TESTS OF OVARY SUBSAMPLING OPTIONS AND PRELIMINARY ESTIMATES OF BATCH FECUNDITY FOR TWO *PARALABRAX* SPECIES

EDWARD E. DEMARTINI[1]
Marine Science Institute
University of California
Santa Barbara, California 93106

ABSTRACT

Hydrated-state ovaries of a few individuals of two species of "rock bass"—the barred sand bass (*Paralabrax nebulifer*) and the kelp bass (*Paralabrax clathratus*)—were analyzed. For both sand bass and the compound taxon, fecundity estimates were indistinguishable based on subsamples taken from anterior, middle, or posterior sections of either member of the ovary pair. Batch fecundity was proportional to the cubic power of body length, and a linear function of somatic weight. These preliminary data strongly suggest that it will be relatively straightforward to calculate the number of eggs per gram of ovary-free body weight in these fishes. Therefore, application of the egg production method (Parker 1980) for estimating stock biomass of rock bass is unlikely to be hindered by problems in estimating batch fecundity.

RESUMEN

Los ovarios en estados de hidratación fueron analizados en un bajo número de individuos de dos especies, *Paralabrax nebulifer* y *P. clathratus*. En ambos casos, similares estimaciones de fecundidad fueron obtenidas en submuestras tomadas en las secciones anterior, central o posterior de uno u otro ovario. La fecundidad de la puesta resultó proporcional al cubo de la longitud corporal y, además, una función linear del peso somático. Estos datos preliminares sugieren una cierta facilidad en el cálculo del número de huevos por gramo de peso corporal (excluyendo ovarios) de estos peces. Por lo tanto, la aplicación del metodo de producción de huevos (Parker 1980) para estimar la biomasa de la población de *Paralabrax* probablemente no se verá afectada por problemas relacionados con la estimación de la fecundidad de la puesta.

INTRODUCTION

The kelp bass (*Paralabrax clathratus*) and the barred sand bass (*Paralabrax nebulifer*) together formed more than 90% of the general "rock bass" (Frey 1971) recreational catch in southern California waters during the first half of this decade (U.S. Dept. Commerce, 1985, and references therein). Although rock bass still constitute a significant fraction of the sport catch, the absolute magnitude of the harvest has declined in recent years (Oliphant 1979; U.S. Dept. Commerce 1985). Accordingly, there has been a growth of interest in mariculture and in the development of improved stock assessment techniques to aid in the future management of these fishes (J. Crooke, CDFG, Long Beach, pers. comm.).

The egg production method (EPM) of Parker (1980, 1984) is the state-of-the-art technique for assessing stock size in pelagic-spawning fishes, particularly species of "serial" or "fractional" spawners whose egg production is seasonally indeterminate (Lasker 1984). Batch fecundity (i.e., the number of eggs released per individual spawning) is a key input parameter for modeling stock size using the EPM.

The purpose of this note is twofold. First, I test several basic assumptions of ovary subsampling protocols necessary for future work on fecundity of these basses. Second, I provide preliminary data on the batch fecundity of rock bass.

METHODS AND MATERIALS

Fish and Ovary Sampling

Female kelp bass and barred sand bass whose ovaries contained visibly "hydrated" (ready to spawn: Hunter et al. 1984) eggs were saved whenever encountered on routine trawl and scuba diving surveys (DeMartini and Allen 1984; Roberts et al. 1984) in the San Onofre-Oceanside area (33°15′N, 117°25′W) during the June through August periods of 1982–85. Freshly collected specimens were measured (total length, TL, in mm); both ovaries were excised and weighed (to 0.1 g); and ovary-free body weight (1 g) was determined, if possible. Ovaries were placed in modified Gilson's fluid (Bagenal and Braum 1971) to free and harden ova for subsequent examination.

[1]Present address: Marine Review Committee Research Center, 531 Encinitas Boulevard, Encinitas, California 92024

[Manuscript received January 26, 1987.]

TABLE 1
Results of ANOVA Testing the Potential Effects of Ovary (Right or Left) and Ovary Subsection (Anterior, Middle, or Posterior) on Batch Fecundity

Barred sand bass only					
Source	*df*	*MS*	*F* value	Significance	*R*-square
Model	4	2.20	28.21	$P < 0.0001$	0.627
TL	1	8.76	112.47	$P < 0.0001$	
Ovary	1	0.01	0.15	$P = 0.70$	
Subsection	2	0.01	0.10	$P = 0.90$	
ERROR	67	0.08	—	—	

Barred sand bass and kelp bass					
Source	*df*	*MS*	*F* value	Significance	*R*-square
Model	4	2.76	38.64	$P < 0.0001$	0.662
TL	1	10.98	153.62	$P < 0.0001$	
Ovary	1	0.02	0.33	$P = 0.56$	
Subsection	2	0.02	0.31	$P = 0.74$	
Error	79	0.07	—	—	

Each pair of preserved ovaries was blotted dry on bibulous paper and reweighed (0.01 g); one subsample was then sectioned from the anterior, middle, and posterior thirds of each member of the pair. Sections were immediately weighed (0.0001 g) and vialed for microscopic examination. Hydrated ova were recognized by their relatively large size and translucent appearance (Hunter et al. 1984). Batch fecundity was estimated from the mean number of hydrated ova present in the three weighed subsamples (Bagenal and Braum 1971), with subsample counts representing the error of the estimate (Hunter et al. 1984).

Statistical Analyses

Two-way ANOVA was used to test whether that member of the ovary pair and position of the ovary subsection might affect the fecundity estimate. The logarithm of total length was used as covariate. The relation between batch fecundity and length and body weight of fish was evaluated by least-squares regression on log-transformed data.

RESULTS

Four kelp bass and 13 barred sand bass whose ovaries contained ova in hydrated condition were collected. An additional female sand bass was in running ripe (ovulated) condition. Body lengths, body weights, and ovary weights were recorded for all kelp bass. Ovary weights were noted for 12 of the 13 hydrated-state sand bass; body weights were available for 10 of those 12 sand bass. Three out of four pairs of kelp bass ovaries provided quantitative samples.

For 12 barred sand bass with quantitative ovary subsections, neither the position of the subsection nor member of the ovary pair significantly influenced the fecundity estimate (Table 1). The same qualitative pattern persists if the two kelp bass with ovary subsection data are included and the data reanalyzed for the pooled rock bass category (Table 1). The coefficient of variation of the three within-ovary estimates averaged about 15%.

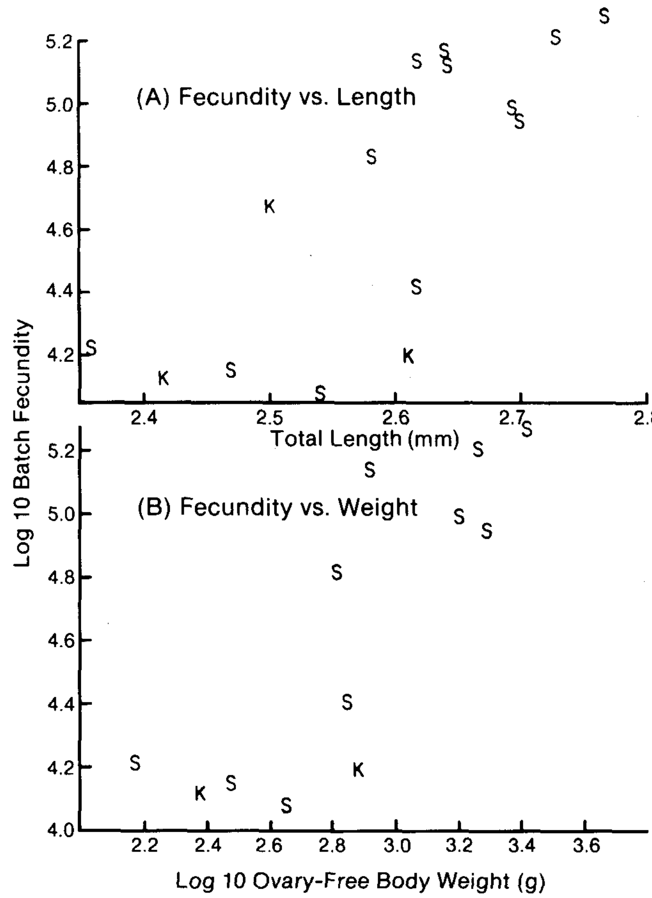

Figure 1. Log-log scatterplot of the relation between estimated batch fecundity and (*A*) total length or (*B*) ovary-free body weight. Regressions were calculated using all 15 pairs of data in *A* and all 12 pairs of data in *B*. Barred sand bass data are indicated as "S" and kelp bass data as "K" on plots.

Batch fecundity was related to the cubic power of TL (Figure 1A), according to the relation

$$\begin{aligned} \text{Log 10 } F &= 3.02 \text{ Log10 TL} - 3.13, \\ \text{where } F &= \text{batch fecundity}, \\ TL &= \text{total body length}, \\ r &= 0.78, \\ n &= 15, \\ \text{and } P &< 0.001. \end{aligned}$$

Fecundity was linearly related to ovary-free body weight (Figure 1B) by the relation

$$\begin{aligned} \text{Log10 } F &= 1.01 \text{ Log10 } W + 1.76, \\ \text{where } W &= \text{ovary-free body weight}, \\ r &= 0.83, \\ n &= 12, \\ \text{and } P &< 0.001. \end{aligned}$$

Fecundity ranged over a factor of 15 from about 12,000 eggs (in a 447-g fish) to > 185,000 eggs (in the heaviest, 2,625-g fish) (Figure 1B). The smallest fish (a 148-g sand bass) contained 16,500 eggs (Figure 1). Sample females contained a mean (± SEM) of 760 ± 80 eggs per g ovary and 70 ± 12 eggs per g ovary-free body weight.

The running ripe barred sand bass was collected between 0930 and 1100 hrs (Pacific standard time). Time of collection of the other 13 sand bass whose ovaries contained ova in hydrated condition ranged from 0900 to 1100 hrs and from 2100 to 0300 hrs, with 8 collected during the day and 5 at night. All 4 hydrated-state kelp bass were collected during daylight (0830–1300) hours.

DISCUSSION

Despite the large inaccuracies (relative to measurement error) that were likely introduced by pooling species and years, these data strongly suggest that batch fecundity is linearly related to ovary-free body weight in rock bass. It is, therefore, meaningful to express fecundity in terms of ovary weight or ovary-free body weight for basses of a range of body sizes (see Hunter and Macewicz 1980). Fecundities can be estimated using tissue sections subsampled randomly from throughout either or both members of an ovary pair.

These data on number of eggs produced per gram body weight might be used as trial input to preliminary egg production method estimates of stock size, once other key parameters have been estimated (Parker 1980, 1984). Future comprehensive stock assessments would require concurrent data on batch fecundity, field abundance of eggs (or yolk-sac larvae), female spawning incidence, and the biomass sex ratio of adults.

Recognizably hydrated eggs were present within ovaries of female basses collected during almost the entire diel period. This observation suggests that either (1) ripe oocytes undergo hydration over a period of many hours in these fishes, or (2) individual females exhibit large diel variation in time of spawning. I suggest that (1) is more likely, and (based on time of collection of the one running ripe female) that barred sand bass spawn during late afternoon or evening. Further studies are needed to determine if and how time of collection affects estimates of batch fecundity and female spawning incidence in these fishes.

ACKNOWLEDGMENTS

Many thanks go to Fritz Jacobsen, Carl Thies, and Steve Lagos of UCSB for saving fish that they captured while doing other field studies. I also thank the numerous individuals who helped collect sample fish for a bass food habits study. The latter study was funded by the Marine Review Committee of the California Coastal Commission, and I gratefully acknowledge their support.

LITERATURE CITED

Bagenal, T.B., and E. Braum. 1971. Eggs and early life history. *In* W. E. Ricker (ed.), Methods for assessment of fish production in fresh waters. IBP (Int. Biol. Programme) Handb. 3, p. 166–198.

DeMartini, E.E., and L.G. Allen. 1984. Diel variation in catch parameters of fishes sampled by a 7.6-m otter trawl in southern California coastal waters. Calif. Coop. Oceanic Fish. Invest. Rep. 25:119–134.

Frey, H.W., ed. 1971. California's living marine resources and their utilization. Calif. Dept. Fish Game, Mar. Res. Agency, 148 p.

Hunter, J.R., and B.J. Macewicz. 1980. Sexual maturity, batch fecundity, spawning frequency and temporal pattern of spawning for the northern anchovy, *Engraulis mordax*, during the 1979 spawning season. Calif. Coop. Oceanic Fish. Invest. Rep. 21:139–149.

Hunter, J.R., N.C.H. Lo, and R.J.H. Leong. 1984. Batch fecundity in multiple spawning fishes. *In* R. Lasker (ed.), An egg production method for estimating spawning biomass of pelagic fish: application to the northern anchovy (*Engraulis mordax*). Southwest Fisheries Center Admin. Rep. LJ-84-37, 321 p.

Lasker, R., ed. 1984. An egg production method for estimating spawning biomass of pelagic fish: application to the northern anchovy (*Engraulis mordax*). Southwest Fisheries Center Admin. Rep. LJ-84-37, 321 p.

Oliphant, M.S. 1979. California marine fish landings for 1976. Calif. Dept. Fish Game, Fish Bull. 170:1–56.

Parker, K. 1980. A direct method for estimating northern anchovy, *Engraulis mordax*, spawning biomass. Fish. Bull., U.S. 78:541–544.

———. 1984. Biomass model. *In* R. Lasker (ed.), An egg production method for estimating spawning biomass of pelagic fish: application to the northern anchovy (*Engraulis mordax*). Southwest Fisheries Center Admin. Rep. LJ-84-37, 321 p.

Roberts, D.A., E.E. DeMartini, and K.M. Plummer. 1984. The feeding habits of juvenile-small adult barred sand bass (*Paralabrax nebulifer*) in nearshore waters off northern San Diego County. Calif. Coop. Oceanic Fish. Invest. Rep. 25:105–111.

United States Department of Commerce. 1985. Marine recreational fishery statistics survey, Pacific coast, 1983–1984. Current Fishery Statistics Number 8325. Washington, D.C., August 1985.