AGE STRUCTURE OF FEMALE EASTERN SPINNER DOLPHINS (*STENELLA LONGIROSTRIS ORIENTALIS*) INCIDENTALLY KILLED IN THE EASTERN TROPICAL PACIFIC TUNA PURSE-SEINE FISHERY

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ABSTRACT

Age was estimated for 1,318 female eastern spinner dolphins (*Stenella longirostris orientalis*). Samples were collected from dolphins incidentally killed in the eastern tropical Pacific tuna purse-seine fishery between 1970 and 1982. In this report I present the age frequency distribution of this data set. The maximum age observed was 26. Preliminary analyses indicate that the observed distribution is significantly different from an expected stable age distribution. In the observed distribution, 0-1 year olds are under represented and 12-17 year olds are over represented.

INTRODUCTION

Two studies have estimated age for specimens of eastern spinner dolphin (*Stenella longirostris orientalis*) sampled from the eastern tropical Pacific (ETP) tuna purse-seine fishery. The first study was conducted during the mid-1970s and was designed to study growth and reproductive parameters of the species (Perrin *et al*. 1977; also see Perrin and Henderson 1984, Barlow 1984). The second study was initiated during the mid-1980s and was designed to document the age structure of the incidental mortality (unpublished). Both studies were based on biological samples collected from dolphins incidentally killed during fishing operations.

Eastern spinner dolphins frequently associate with yellowfin tuna, *Thunnus albacares*, in the ETP, and this association has been exploited to catch tuna (Perrin 1969) for more than four decades. Large numbers of spinner dolphins incidentally killed during the early years of the fishery depleted the population to approximately 20% of its original abundance (Smith 1983, Wade and Gerrodette 1993, Wade 1993). Since the 1970s, research on ETP dolphin populations impacted by the purse-seine fishery has focused on distribution and stock structure, abundance and fishery mortality estimation, vital rates and behavior. All studies were designed to better understand the dynamics of the dolphin populations and the impacts of the fishery on them.

Age is traditionally the parameter used to quantify rates of birth and survival for modeling population dynamics. Although the underlying age structure of a population is rarely known for wild animals, particularly cetaceans, a stable age distribution is generally assumed and knowing the age structure of animals taken in a harvest or incidentally killed in a fishery facilitates the assessment of potential impacts of the takes on the population's dynamics.

In this paper, I present the age distribution for female eastern spinner dolphins that resulted from the previously unpublished study initiated in the mid-1980s. There were 1,330 female eastern spinner dolphin specimens collected between 1970 and 1982 used in the study. Unlike the earlier studies of growth and reproduction (Perrin *et al*. 1977), the aim of this study was to determine the age structure of the incidental kill in the US tuna purse-seine fishery.

METHODS

The National Marine Fisheries Service (NMFS) began to monitor mortality and collect biological data from dolphins incidentally killed during fishing operations in 1968. Part of the observer's duties included collecting biological samples from the dolphins incidentally killed during fishing operations. Beginning in 1974, life history data collection procedures were standardized, and the original sampling scheme that selectively collected large, female specimens was replaced by a less-selective sampling scheme that sampled the first available dead dolphins brought aboard (Perrin and Oliver 1982). In 1979, the Inter-American Tropical Tuna Commission (IATTC) joined the NMFS in placing observers aboard U.S. vessels and collecting life history data. Instructions and protocols for collecting life history data were the same for NMFS and IATTC observers.

Biological data collected

NMFS and IATTC observers only collected biological data aboard US-registered tuna purse-seine vessels. The observers recorded the species, stock and sex of cetaceans involved in each set along with the date and geographic location of the set and a tally of dolphins killed. Life history data were collected from dead dolphins brought on board with the tuna, and therefore represent a sub-sample of the total kill. Each dolphin sampled had a measurement of total body length recorded along with its species, stock and sex. Reproductive organs and a section of the jaw were also collected for many specimens, and they were preserved in formalin for later processing to determine state of sexual maturity and age of the specimen. Procedures for the collection of life history data are described in Perrin *et al*. (1976), and the data forms used to collect the data are included as appendices in Perrin and Oliver (1982).

Sample selection and processing

Specimens with total body length recorded and teeth collected were randomly selected from all available specimens for this study. However, additional specimens with lengths < 150 cm were selected to get the underlying length distribution of the aged sample to match the underlying length distribution of all female eastern spinner dolphins sampled as closely as possible. This was necessary because teeth were generally not collected from the smaller, younger animals.

Teeth were extracted from the jaw sections collected by observers. Two or three individual teeth were removed from the jaw section of each specimen, and hemotoxilyn-stained thin sections were mounted on microscope slides for aging (Myrick *et al*. 1983). The tooth reading data collection and processing methods developed for a study of pantropical spotted dolphin (*Stenella attenuata attenuata*) were used in this study (Hohn and Hankins 1983).

Estimation of age

Age was estimated by counting growth layer groups (GLGs) in the dentine and cementum of the prepared tooth sections (Myrick *et al*. 1983). The GLGs identifiable in eastern spinner dolphin teeth were interpreted as annual events based on conclusions from a calibration experiment that used Hawaiian spinner dolphins (Myrick *et al*. 1984). Two readers independently read each specimen. A pooled mean estimate of age for each specimen was calculated as the average of the two readers best estimates of age determined for each specimen.

RESULTS AND DISCUSSION

Age estimates

Between 1970 and 1982, 1,650 female eastern spinner dolphins were sampled from dolphin herds classified by observers as "eastern spinners"[1] (Perrin 1990, Perrin *et al*. 1991) and had teeth collected. From this sample, 1,330 specimens were randomly selected for aging. The final data set for analyses included 1,318 female eastern spinner dolphin specimens collected throughout their range in the ETP (Fig. 1); 12 specimens were excluded from the data set either because an estimate of age could not be made or collection location was unknown.

The length distribution of the aged sample is not significantly different from the length distribution of all eastern spinner dolphins sampled during those years (Chi-square P > 0.05). Thus, the additional sampling of the length classes <150cm seems to have corrected for the under sampling of teeth from those smaller length classes (Fig. 3).

The age frequency distribution resulting from this study is significantly different from an expected stable age distribution (Chi-square P <0.001). The observed age distribution has fewer 0-1 year-olds, more 2-5 year-olds and more 12-17 year-olds than expected (Fig. 2). The maximum age observed was 26 years. The eastern spinner dolphin age distribution does not show an under-representation of juveniles, which might be expected if, like many herding mammals species, juvenile dolphins segregated from other dolphins and the purse-seine fishery did not set on those groups. Juveniles (age classes 5 to 15) were observed to be under-represented in the female pantropical spotted dolphin age distribution (Barlow and Hohn 1984; Fig. 4), which suggests juveniles of that species segregate, or there is a sampling bias that excludes those animals.

Comparison to prior studies

In the studies published by Perrin *et al*. (1977) and Perrin and Henderson (1984), 250 eastern spinner dolphins were aged and analyzed. Although several hypotheses of GLG deposition rates were explored in their analyses, when I interpreted their ages assuming 1 GLG/year, the age frequency distribution was significantly different from that of the present study (Chi-square P < 0.001). That is, young (< 6 years) and old (> 15 years) animals appear to be under represented in the sample analyzed by Perrin and colleagues. This may have resulted from the way samples were selected and aged, or maybe an artifact of the smaller sample size. As in the present study, the age distribution differed from an expected stable age distribution (Chi-square P < 0.001). That is, 0 and 4-8 year-olds were under represented and 12-15 year-olds were over represented.

Some of the same specimens were aged in the study by Perrin and colleagues, and this study. I will continue to explore these data sets, including the effect of different GLG deposition hypotheses, to determine whether the data sets can be combined into a single, larger data set for further analyses.

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[1] Dolphin herds were classified by the observer on board based on the predominant morphotype (*i.e*., eastern or whitebelly); individual specimens varied in morphotype.

Concluding remarks

The preliminary description of these data indicates that the observed age distribution is significantly different from an expected stable age distribution. Additional analyses of these age data are planned to examine the apparent age selectivity of the incidental kill, and whether it may reflect sampling bias, fishery selectivity or the underlying age structure of this depleted population.

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Figure 1. Location where each eastern spinner dolphin (*Stenella longirostris orientalis*) specimen aged was collected (n=1,318). The dolphins were sampled in the eastern tropical Pacific yellowfin tuna purse-seine fishery between 1970 and 1982.

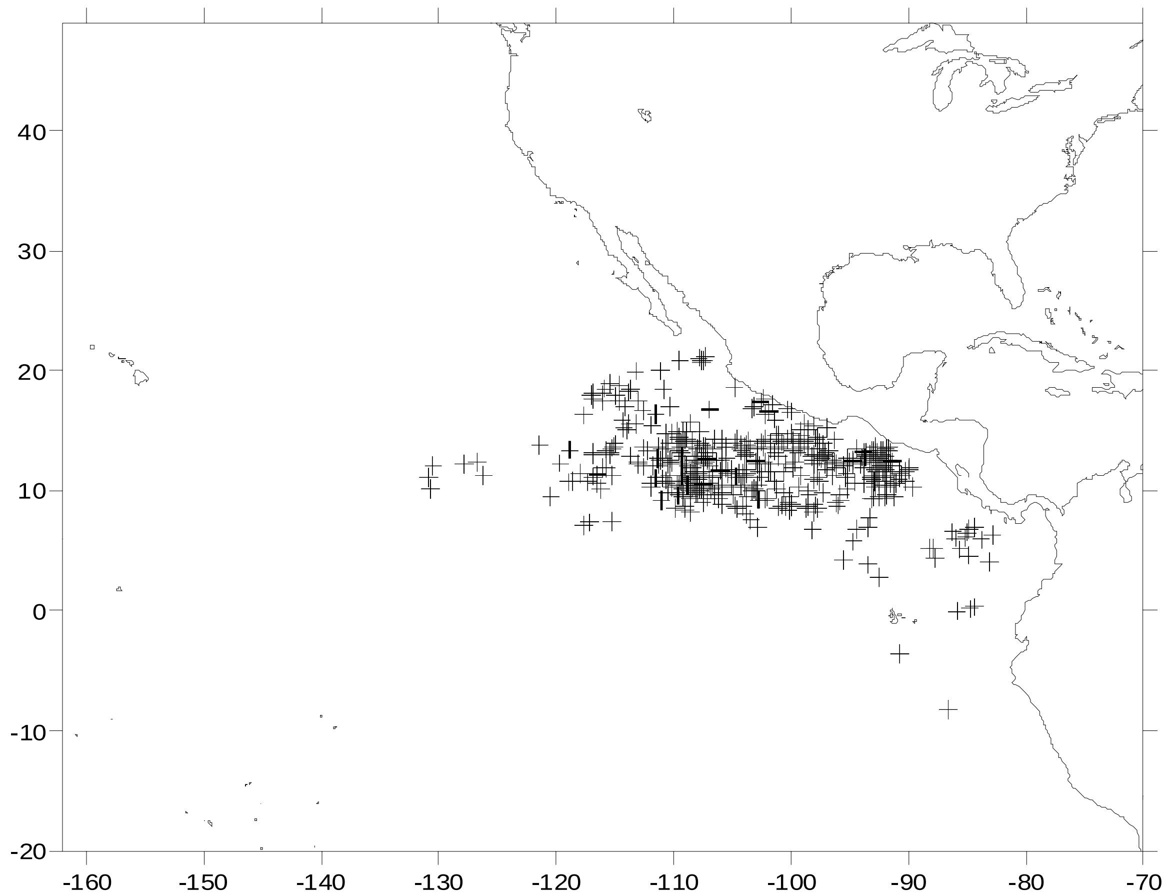
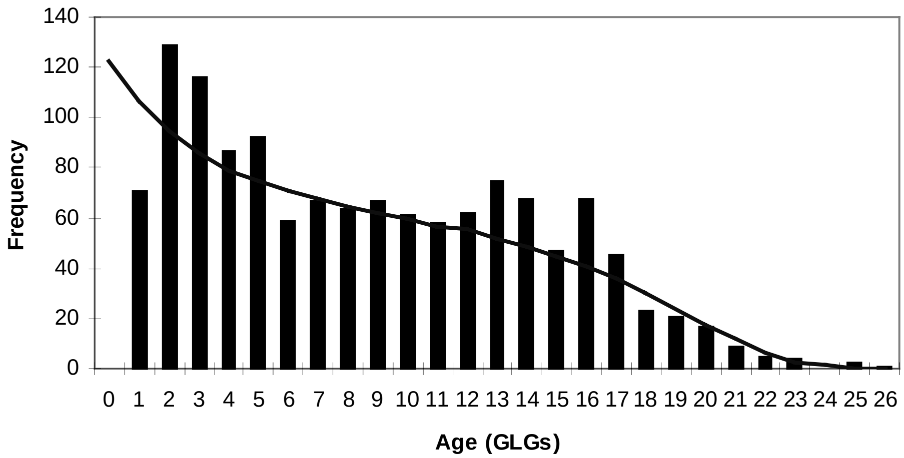


Figure 2. Age frequency distribution of eastern spinner dolphin specimens aged (a) in this study and (b) in the Perrin *et al*. (1977), and Perrin and Henderson (1984) studies. The solid line represents a typical stable age distribution for a sample of the size studied. The estimation of age-specific survival rates used to generate the stable age distribution was based on the parameters in Barlow and Boveng (1991).

(a)



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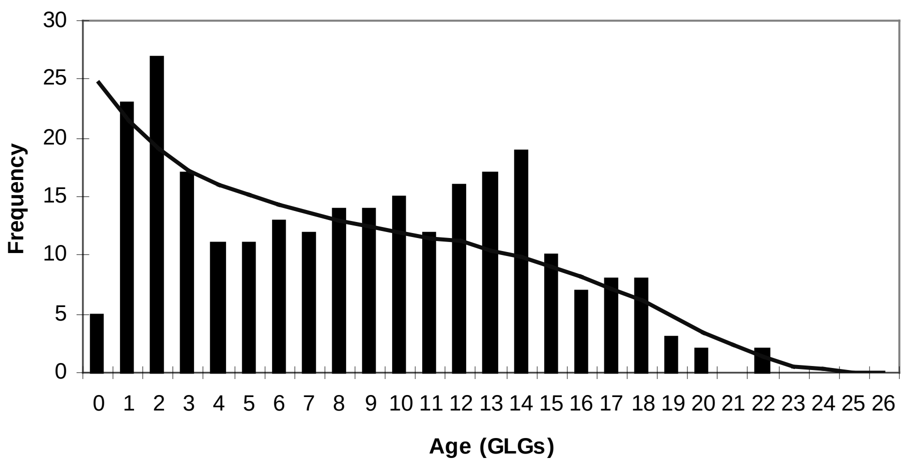

Figure 3. Length frequency distribution for (a) all female eastern spinner dolphin specimens sampled from the fishery (n = 3,127; solid bars), and (b) aged in this study (n = 1,318; open bars).

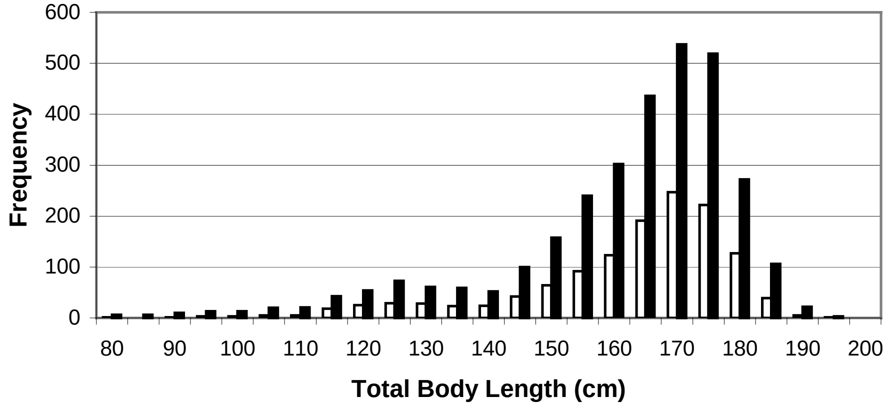

Figure 4. Age frequency distribution for the northeastern stock of pantropical spotted dolphin (*Stenella attenuata attenuata*). The solid line represents a typical stable age distribution for a sample of the size studied. The estimation of age-specific survival rates used to generate the stable age distribution was based on the parameters in Barlow and Boveng (1991).