Karyology of the Ladyfish *Elops saurus*

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The ladyfish *Elops saurus* Linnaeus occurs along the eastern coast of the United States from Massachusetts to Florida, in Bermuda, the northern Gulf of Mexico, and throughout the Caribbean at least as far south as Brazil (Hoese and Moore, 1977). Although this long, slender fish is not highly valued for food, the species has considerable popularity as a game fish because of a spectacular fighting ability like that of its near relative the tarpon *Megalops atlanticus* Valenciennes. Regan (1909) recognized seven species of *Elops*, but, more recently, Whitehead (1962) and Nelson (1976) indicated five or six. Smith (1965) suggested that there may be a single species with a nearly world-wide distribution in the tropics and subtropics. Regardless of the number of species comprising the genus, *Elops* has remained of considerable interest to systematic ichthyologists. The affinities of *Elops* among fossil and living primitive teleosts and its position in actinopterygian phylogeny are recurrent topics for interpretation and debate (e.g., Nybelin, 1956; Gosline, 1965, 1971; Greenwood et al., 1966; Nelson, 1973a, b). No karyotypes are available for fishes confamilial with the ladyfish, and this report is the first published account of the karyology of *Elops*.

Materials and methods

Live specimens of *Elops saurus* were collected from four localities on the Louisiana coast in the northern Gulf of Mexico between Port Fourchon and Grand Isle during 1978~1980. Fish used in the preparation of chromosome microslides were cataloged into the permanent collection of fishes at the Louisiana State University Museum of Zoology (LSUMZ 2722~2734). Tissue from gills, spleen, kidney, and liver were used in chromosome preparation techniques described by McPhail and Jones (1966), Beamish et al. (1971), and LeGrande and Fitzsimons (1976). Slides were scanned with a Wild M20 KGS phase contrast microscope. Chromosome numbers and configurations were determined from camera lucida drawings and photomicrographs made with a Polaroid MP-4 land camera. Identification of chromosome types (metacentric, submetacentric, subtelocentric and telocentric or acrocentric) is referable to the classification of centromere positions on chromosomes (median, submedian, subterminal, and terminal) outlined by Levan et al. (1964). The ratio of long arm to short arm (L/S) was used to assign each chromosome to a structural group. Fundamental chromosome number was obtained by assigning a value of 2 to metacentric and submetacentric chromosomes and 1 to subtelocentric and telocentric elements.

Results and discussion

One hundred and thirteen analyzable chromosome spreads were obtained for six males and seven females of *Elops saurus*. The modal diploid and fundamental chromosome numbers were 48 and 54 respectively, comprising 85.8 and 81.2 percent of the total counts (Table 1). With the exception of a single cell (2n=50, FN=56), counts were negatively skewed. Counts below 48 probably are attributable to a loss of chromosomes during the preparation of microslides or inaccurate counts due to chromosome overlap and/or contraction. The one count above 48 may represent the recruitment of two chromosomes from an adjacent cell during spreading or may have been caused by premature separation of chromatids during mitosis. The usual chromosome complement of *E. saurus* included six strongly biarmed elements and 42 chromosomes with terminal or near-terminal centromeric attachments (Table 1, Fig. 1). Accurate pairing of homologs was not possible because of overlap in L/S ratios and the gradual size differences between chromosomes within structural groups. No differences in chromosome numbers or types were detected between sexes.

Among lower teleost fishes, the chromosome complement of *Elops saurus* most closely resembles those known for the few karyotyped clupeiforms, i.e., six species in the Clupeidae and Engraulidae. As in *E. saurus*, a diploid number of 48 is reported for *Alosa pseudo-*

Fig. 1. Diploid chromosome complement of *Elops saurus*. Chromosome spread: ×2130; karyogram: ×2130.

harengus (Wilson) (Mayer and Roberts, 1969), *Dorosoma cepedianum* (LeSeur), *D. petenense* (Günther) (Fitzsimons and Doucette, 1981), *Engraulis japonicus* Schlegel (Nogusa, 1960), and *E. mordax* Girard (Ohno et al., 1968; Klose et al., 1968), but Atlantic and Pacific populations of *Clupea harengus* Linnaeus have 52 chromosomes in the diploid complement (Roberts, 1966; Ohno et al., 1968). In these fishes, biarmed chromosomes were noted respectively in *Clupea harengus* and in the two species of *Dorosoma*. Diploid and fundamental chromosome numbers for other lower teleosts (sensu Gosline, 1971; specifically Osteoglossiformes, Salmoniformes, Anguilliformes, and Cypriniformes) are usually either markedly lower or higher than observed in *Elops saurus* (e.g. Beamish and Tsuyuki, 1971; Ebeling et al., 1971; Uyeno and Smith, 1972; Uyeno and Miller, 1973; Booke, 1974; Gold et al., 1979; Sola et al., 1980; and many others).

Table 1. Chromosome numbers and configuration in six males and seven females of *Elops saurus*. Parentheses indicate number of cells. Modal counts are in boldface.

Chromosome numbers		Chromosome Types	
diploid	fundamental	metacentric-submetacentric	subtelocentric telocentric
50 (1)	56 (1)	**6** (60)	46 (1)
48 (97)	**54** (56)	5 (1)	45 (1)
47 (4)	53 (2)	2 (4)	44 (2)
46 (5)	52 (3)		43 (1)
45 (1)	50 (2)		**42** (63)
44 (1)	49 (2)		41 (1)
43 (1)	48 (1)		40 (3)
42 (1)	47 (2)		38 (1)
41 (2)			37 (1)
			35(2)

For teleost fishes, a diploid chromosome complement of 48 acrocentric elements is regarded as primitive by certain authors (Nayyar, 1966; Ohno et al., 1968; Ohno, 1970; Fitzsimons, 1972; LeGrande, 1975), and karyotypes with biarmed chromosomes are considered derived (Ohno et al., 1968; Ohno, 1970; Denton, 1973). Even if further studies reinforce the hypothesis of 48 acrocentric chromosomes as the primitive complement for teleosts, it will still be a matter of speculation whether the possession of 2n=48 in *Elops saurus* arose from parallel rather than convergent evolution. The diploid number of 48, if primitive among teleosts, would be primitive also in *E. saurus* only if the biarmed elements developed from pericentric inversions in individual acrocentric chromosomes. However, if these biarmed elements were derived from the centric fusion of pairs of acrocentrics, as seems likely because of their large size, the ancestral karyotype would have had a diploid number that exceeded 48. Nybelin's suggestion (1956) of allying the Elopidae with recent holosteans rather than teleosts is not supported by karyotypic data. *Elops saurus* lacks the microchromosomes of *Lepisosteus oculatus* (Winchell) (Ohno et al., 1969) and its karyotype is neither similar to nor easily derived from that of *Amia calva* Linnaeus (2n=46 with 10 pairs of metacentrics and 13 pairs of acrocentrics, according to Ohno et al., 1969).

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カライワシ科 *Elops saurus* の染色体

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Elops saurus の染色体は 2n=48, FN=54 で，核型は 6 個の中・次中部着糸型染色体と 42 個の端・次端部着糸型染色体で構成されていた．本種の染色体数はニシン科の *Alosa pseudoharengus*, *Dorosoma cepedianum*, *D. petense*, カタクチイワシ科の *Engraulis japonicus*, *E. mordax* と同じである．硬骨魚類の染色体進化について論議をおこなった．