

Addition of Round Gobies to the Prey Community of Lake Ontario and Potential Implications to Thiamine Status and Reproductive Success of Lake Trout

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Table 1. Round goby density estimated from lake trout egg traps at one spawning reef in Lake Ontario and four reefs in north-eastern Lake Michigan during the fall (^aspring). Abbreviations: GTB-Grand Traverse Bay, MDNR-Michigan Department of Natural Resources.

| Lake | Location | Year | Goby abundance (number·m ⁻²) (X±SEM) | Source |
|----------|-------------------|-------------------|---|---|
| Ontario | Port Weller | 2001 ^a | 26±7 | This study |
| | | 2001 | 109±15 | This study |
| | | 2002 | 142±27 | This study |
| Michigan | Bay Harbour | 2000 | 0 | Jonas et al. 2005 |
| | | 2001 | 4.7 | Jonas et al. 2005 |
| | | 2003 | 4.5 | Jonas et al. 2005 |
| | | 2004 | 3.1 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | | 2005 | 4.3 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | | 2006 | 6.6 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | Elk Rapids | 2005 | 1.9 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | | 2006 | 1.8 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | GTB-Ingalls Point | 2004 | 0 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | | 2005 | 5.9 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| 2006 | | 20.0 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) | |
| LTB-Crib | | 2001 | 0 | Jonas et al. 2005 |
| | | 2003 | 14.6 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | | 2004 | 8.6 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | | 2005 | 12.6 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |
| | | 2006 | 15.5 | J. Jonas and R. Claramunt, MDNR, Charlevoix (unpub. data) |

Table 2. Lake trout diet composition (% wet mass) by length category for four prey species at four locations in Lake Ontario, during spring and summer of 2005. Abbreviations: N-sample size, NOTL-Niagara on the Lake. Prey abbreviations: AW-alewife, RS-rainbow smelt, SS-slimy sculpin, RG-round goby.

| Location | Season | Prey/N | Lake trout size (mm) | | | Composite average |
|-------------|---------|--------|----------------------|---------|---------|-------------------|
| | | | 601-700 | 701-800 | 801-900 | |
| NOTL | Spring | AW | 72.8 | 81.6 | 71.5 | |
| | | RS | 16.8 | 4.5 | 11.3 | |
| | | SS | 0 | 0 | 7.8 | |
| | | RG | 10.3 | 13.9 | 9.4 | |
| | | N | 14 | 16 | 10 | |
| | Summer | AW | 77.5 | 72 | 93.5 | |
| | | RS | 21 | 25 | 6.5 | |
| | | SS | 0 | 0 | 0 | |
| | | RG | 1.3 | 3 | 0 | |
| | | N | 15 | 8 | 1 | |
| | Average | AW | 75.2 | 76.8 | 82.5 | 78.2 |
| | | RS | 18.9 | 14.8 | 8.9 | 14.2 |
| | | SS | 0 | 0 | 3.9 | 1.3 |
| | | RG | 5.8 | 8.5 | 4.7 | 6.3 |
| | | N | 29 | 24 | 11 | 64 |
| Port Credit | Spring | AW | 67 | 37 | 31 | |
| | | RS | 0 | 36 | 2.1 | |
| | | SS | 33 | 28 | 0 | |
| | | RG | 0 | 0 | 67 | |
| | | N | 3 | 3 | 3 | |
| | Summer | AW | 71.4 | 71.4 | | |
| | | RS | 28.6 | 14.3 | | |
| | | SS | 0 | 0 | | |
| | | RG | 0 | 14.3 | | |
| | | N | 7 | 7 | | |
| | Average | AW | 69.2 | 54.2 | 31 | 51.4 |
| | | RS | 14.3 | 25.2 | 2.1 | 13.9 |
| | | SS | 16.5 | 14 | 0 | 10.2 |
| | | RG | 0 | 7.2 | 67 | 24.7 |
| | | N | 10 | 10 | 3 | 23 |
| Cobourg | Spring | AW | 68.4 | 75.2 | | |
| | | RS | 24.6 | 24.1 | | |
| | | SS | 7.0 | 0.8 | | |
| | | RG | 0 | 0 | | |
| | | N | 8 | 12 | | |
| | Summer | AW | 100 | 100 | | |
| | | RS | 0 | 0 | | |
| | | SS | 0 | 0 | | |
| | | RG | 0 | 0 | | |
| | | N | 6 | 3 | | |
| | Average | AW | 84.2 | 87.6 | | 85.9 |
| | | RS | 12.3 | 12.0 | | 12.2 |
| | | SS | 3.5 | 0.4 | | 2.0 |
| | | RG | 0 | 0 | | 0 |
| | | N | 14 | 15 | | 19 |
| Oswego | Spring | AW | 90.2 | 100 | 100 | |
| | | RS | 0 | 0 | 0 | |

| | | | | | | |
|--|---------|----|------|-----|-----|------|
| | | SS | 9.8 | 0 | 0 | |
| | | RG | 0 | 0 | 0 | |
| | | N | 12 | 3 | 1 | |
| | Summer | AW | 100 | 100 | | |
| | | RS | 0 | 0 | | |
| | | SS | 0 | 0 | | |
| | | RG | 0 | 0 | | |
| | | N | 4 | 4 | | |
| | Average | AW | 95.1 | 100 | 100 | 98.4 |
| | | RS | 0 | 0 | 0 | 0 |
| | | SS | 4.8 | 0 | 0 | 1.6 |
| | | RG | 0 | 0 | 0 | 0 |
| | | N | 16 | 7 | 1 | 24 |

Table 3. Diet composition of Lake Ontario lake trout from the entire lake in 1998-1999 (Lantry, 2001), four locations in 2005, and three future diet scenarios and corresponding estimated composite dietary thiaminase activity with and without seasonal adjustment based on Tillitt et al. (2005), egg thiamine concentration and mortality resulting from either EMS or growth retardation. Abbreviations: AW-alewife, RS-rainbow smelt, SS-slimy sculpin, RG-round goby.

| Year | Species | AW | RS | SS | RG | Estimated composite thiaminase activity (seasonally adjusted) (pmol g ⁻¹ min ⁻¹) | Estimated egg thiamine concentration (nmol g ⁻¹) | Estimated EMS (%) | Estimated mortality from growth retardation (%) |
|-------------------|---------------------|------------------------------|------|------|------|---|--|-------------------|---|
| | Location | Proportion of diet by weight | | | | | | | |
| 1998-1999 | Entire lake | 79.5 | 6.4 | 14.1 | 0 | 3640 (5019) | 1.49 | 50 | 100 |
| 2005 | Niagara on the Lake | 78.2 | 14.2 | 1.3 | 6.3 | 3769 (5125) | 1.43 | 55 | 100 |
| 2005 | Port Credit | 51.4 | 13.9 | 10.2 | 24.7 | 2618 (3509) | 2.81 | 4 | 0 |
| 2005 | Cobourg | 85.9 | 12.2 | 2.0 | 0 | 4050 (5540) | 1.20 | 70 | 100 |
| 2005 | Oswego | 98.4 | 0 | 1.6 | 0 | 4236 (5928) | 1.02 | 82 | 100 |
| Future scenario 1 | | 50 | | | 50 | 2177 (3044) | 3.42 | 0 | 0 |
| Future scenario 2 | | 25 | | | 75 | 1098 (1531) | 6.45 | 0 | 0 |
| Future scenario 3 | | 0 | | | 100 | 18 (18) | 12.18 | 0 | 0 |

Fig. 1. Seasonal variation in water temperature for a shallow water reef (Port Weller, Lake Ontario, 2001-2002) and a deep water reef (Sheboygan Reef, Lake Michigan, 1995-1996). Lake trout egg deposition occurred Oct 15, and emergence began April 15, ending 30 days later.

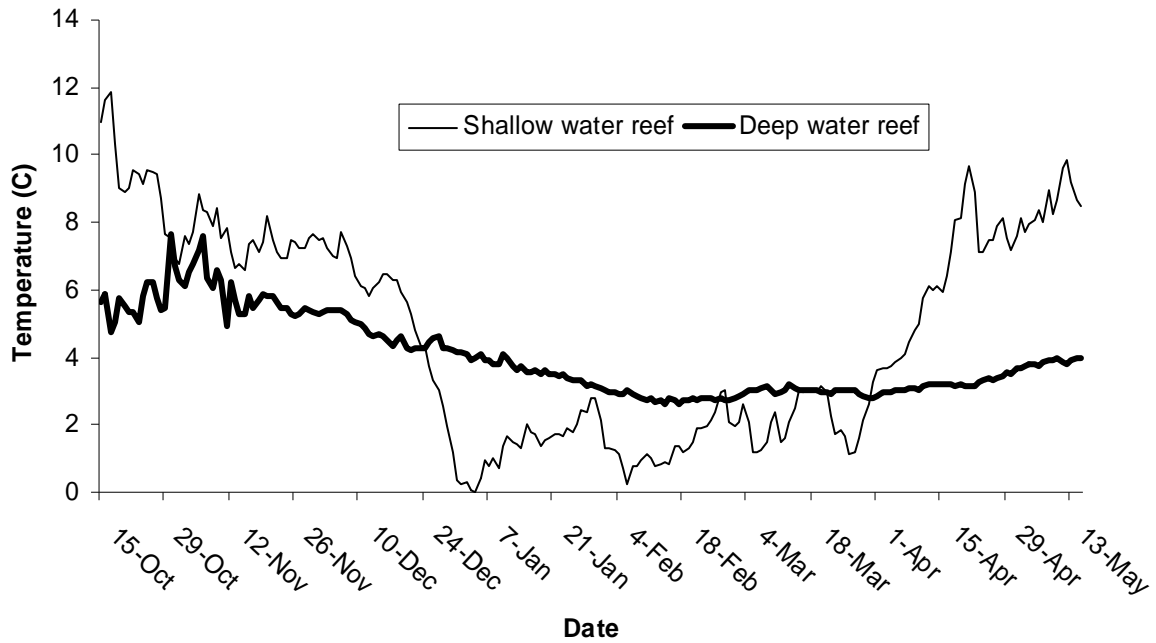


Fig. 4. A comparison of changes in egg density over a 213 day goby residence period for a shallow water and a deepwater temperature regime at four initial egg densities (100, 500, 1000 and 5000 eggs·m⁻²) for one, nine, and 18 gobies·m⁻².

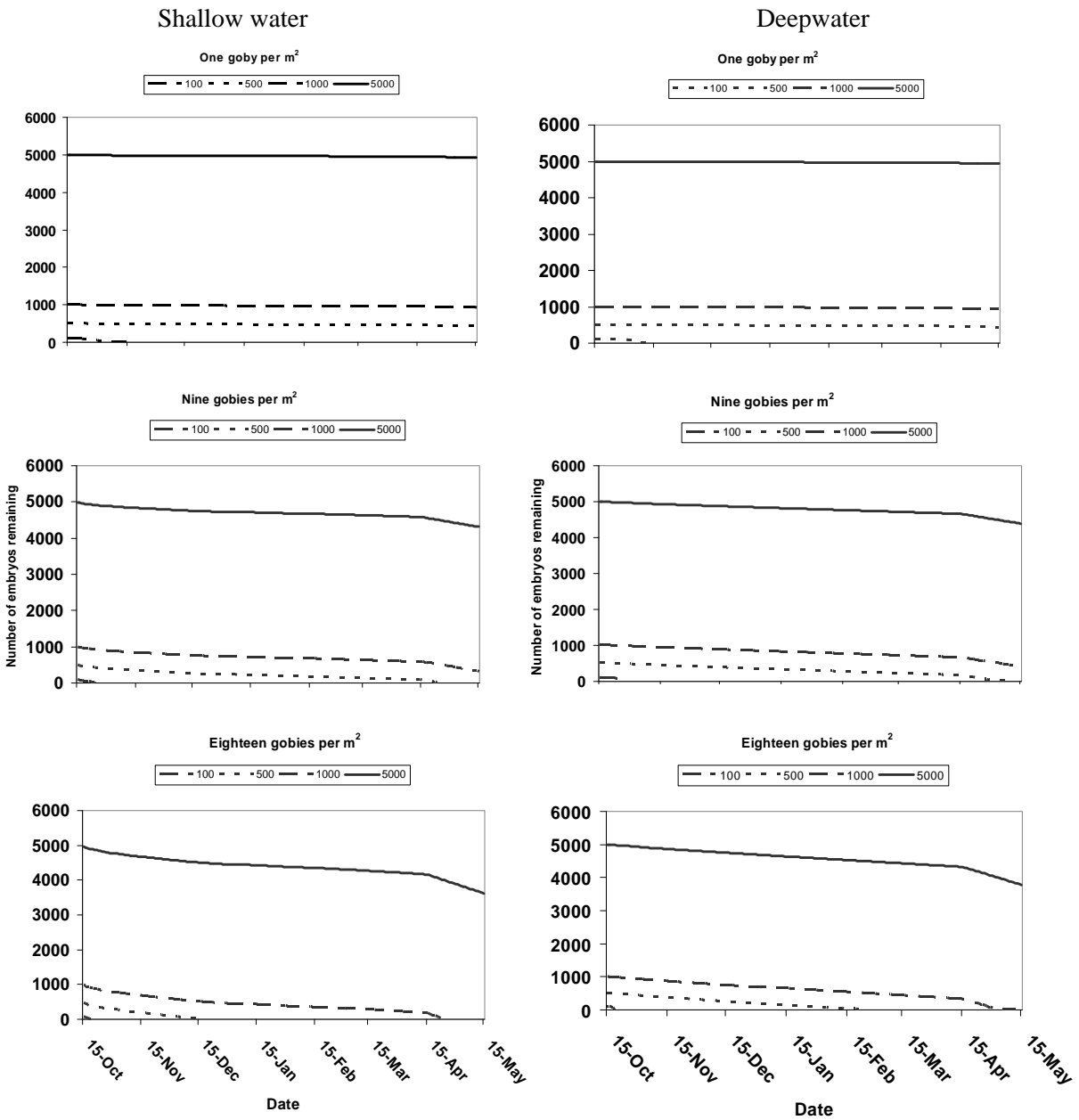


Fig. 5. A comparison of changes in egg density over a 213 day goby residence period for a shallow and deepwater temperature regime at four initial egg densities (100, 500, 1000 and 5000 eggs·m⁻²) for 35, 75 and 150 gobies·m⁻².

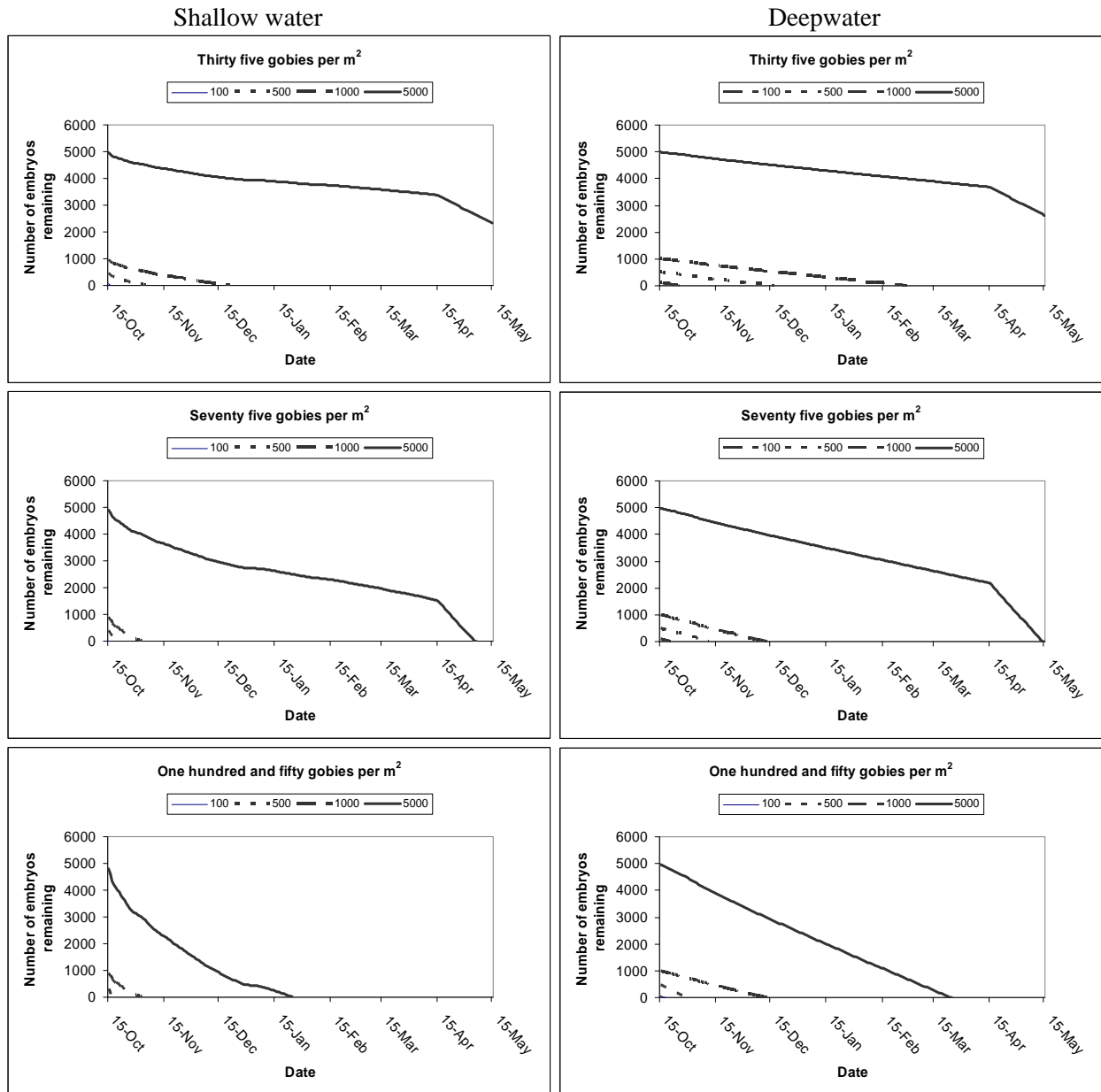


Fig. 6. A comparison of changes in egg density over a 213 day goby residence period at four initial egg densities (100, 500, 1000 and 5000 eggs·m⁻²) with six goby densities and negative growth effects for the shallow-water temperature regime.

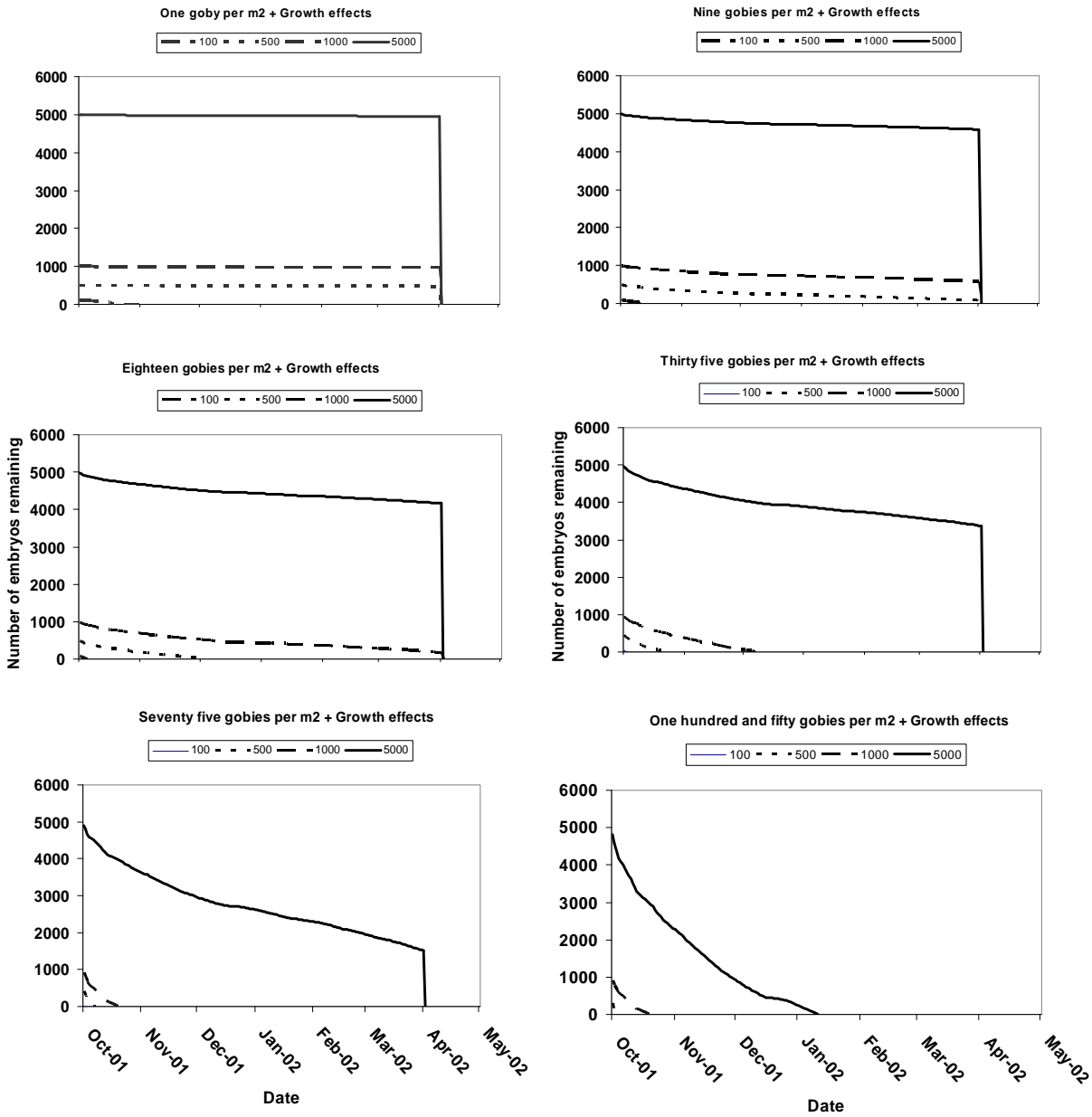


Fig. 11. Relationship between CPUE for mature lake trout females (>4000 g) and lake trout egg abundance at the lake trout spawning reef at Port Weller (1992-1999).

