26	9.640	0.969	0.342	4.187	0	65.22	224.15	42.79