3.3.1 Gobies Gobiidae

Gobies belong to a speciose family (Gobiidae) of small, demersal fishes that are found worldwide in shallow tropical and subtropical environments. The family contains around 1,875 species in 212 genera (Nelson 1994, Moser 1996). Twenty-one goby species from 16 genera occur from the northern California border to south of Baja California (Moser 1996) and eight of these species are common in the MBPP study area (Miller and Lea 1972, Love et al. 1996).

Members of the family Gobiidae share many life history characteristics. Adult gobies are oviparous and produce demersal eggs that are elliptical in shape, typically adhesive, and attached to a nest substratum at one end (Wang 1986, Matarese et al. 1989, Moser 1996). Most species that occur in Morro Bay inhabit burrows in mud flats and other shallow regions of bays and estuaries (Miller and Lea 1972). The fecundity of the arrow goby *Clevelandia ios* ranges from 750 to 1,000 eggs (Wang 1986). Goby larvae enter the plankton following hatching and remain in this pelagic phase until they transform and become benthic-oriented juveniles.

The duration of the planktonic phase varies greatly within the family and is not well described for most of the goby species in the study area. Larval gobiids are distinct from larvae of other families of fishes in the study area, but in many cases are difficult to separate from other sympatric gobiids at these early life stages. The period of entrainment risk used in the *ETM* model were estimated from a growth rate for blackeye goby *Coryphopterus nicholsii* reported by Steele (1997).

Myomere counts and pigmentation characteristics can be used to identify many larvae to the species level (Moser 1996). However, identification of larval gobies to the species level can be problematic since several sympatric gobiids share morphologic and meristic characters during early larval stages. Larval gobies collected during MBPP sampling that could not be identified to the species level were left at the family level (i.e., Gobiidae). These were probably composed of some combination of morphologically similar species that co-occur in the study area. Five larval specimens from the "unidentified goby' group were sent to Dr. David Jacobs for DNA testing and all were genetically identified as arrow goby. We believe that the majority of the larval fishes in this group are arrow goby.

In early stages, bay goby *Lepidogobius lepidus* may also share similar morphologic characters with yellowfin and arrow goby making it difficult to separate them especially when the specimens are not in good condition. Moser (1996) indicates that arrow goby,

cheekspot goby, and the shadow goby cannot be differentiated during any larval stage. Brothers (1975) reported difficulty in separating more developed arrow and cheekspot goby that were less than 65 mm (2.6 in.) long. Recent genetic identifications undertaken during this study (Appendix G) indicated that the endangered tidewater goby and the shadow goby might share sufficient meristic and morphologic characters to render them inseparable during their larval phase. Results from these studies also showed that none of the larvae tentatively identified from morphologic characters as tidewater goby were genetically identified as tidewater goby and that the majority (96 percent) of the specimens initially identified as tidewater goby were shadow goby.

Many of the adults of the gobiid larvae are known to occur in the study area (Appendix B). Adult shadow goby were collected in shallow waters in the back bay, south of our source water Station 4 (Horn 1980). Arrow and bay gobies were collected in surveys conducted by Fierstine et al. (1973), Horn (1980), and in CDFG otter trawls (CDFG, unpubl. otter trawl data). Bay goby were collected in both MBPP impingement studies, while arrow goby were not collected in either impingement study (Behrens and Sommerville 1982; Section 4.0 – Impingement). Longjaw mudsucker *Gillichthys mirabilis* were collected by Fierstine et al. (1973) and were also collected in the 1999-2000 impingement study.

3.3.1.1 Unidentified Goby Results

Larvae identified to the family Gobiidae were the most abundant and most frequently collected at the MBPP intake station. Based on the results of the DNA analysis, we believe that the majority of these unidentified gobiids were arrow goby. They were collected in nearly 100 percent of the weekly surveys conducted at the MBPP intake station (Figure 3-8) and accounted for 75 percent of the total number of fishes collected at the MBPP intakes (Figure 3-2). Goby concentration varied seasonally and spawning activity appeared to continue year-round in the vicinity of the MBPP.

The length frequency distribution for a representative sample of unidentified Gobiidae larvae showed that the majority of the larvae were small (average size of 3.7 mm [0.15 in.]) and likely to be recently hatched (Figure 3-9). The samples also contained larger larvae up to 8.2 mm (0.32 in.). Most of the unidentified Gobiidae larvae are thought to be arrow goby *Clevelandia ios* and are probably represented by the distinct peak in the frequency distribution at 3.5 mm (0.14 in.). The break in the frequency distribution may represent a species other than arrow goby that have a larger hatching size or different larval behavior.

Unidentified gobiids were also the most common and abundant larval fish taxa collected in the monthly paired surveys (Figure 3-10). The majority of these larvae were collected from stations inside Morro Bay. The greatest concentrations of unidentified gobiid larvae were consistently collected from the stations in the southernmost enclosed portion of Morro Bay (stations 3 and 4).

Concentrations (#/m^3) of unidentified gobiid (Gobiidae) larvae were compared among stations for collections made at ebb and flood tides (Figure 3-11). Larval goby abundance was generally higher on ebb tides. Goby larvae were not very abundant at the Estero Bay station (Station 5) and therefore no conclusion could be made on the relationship between their abundance at that station and the tidal current in which they were collected. Inside the bay, the concentrations of goby larvae probably increased during ebb tides at the stations in the southernmost enclosed portion of Morro Bay (stations 3 and 4) when larvae were drawn out of the shallow mudflat and eelgrass habitats of the bay where adult gobies are most abundant.

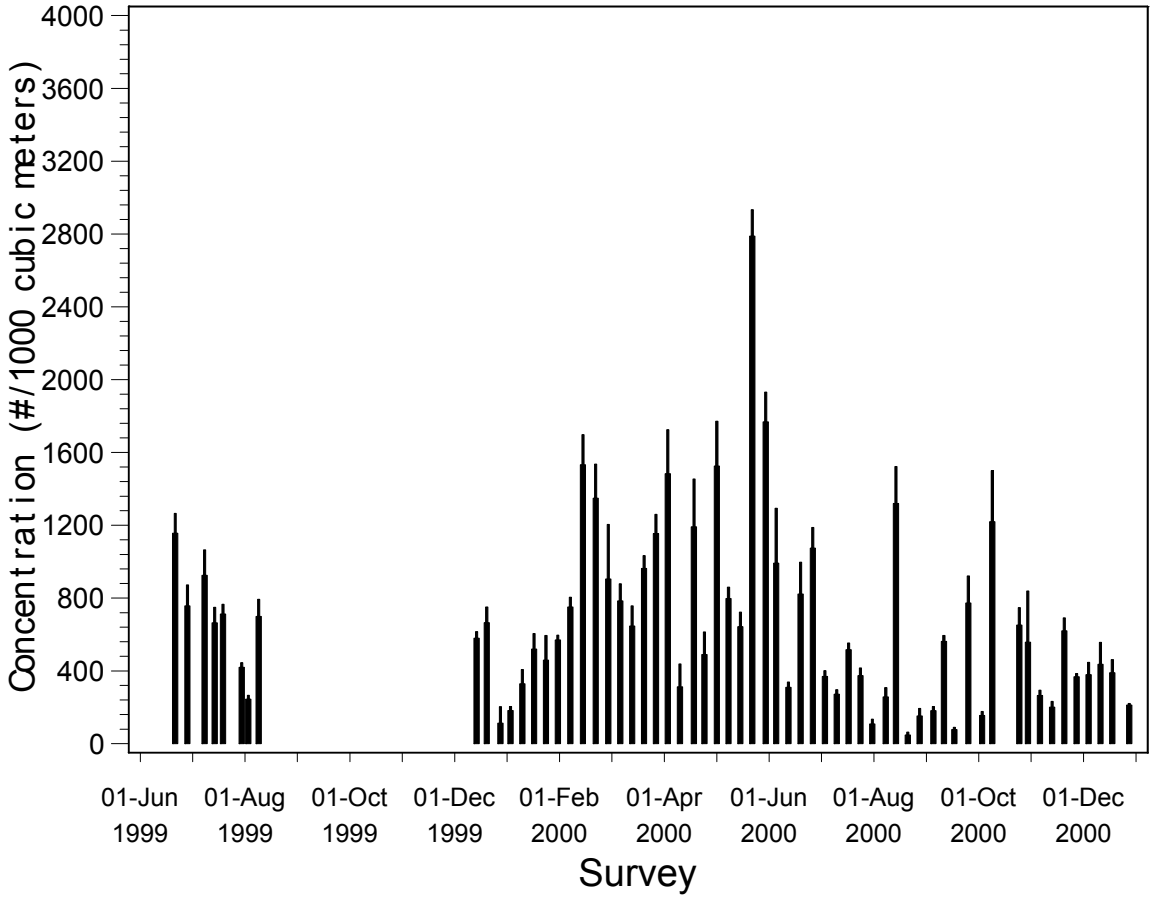

Figure 3-8. Weekly survey mean concentrations of unidentified larval Gobiidae collected at the MBPP intake station with standard error indicated (+1 SE). Weekly surveys were collected from June 21 through August 10, 1999 and from December 14, 1999 through December 29, 2000.

Note: The October 16, 2000 survey was cancelled due to the unavailability of a boat.

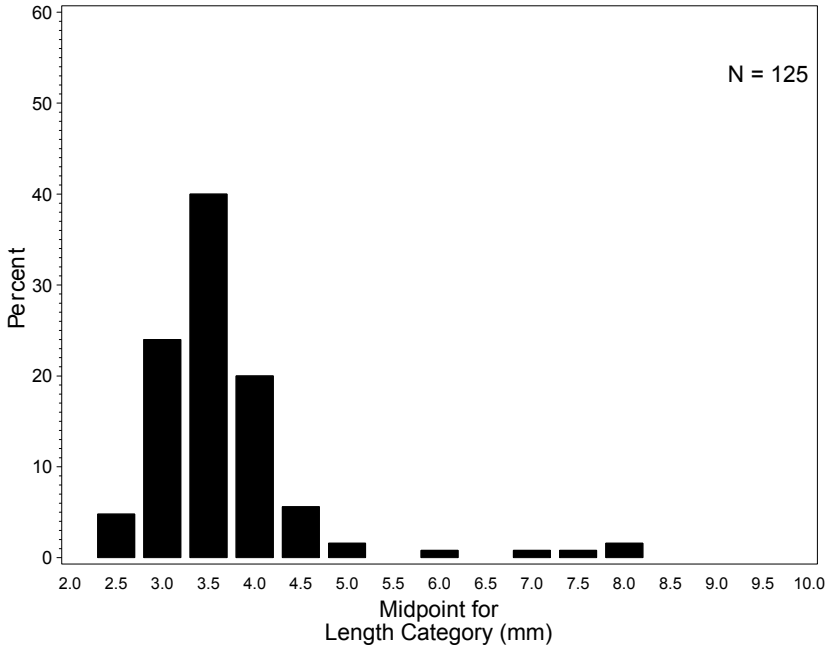

Figure 3-9. Length frequency (mm) distribution for larval Gobiidae collected at the MBPP intake station from January – December 2000. The frequency distribution is based on the lengths of a representative sample of approximately 100 larvae.

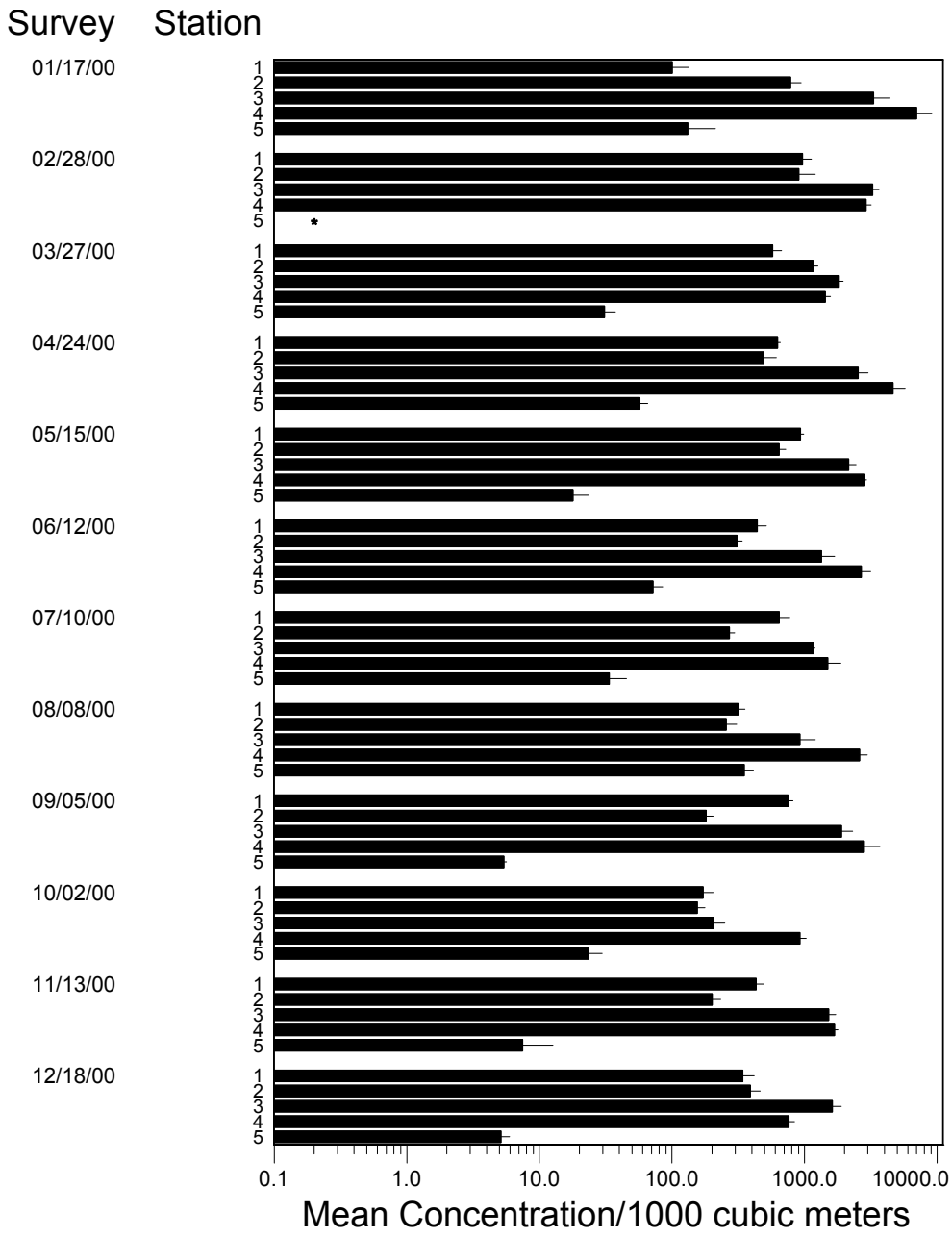

Figure 3-10. Mean unidentified larval Gobiidae concentration in monthly paired surveys at the MBPP intake (Station 2), Morro Bay source water (Stations 1, 3, and 4), and Estero Bay (Station 5) from January – December 2000 with standard error indicated (+1 SE).

Note: During the January 17, 2000 survey, source water stations 1, 3, 4, and 5 were sampled only in daylight hours. Beginning in February 2000 the sampling frequency was increased to cover a 24-hour period.

* Estero Bay Station 5 could not be sampled in February 2000 due to unsafe sea conditions.

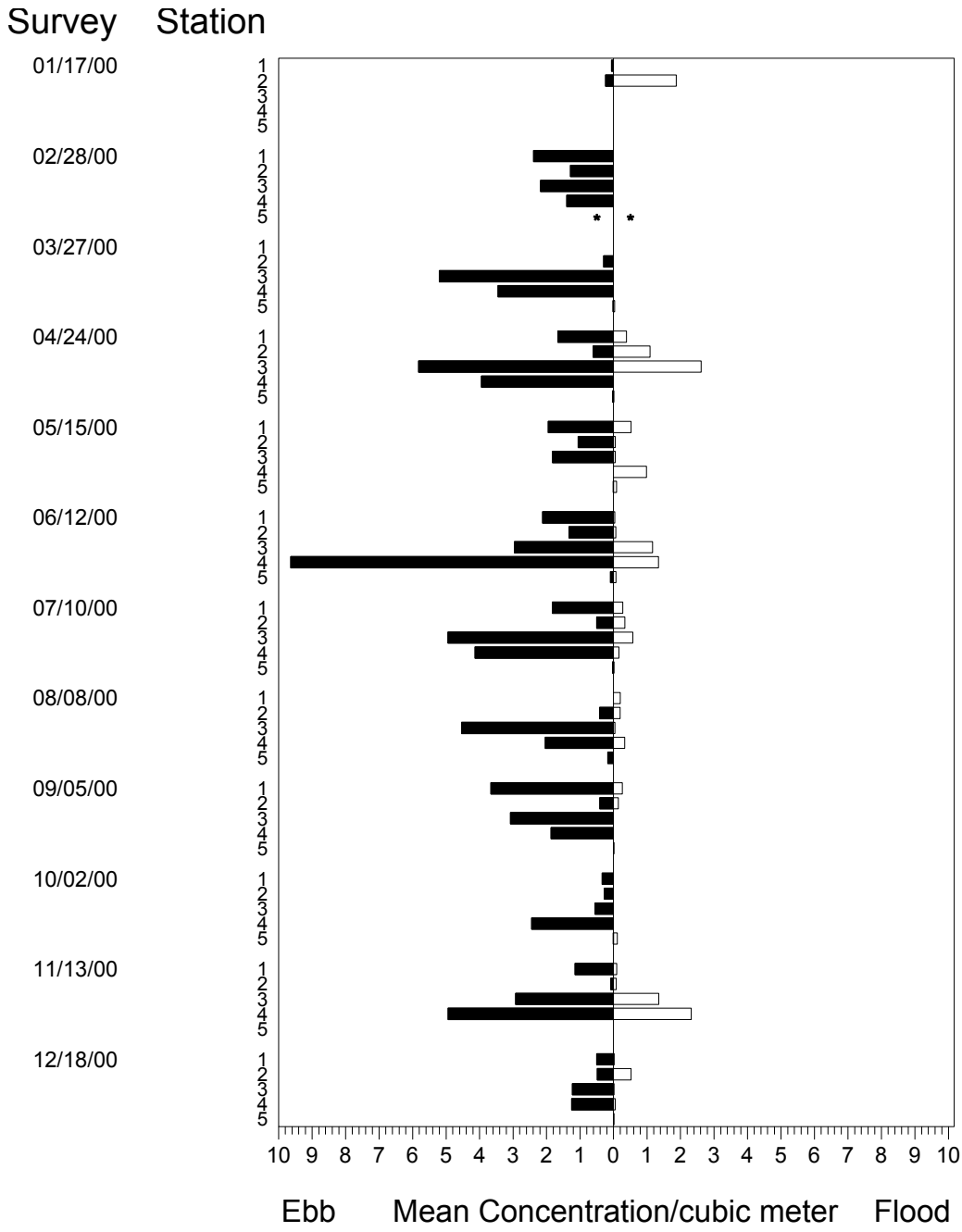

Figure 3-11. Mean concentration of unidentified larval Gobiids from monthly paired surveys by tidal current (ebb – solid bars; flood – clear bars) and sampling station (Morro Bay stations 1–4 and Estero Bay Station 5) from January – December 2000.

Note: During the January 17, 2000 survey, source water stations 1, 3, 4, and 5 were sampled only in daylight hours. Beginning in February 2000 the sampling frequency was increased to cover a 24-hour period.

*Estero Bay Station 5 could not be sampled in February 2000 due to unsafe sea conditions.