Relationships among abundance indices and other important factors

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Delta smelt (smelt) are sampled annually in four surveys:

- Kodiak Trawl: beginning in 2002, samples monthly for adults, typically starting with January and, now, ending in May
- 20 mm survey: beginning in 1995, samples biweekly for larval and juvenile delta smelt from March to July
- Summer townet survey (STN): beginning in 1959, originally designed to catch young-of-the-year striped bass, samples for juvenile delta smelt biweekly in June through August, although early years often did not include samples in June or August
- Fall midwater trawl (FMWT): beginning in 1969, samples sub-adult delta smelt each month in September through December.

I developed estimates of the population of adult delta smelt from the Kodiak trawl data (Miller 2005a). Fleming developed estimates of larval-juvenile abundance by summing the catch per unit effort values for the first eight 20 mm surveys each year (Fleming 2004).

Previous papers in this series analyzed the relationship between smelt-prey co-occurrence in the summer and the subsequent FMWT index (Miller 2005b) and estimated percentage adult entrainment (Miller 2005c) and percentage larval-juvenile entrainment (Miller 2005d) at the Banks and Tracy export pumping plants (Banks and Tracy).

This paper examines the relationships among these various indices of abundance and seeks relationships between abundance and entrainment at Banks and Tracy. Results are shown in Figure 1. This figure shows the time of year of sampling for the four abundance indices. It shows when adult and larval-juvenile entrainment occur. The small graphs show the correlations between various pairs of abundance indices. The graphs on the top of the figure show correlations between sequential abundance indices, FMWT sub-adults to Kodiak adults, Kodiak adults to 20 mm larvae-juveniles, 20 mm larvae-juveniles to summer juveniles, and summer juveniles to fall sub-adults. The graphs on the bottom of the figure show relationships between non-sequential abundance indices, FMWT sub-adults to 20 mm larvae-juveniles, FMWT sub-adults to summer juveniles, and FMWT sub-adults to the following year's FMWT sub-adults. The graph on the far right shows the correlation between July smelt prey co-occurrence and the subsequent FMWT sub-adult abundance.

The following conclusions can be drawn from this analysis:

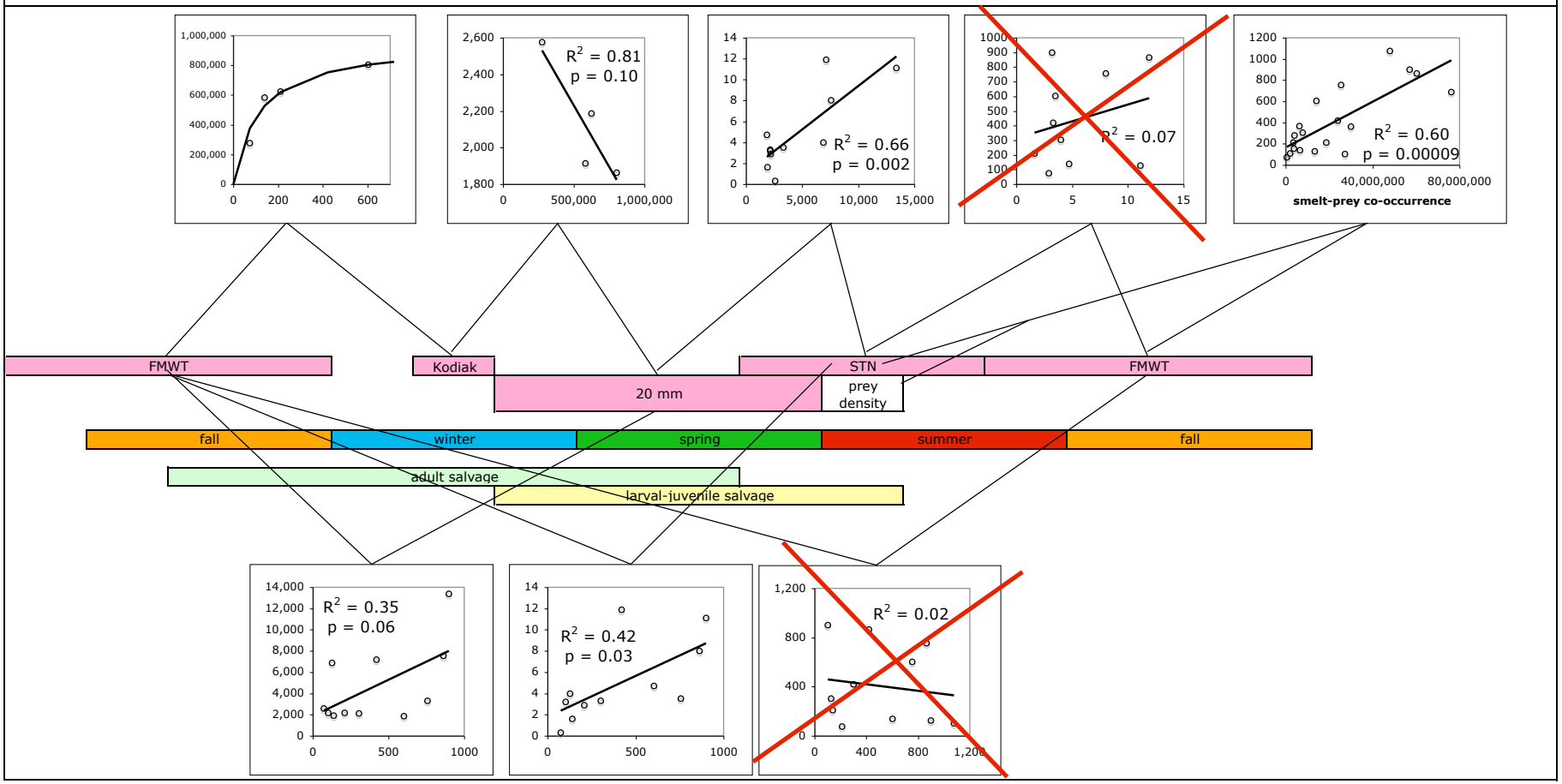
All sequential abundance indices show expected relationships except the one between the summer juveniles and fall sub-adults. The lack of correlation between the STN and subsequent FMWT can be explained by the co-occurrence graph. The abundance of sub-adults in the fall, measured by the FMWT index, does not simply depend on the abundance of smelt juveniles in July but primarily on their co-occurrence with prey. It is possible to have high abundance of juveniles in July and a subsequent low FMWT index if those juveniles did not co-occur with prey as in 1996. It is also possible to

have a low abundance of juveniles in July and a subsequent high abundance of sub-adults in the fall if the juveniles highly co-occurred with prey as in 1995.

Numerous attempts were made to find a correlation between some measure of entrainment (including smelt salvage and export amounts) and subsequent abundance, without success. Figure 1 shows why this is not surprising. Essentially all entrainment occurs before the critical summer period when juvenile smelt-prey co-occurrence largely determines the subsequent abundance of FMWT sub-adults.

Obviously, if all adults or larval-juvenile smelt were entrained, there would be no juveniles in July, but so far, the percentage adult and larval-juvenile entrainment estimates do not indicate that this unfortunate event has come close to occurring.

Figure 1
Comparison of delta smelt abundance indices



References

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