SCOTTISH ENVIRONMENTAL PROTECTION AGENCY

LOCH LOMOND ZOOPLANKTON

CREINCH AND CAILNESS
2001 - 2005

SCIENTIFIC REPORT

MARCH 2008

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1 BACKGROUND

Zooplankton form a vital link in aquatic food webs, being major consumers of phytoplankton and the main food source for the powan (*Coregonus lavaretus*) in Loch Lomond and the juveniles of many other fish species. As such, zooplankton populations can provide valuable information to help assess the ecological integrity of waterbodies. Zooplankton have rapid life-cycles and are highly responsive to changes in the physical and chemical conditions of waterbodies.

As well as being highly responsive to short-term environmental changes, zooplankton are useful indicators of long-term trends in lake ecosystems. Zooplankton have been the subject of many studies into the effects of climate change on the ecology of lakes in the UK (George & Harris, 1985). The development of zooplankton populations during summer months has been shown to vary considerably depending on the winter temperatures. As such, climate change has been shown to influence the abundance and nature of zooplankton populations (George & Hewitt, 1999). The effects of climate change can be measured in changes in abundance and composition of zooplankton populations over time, and ultimately may lead to the decline of native species in favour of invasive ones. A better understanding of the composition of zooplankton populations will lead to an ability to monitor and even predict the effects of climate change on lake ecology.

With respect to Loch Lomond, zooplankton comprise the diet of the powan, a rare planktivorous fish which is designated as a LBAP species and is protected under Schedule 5 of the Wildlife and Countryside Act. Powan feed heavily on zooplankton from late spring to late autumn and are highly selective in the species, size and morph of their prey (Pomeroy, 1994). Therefore, long-term data for zooplankton will help inform the management of powan in Loch Lomond.

Additionally, zooplankton have provided useful indicators of the trophic state of Loch Lomond by describing a gradient from the oligotrophic north basin to the mesotrophic south basin. Rotifer abundance, in particular, is considered to be the most useful indicator of future changes in the trophic state of Lock Lomond (May & O'Hare, 2005).

The zooplankton samples enumerated were collected monthly in spring, summer and autumn from two sites in Loch Lomond. APEM analysed the samples collected from 2002 to 2004, along with one sample each collected in autumn 2001 at Creinch and Cailness, and spring 2005 at Cailness only. Creinch is located in the southern basin, which is charactised as broad and shallow (with a maximum width of 8.8 km and depths between 5 and 20 m, May and O'Hare, 2005). This system is classified as mesotrophic and has a higher population density in the surrounding catchment than the northern basin, and it is well mixed (May & O'Hare, 2005). The site at Cailness is in the northern basin which is narrow and deep (20 km long with a maximum width of 1.5 km and a maximum depth of 194 m; May & O'Hare, 2005). In contrast to the southern basin, the northern basin is oligotrophic with a thermocline at around 15-20 m (May & O'Hare, 2005).

2 METHODS

2.1 *Method of Zooplankton Sample Processing*

2.1.1 Sample Preparation

Prior to enumeration samples were sieved through a 53 µm mesh sieve and rinsed with deionised water to remove the preservative. A 53 µm mesh sieve was chosen as it is smaller than mesh of the net used for sample collection (140 µm). Samples were then diluted to an appropriate volume in a beaker, dependent on the number of zooplankton present (between 20 and 50 ml). A wide bore pipette with an inside diameter of 4 mm was used to thoroughly mix the samples and to collect a subsample for enumeration. Both the dilution volume and the volume of the subsample used for enumeration were recorded to be used in calculating the abundance of each zooplankton taxon or group identified.

2.1.2 Sample Enumeration

Subsamples were dispensed into a petri dish etched with 1 cm gridlines and enumerated under a dissection microscope at 20 times magnification. A compound microscope was used to examine distinguishing features to further aid identification as necessary. Up to 200 individuals per sample were enumerated and identified. Digital images of the most commonly occurring taxa were taken.

2.1.3 Size-class Determination

For each individual identified, one of the following size classes was assigned:

Small:	0.2 - 1.3 mm
Medium:	1.3 - 2.0 mm
Large:	2.0 - 3.2 mm

Size classes were determined using an eyepiece graticule or a strip of laminated graph paper with 1 mm markings, as appropriate. Once enumerated, samples were returned to their original containers and preserved with a 90% Methanol, 1% Glycerol solution.

2.1.4 Calculation of Abundance

The volume of sample counted and the number of each organism present was used to determine an estimate of the number of organisms within the entire sample. This figure was then converted into numbers per cubic metre of sample water, taking into account the diameter of the net aperture (30 cm) and the distance through which the net was hauled (5 m). The calculated abundance data are provided in the appendix.

2.2 *Zooplankton Identification*

Zooplankton were identified to species level where possible for all groups, or to the lowest practical taxonomic level. It is impossible to identify to species level immature specimens of some groups, such as copepods. Other groups such as rotifers and cnidarians are difficult to identify when preserved. These difficult groups wereidentified as far as possible using the available keys. Keys used included Scourfield and Harding (1966), Pontin (1978) and Harding and Smith (1974).

2.3 *Analytical Quality Control - Processing and Identification*

One sample in ten was be re-analysed by a second biologist. A random sample was selected from every batch of ten that was completed, and re-analysed within two weeks of the primary analysis. The quality control analysis was carried out following the same methodology as the primary analysis.

2.4 *Data Analysis*

Data were tabulated and graphed using MS Excel 2003. Broad groups were plotted against date for every year in which samples were analysed and for each site. The size structure of the zooplankton community as a whole was illustrated using bar graphs. Data were plotted according to sampling month, and in instances where two samples were taken at the beginning and end of one month, one of the samples was assigned to the month following (or preceding depending on the situation). The population dynamics of each species or group identified were illustrated using line graphs for each year in which a full dataset was available. The samples collected in 2001 and 2005 were not plotted in this way as there was only one data point for each year at each site in 2001 and only one sample was collected (at Cailness) in 2005.

3 RESULTS

A total of 13 taxa and 4 broad groups were identified in the zooplankton samples collected from Creinch and Cailness, Loch Lomond from 2001 to 2005 (Table 3.1). The most commonly occurring groups were calanoid and cyclopoid copepods, which were present on every date sampled. The cladoceran *Daphnia hyalina* was also commonly present. The remaining taxa were found in less than half of the samples analysed (Table 3.1). Images of the most commonly encountered taxa are provided in Figure 3.1. Although not present in official counts, *Holopedium* and *Polyphemus* spp. were observed in samples during the production of the images in Figure 3.1.

Table 3.1 Zooplankton present in Loch Lomond samples from 2001 to 2005 listed in order of decreasing incidence of occurrence.

Taxa/Group	Broad Group	No. Dates of Occurrence
Calanoida	Copepoda	45
Cyclopoida	Copepoda	45
Nauplii	Copepoda	42
Daphnia hyalina	Cladocera	37
Bosmina coregoni var obtusirostris	Cladocera	19
Bythotrephes longimanus	Cladocera	14
Asplanchna sp	Rotifera	11
Kellicotia sp	Rotifera	10
unidentified Rotifera	Rotifera	10
Leptodora kindtii	Cladocera	7
Branchionus sp	Rotifera	7
Chaoboridae	Diptera	4
Bosmina coregoni var longirostris	Rotifera	2
Chydorus sp	Cladocera	1
Daphnia longispina	Cladocera	1
Diaptomus sp	Copepoda	1
Keratella sp	Rotifera	1

Figure 3.1 Zooplankton commonly present at Creinch and Cailness from 2001 to 2005: a. *Leptodora kindtii*; b-c. two different cyclomorphic forms of *Daphnia hyalina*; d. *Bythotrephes longimanus* (second instar juvenile) e. two calanoid copepods; f. *Bosmina coregoni*; g-h. nauplii; i. *Asplanchna* sp.; j. cyclopoid copepod.

Copepods were generally the most abundant zooplankton group throughout the samples analysed, with very few exceptions (Figure 3.2). They were most abundant in early summer, with a second smaller peak in abundance occurring in late summer or autumn in 2002, 2003 and 2004 (Figure 3.2). There was no marked difference in the abundance of copepods at Creinch and Cailness; however, copepods were more abundant during the early summer peak at Cailness from 2002 to 2004 than they were at Creinch. Copepod nauplii were commonly present in samples and were generally most abundant in spring from 2002 to 2004 (Figure 3.2). The spring peaks in nauplii abundance were most pronounced at Cailness in 2003 and 2004.

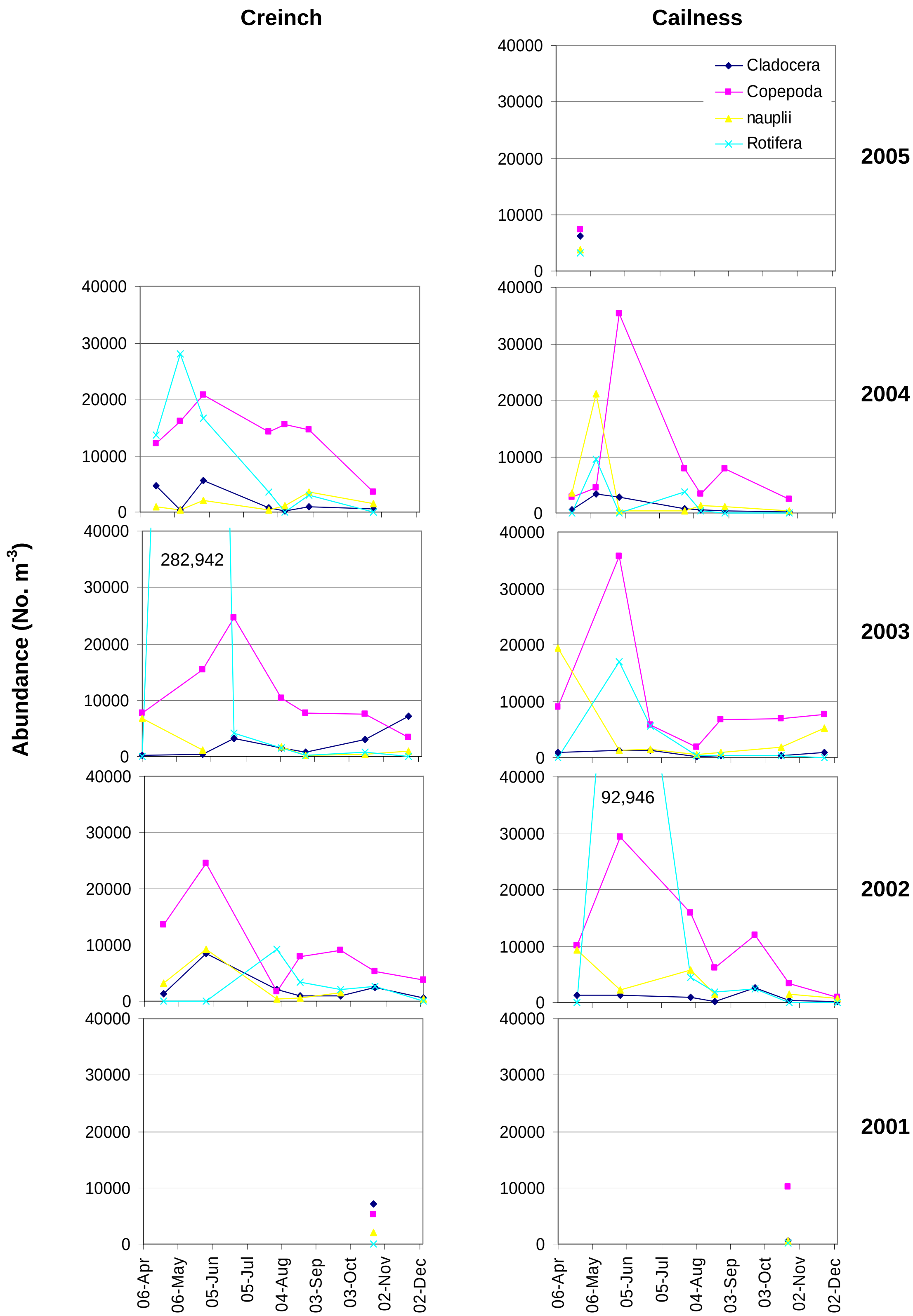

Figure 3.2 Abundance of zooplankton (classified according to broad group) in samples collected at Creinch and Cailness in Loch Lomond from 2001 to 2005.

Rotifers generally reached their highest abundance in spring or early summer from 2002 to 2004, and were found in relatively high numbers in the samples collected on 30/05/2002 at Cailness (92,946 individuals m^{-3}) and on 29/05/2003 at Creinch (282,942 individuals m^{-3}). Rotifers surpassed copepods in abundance in the samples collected on these dates, and additionally on 30/07/2002, 20/04/2004 and 11/05/2004 at Creinch, and on 11/05/2004 at Cailness (Figure 3.2).

Cladocerans were also common among samples, but they were generally present at relatively low abundances compared to copepods (Figure 3.2). Cladocera tended to be most abundant in spring or early summer, but this peak was not as pronounced as it was in copepod and rotifer abundance. Cladocera were the most abundant zooplankters on two dates in the autumn; on 24/11/2003 and 23/10/2001 at Creinch (Figure 3.2).

3.1 *Size Structure*

In terms of size structure, small (0.2-1.3 mm) zooplankton dominated the samples taken at both Creinch and Cailness between 2001 and 2005 (Figure 3.3). Medium sized (1.3-2.0 mm) zooplankton increased in relative abundance in summer and autumn, dominating occasionally (September 2004, at Creinch; June and October 2004 at Cailness). The dominance of small zooplankton in the samples analysed from Loch Lomond was largely due to the rotifers and nauplii that were often present at relatively high abundances. Excluding these typically small species (which do not normally reach sizes beyond 2.0 mm) results in a community dominated jointly by small and medium sized zooplankton (Figure 3.4). Small sized zooplankton dominated in 2002, however, at both Creinch and Cailness (Figure 3.4).

Large (2.0-3.2 mm) zooplankton were present at relatively low abundances (if at all; see Figure 3.4) in the samples analysed. Large zooplankton were represented mainly by *Bythotrephes longimanus* and *Leptodora kindtii*, all of which were present as large individuals except on one and two dates respectively (small *B. longimanus* individuals were found on 27/07/2004 at both Creich and Cailness; medium *L. kindtii* individuals were found on 10/08/2004 at Creinch and on 20/08/2002 at Cailness). Members of the family Chaoboridae were present in four of the samples collected at Cailness, and these were represented by large individuals on three occasions (20/08/2002, 05/08/2003 and 27/07/2004). Small members of Chaoboridae were present on 27/07/2004 (in addition to the large individuals found on this date) and on 10/08/2004.

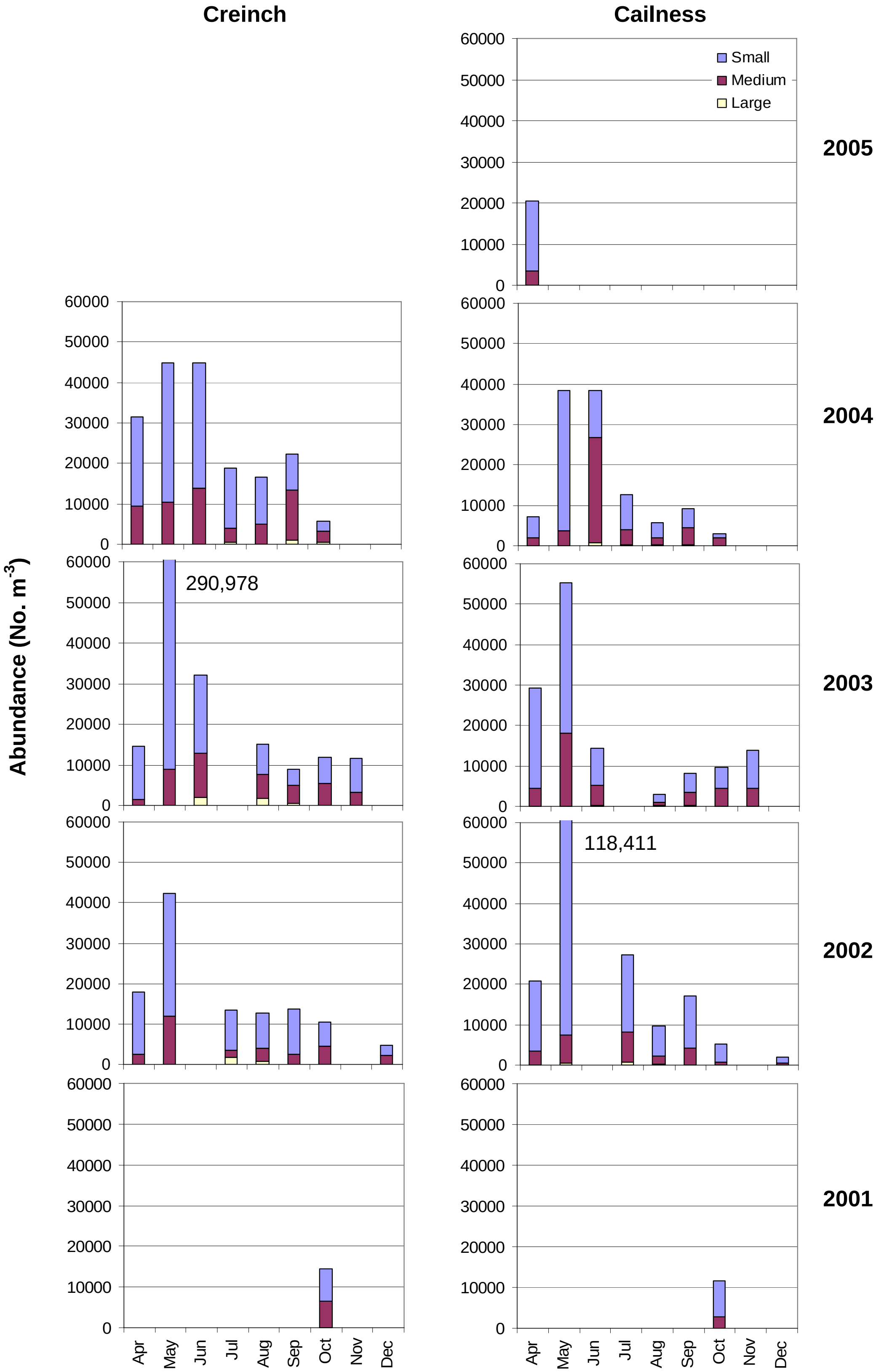

Figure 3.3 Size structure of zooplankton in samples collected at Creinch and Cailness from 2001 to 2005.

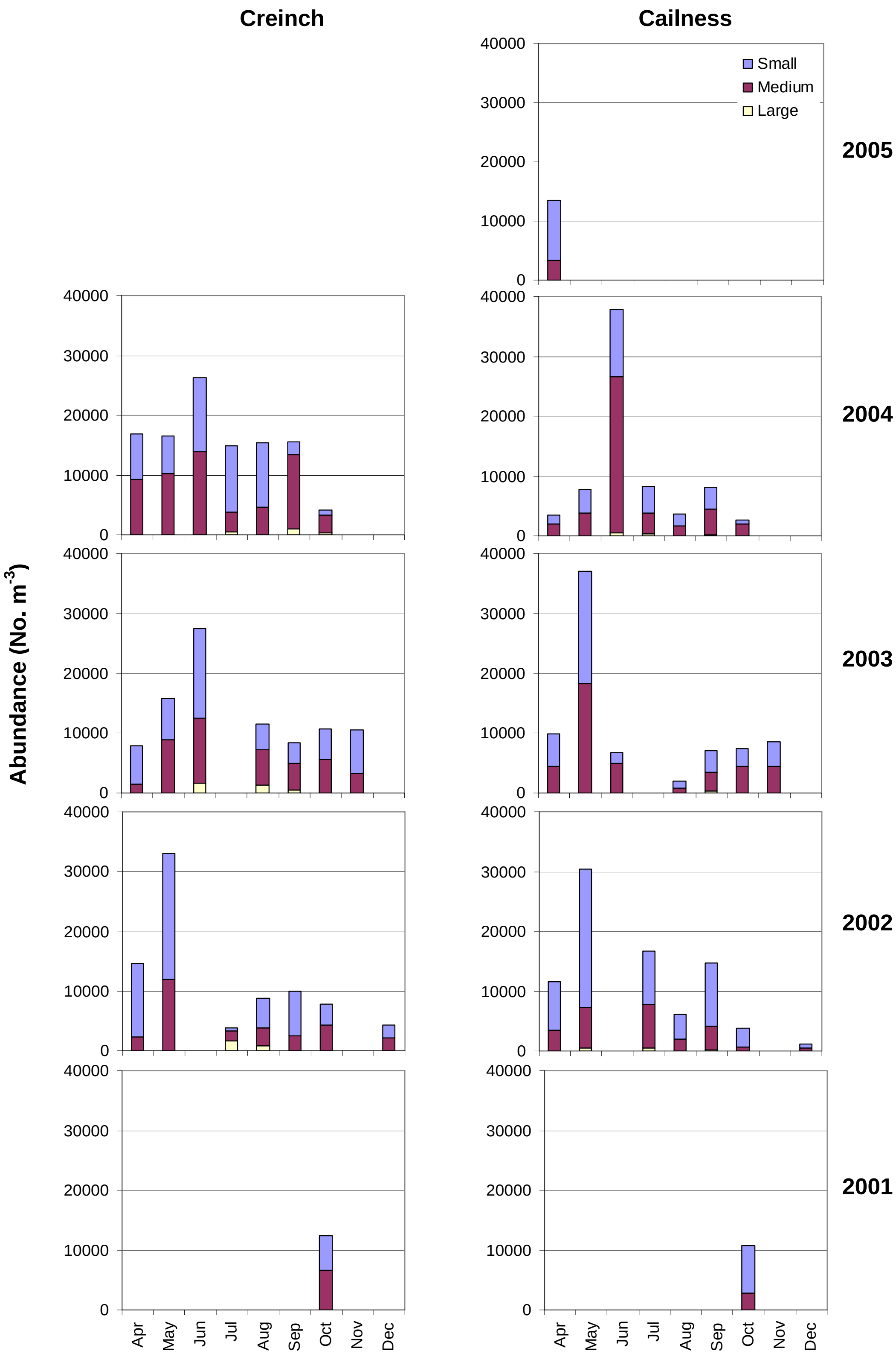

Figure 3.4 Size structure of zooplankton in samples collected at Creinch and Cailness from 2001 to 2005, excluding nauplii and rotifers.

In addition to the large predatory zooplankton observed above, large copepods (mostly cyclopoid copepods however one large calanoid copepod was also found) and large *Daphnia hyalina* individuals were present. Large copepods and *Daphnia hyalina* were present in low abundance; however, they were slightly more abundant at Creinch than at Cailness (Figure 3.5 and Figure 3.6).

Among calanoida, medium sized calanoid copepods appear to have increased in abundance from 2001 to 2005 at both Creinch and Cailness. Small calanoid copepod abundance remained relatively stable throughout these years (aside from seasonal effects) while it seems to have decreased at Cailness (Figure 3.5). Small cyclopoids attained higher abundances at Creinch than at Cailness. Copepod identification to genus was only possible on one small sized specimen, a species of *Diaptomus* which was present in the sample collected at Creinch on 23/04/2002.

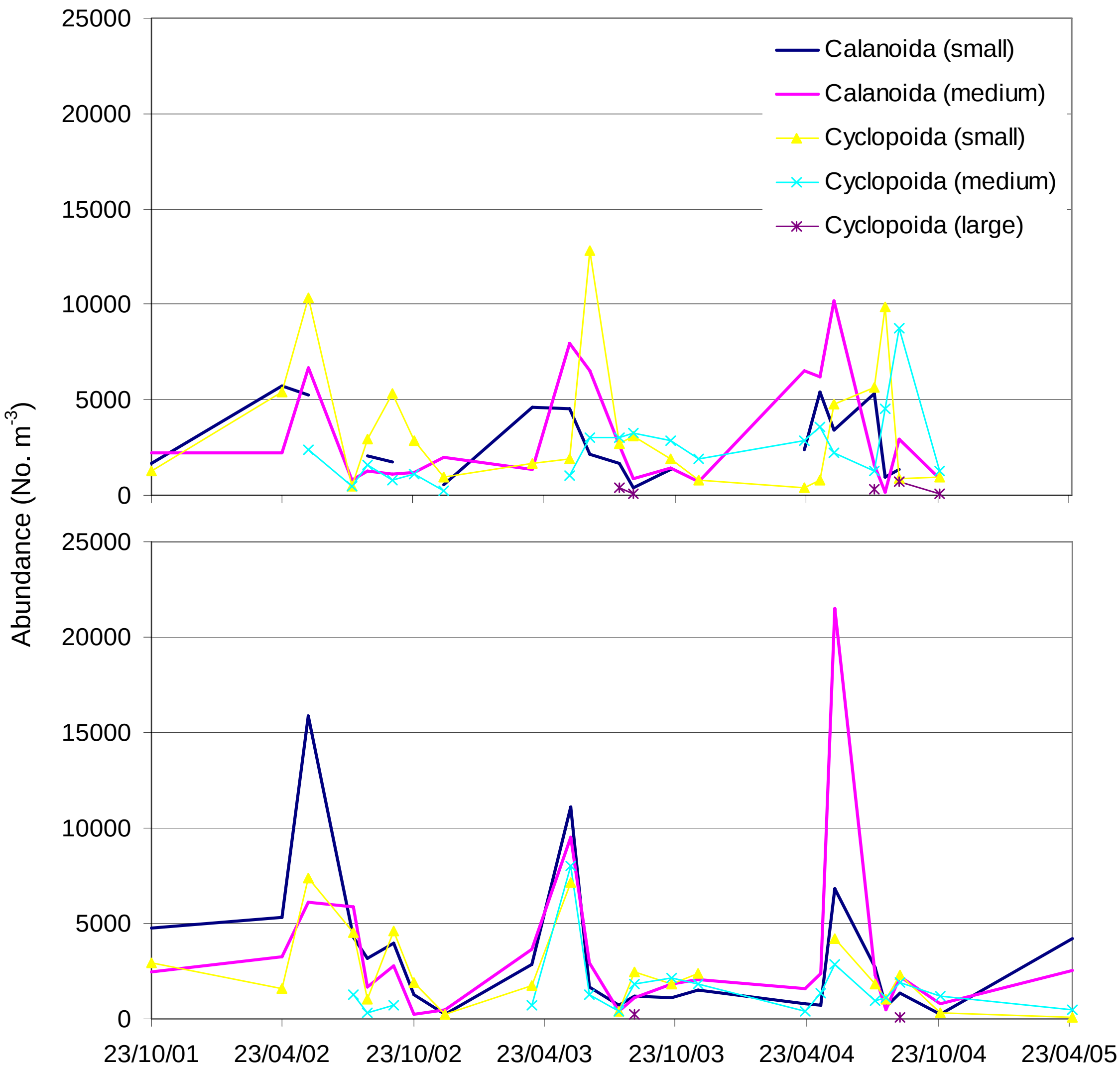

Figure 3.5 Copepod size structure from 2001 to 2005 at Creinch (top) and Cailness (bottom).

Most of the *Daphnia hyalina* found were medium sized at both Creinch and Cailness (Figure 3.6). *Bosmina coregoni* var *obtusirostris* (small) attained greater abundances at Creinch than at Cailness, and was far more abundant than *D. hyalina* at times in samples collected at Creinch. In samples collected at Cailness, small *Bosmina coregoni* var *obtusirostris* were present at abundances similar to *D. hyalina* throughout all the samples analysed (Figure 3.6).

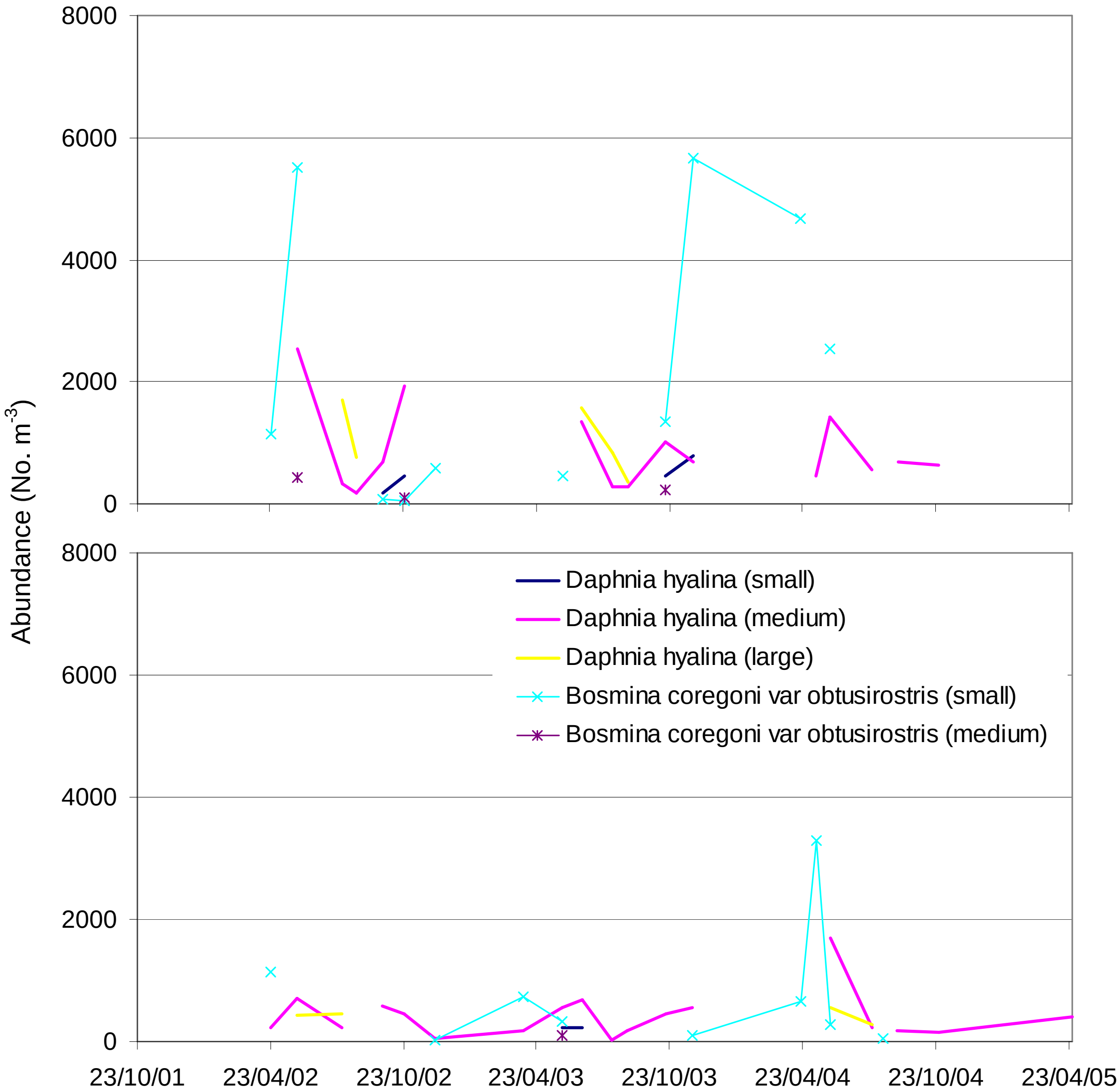

Figure 3.6 *Daphnia hyalina* and *Bosmina coregoni* var *obtusirostris* size structure from 2001 to 2005 at Creinch (top) and Cailness (bottom).

3.2 *Species Composition and Possible Predatory Impacts*

The copepod population dynamics for 2002, 2003 and 2004 are illustrated in Figure 3.7. Copepods as a whole and nauplii attained higher maximum abundances at Cailness than at Creinch (with the exception of nauplii in 2002, which attained similar spring maxima at both Creinch and Cailness). Calanoid copepods were more common among the samples analysed at Cailness than cyclopoid copepods. Abundances of both cyclopoid and calanoid copepods at Creinch were more similar to each other than they were at Cailness, however maxima of each group occurred at different times of the year in 2003 and 2004 (see Figure 3.7).

Daphnia hyalina and *Bosmina coregoni* var *obtusirostris* were by far the most commonly occurring cladocerans among the samples analysed from Loch Lomond (Figure 3.8). Aside from the predatory cladocerans *B. longimanus* and *L. kindtii* mentioned previously, the herbivourous cladocerans *Bosmina coregoni* var *longirostris*, *Chydorus* sp. and *Daphnia longispina* were also encountered in the samples analysed. *Bosmina coregoni* var *longirostris* was found in April 2003 at Creinch, and in April 2005 at Cailness (at a relatively high abundance of 5,829 individuals m^{-3}). A single *Chydorus* sp. was found on one occasion on 24/09/2002 at Creinch, and *Daphnia longispina* was found at Cailness on 23/10/2001. These three species were not plotted on Figure 3.8 due to the sparsity with which they were encountered in samples.

Rotifer genera identified from the samples collected in Loch Lomond included *Asplanchna*, *Branchionus*, *Kellicotia* and one instance in which *Keratella* was encountered (on 20/08/2002 at Creinch). Speciation of rotifers requires that they be narcotised prior to preservation and the specialist examination of jaw parts. Hence, rotifers were identified to the level of genus and numerous individuals remained unidentified. Rotifers as a whole were plotted in Figure 3.9 due to the relative paucity of species data obtained.

The population dynamics of the predatory cladocerans *B. longimanus* and *L. kindtii* are plotted along with copepods, herbivorous cladocerans and the rotifers in Figure 3.7 to Figure 3.9 in order to illustrate possible predatory impacts of these two species on the zooplankton population of Loch Lomond. In each of the figures, it appears as though depressions in copepod, herbivorous cladoceran and rotifer populations coincide with the population maxima of either or both of these predators. There are four instances in which the population maxima of either *B. longimanus* or *L. kindtii* coincide with that of the remaining zooplankton groups, and these are on 10/08/2004 when cyclopoid copepod and *L. kindtii* maxima occurred; 31/05/2004 when a maximum of *B. longimanus* at Cailness coincided with maxima in *D. hyalina* and copepods; 25/06/2003 when *B. longimanus*, *D. hyalina* and cyclopoid copepods occurred at a maximum abundance at Creinch; and on 30/07/2002 when the maximum abundance of *B. longimanus* and rotifers was observed at Creinch. Aside from these exceptions, peaks in *L. kindtii* and *B. longimanus* all occurred either prior or preceding peaks in the other zooplankton groups (see Figure 3.7 to Figure 3.9).

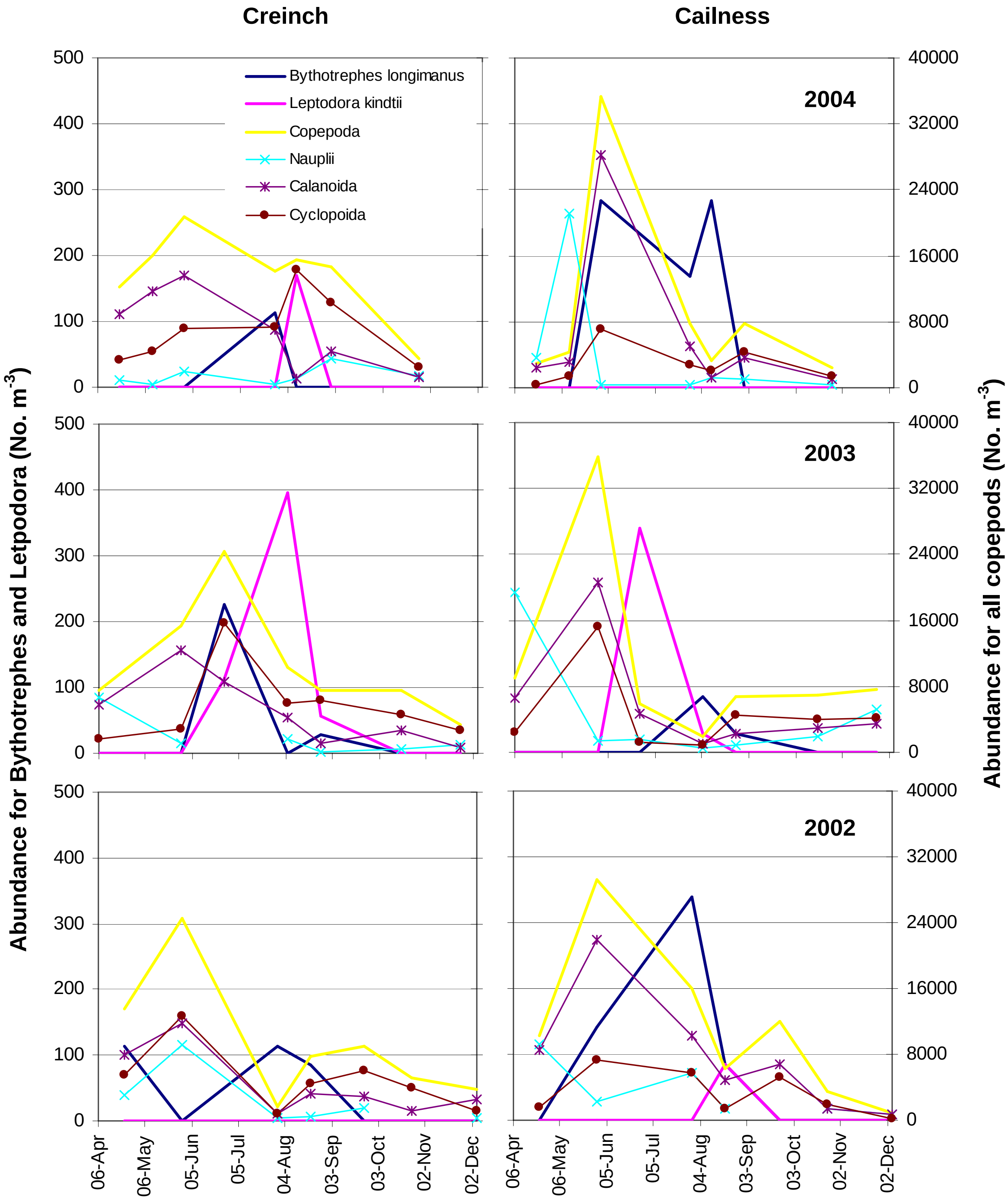

Figure 3.7 Population dynamics of copepoda within the samples collected from 2002 to 2004 at Creinch and Cailness in Loch Lomond. The population dynamics of the predatory cladocerans *B. longimanus* and *L. kindtii* are also plotted. (N.B. *B. longimanus* and *L. kindtii* are plotted on the primary y-axis and the remaining groups are plotted on the secondary y-axis).

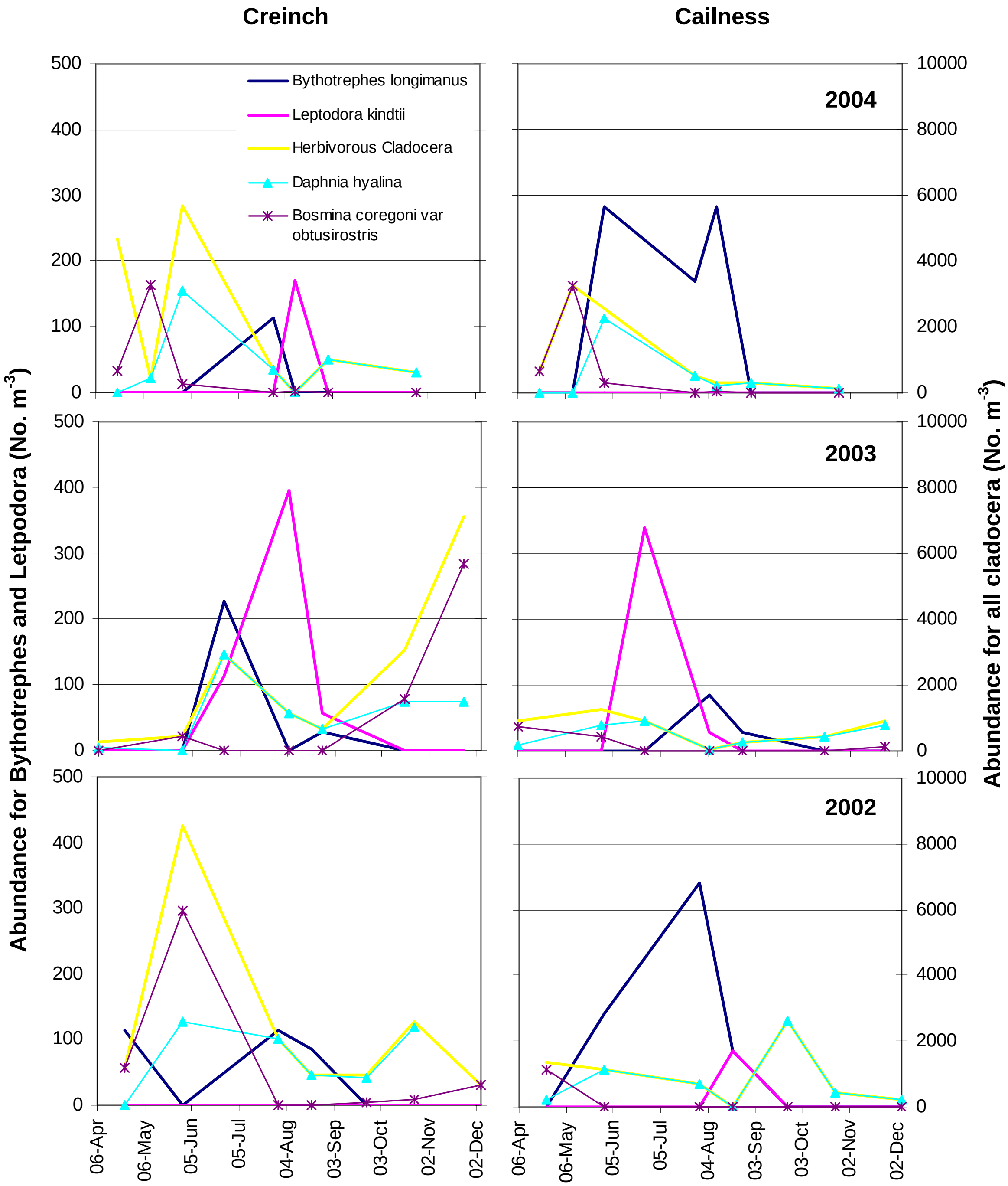

Figure 3.8 Population dynamics of cladocera present within the samples collected between 2002 and 2004 at Creinch and Cailness in Loch Lomond. A total of all herbivorous cladoceran species are plotted in addition. (N.B. *B. longimanus* and *L. kindtii* are plotted on the primary y-axis and the remaining groups are plotted on the secondary y-axis).

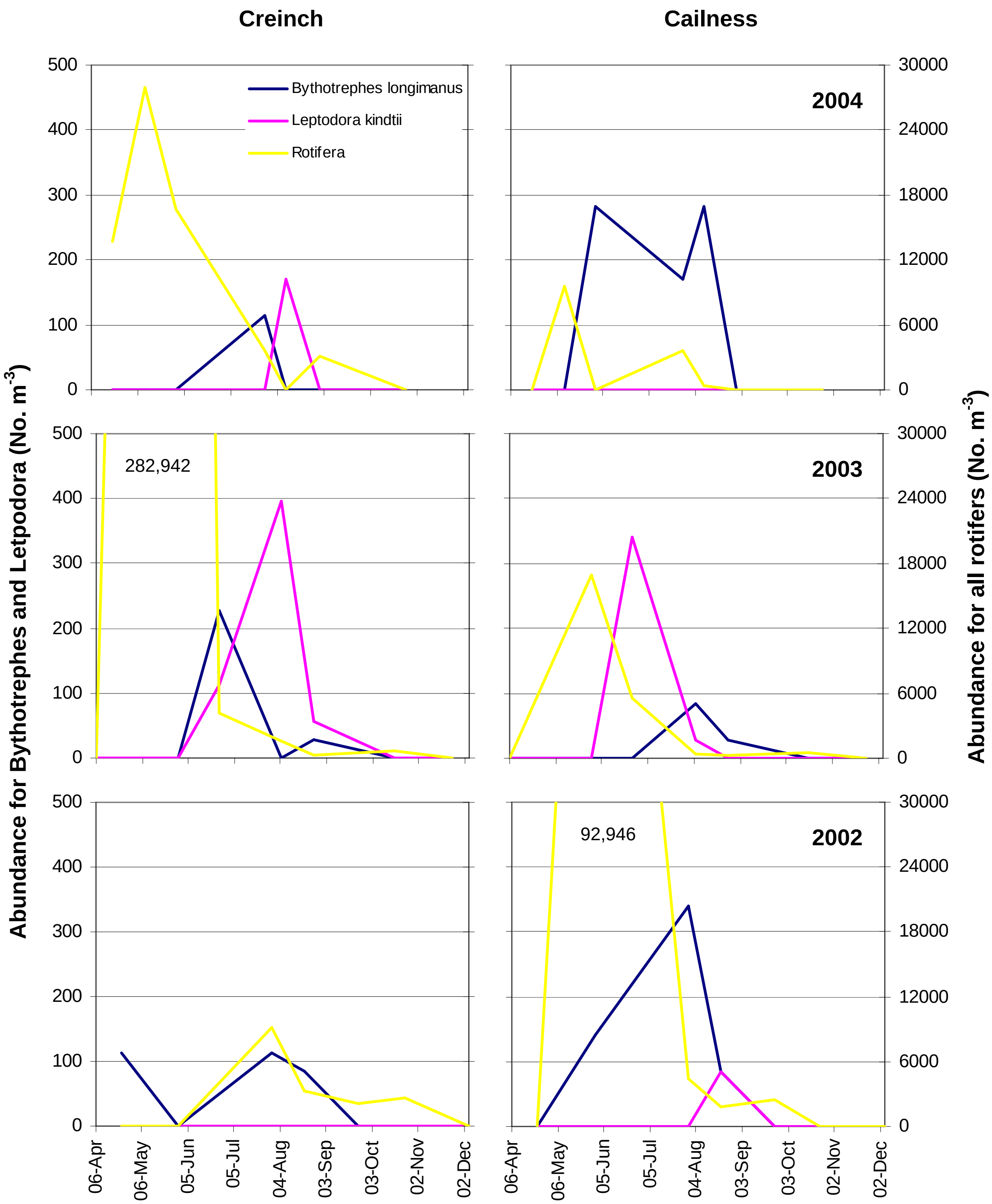

Figure 3.9 Population dynamics of rotifera present within the samples collected between 2002 and 2004 at Creinch and Cailness in Loch Lomond. (N.B. *B. longimanus* and *L. kindtii* are plotted on the primary y-axis and rotifers are plotted on the secondary y-axis).

4 DISCUSSION

The zooplankton species found in the samples analysed have been found previously in Loch Lomond by other researchers (Pomeroy, 1994). It has also been found that *Daphnia hyalina* and *Bosmina coregoni* var *obtusirostris* are the principle phytoplankton grazing cladocerans in Loch Lomond (Pomeroy, 1994).

Zooplankton abundance is dependent on temperature, food resources and predation pressure. Water temperatures within the top 5 m did not vary greatly between Creinch and Cailness according to the work conducted in 2002 by May and O'Hare (2005), and maximum and minimum surface water temperature appears to have been no more than 2 degrees Celsius different between Creinch and Cailness from 2001 to 2005 (Krokowski, 2007). Mean total Phosphorous and Chlorophyll *a* concentrations at Creinch and Cailness were not greatly different in 2002, with the mean of each parameter at Cailness falling within 1 standard error of the mean at Creinch (May and O'Hare, 2005). According to Krokowski (2007), however, phytoplankton abundance at Creinch was generally double that at Cailness, and population peaks occurred approximately a month earlier at Creinch. Krokowski (2007) found no discernable pattern in variation of green algae abundance between the two sites, however, did find that total diatom abundance was highest in the southern basin, with relative abundance increasing over the scope of the data set (which encompassed the period from March 1994 to August 2005). Likewise, desmid abundances were higher in the summer basin, as were cyanobacteria abundances.

All the species of cladocera found aside from the predatory *L. kindtii* and *B. longimanus* were herbivorous. They feed by filtering particles such as algae out of the water column, and the size of the particle grazed is limited by the morphological structure of the filtering apparatus in addition to chemical factors within the water column which affect the filtering rate in cladocera. Large or unpalatable algae species such as certain cyanobacteria can reduce the filtering rate in cladocerans (Porter, 1973 in Wetzel, 2001).

Cyclopoid copepods comprised both herbivorous and predatory species. They feed by randomly encountering food items and seizing them with their mouth parts (Wetzel, 2001). Carnivorous cyclopoids tend to be larger than herbivorous ones. Calanoid copepods move in such a way as to create currents which bring food particles to their mouth parts, and these are specially modified to remove the water.

Feeding in cladocera and copepods has been shown to be selective, and differences in the phytoplankton community between Creinch and Cailness may have contributed to the differences observed in the abundance of these zooplankters. It is difficult to draw conclusions without information on the quality of phytoplankton present as food (i.e. without phytoplankton species information), however, certain green algae species and diatoms are selectively ingested by herbivorous zooplantkon.

Predation by either fish or predatory zooplankton may be responsible for the size structure seen in Loch Lomond. *Bythotrephes* has been shown to dramatically affect the size structure of zooplankton in Harp Lake (Ontario, Canada) where it is an invasive species (Yan and Pawson, 1997). It was found that *Bythotrephes cederstroemi* selectively preyed upon small zooplankton species (recent genetic data suggest that *B. longimanus* and *B. cederstroemi* are the same species; Therriault *et al*., 2002). There is some evidence in Figures 3.7 to 3.9 that *L. kindtii* and *B. longimanus* may be responsible for depressions in copepod, cladoceran and perhaps rotifer abundance, however size structuring such that numbers of small zooplankton decreased was not readily evident (Figure 3.4). Medium zooplankton declined in numbers in 2004 during maximum *B. longimanus* and *L. kindtii* numbers at Creinch, and both medium and small zooplankton declined at Cailness (where incidentally, *B. longimanus* reached higher abundances). In 2002 and 2003 both small and medium zooplankton decline in abundance toward summer and autumn. Predaceous zooplankton may prey upon the medium sized zooplankton, however declines in these species may also be due to fish predation.

Chaoborids also prey upon zooplankton; however, Chaoborids have been known to migrate into the water column at night to avoid predation by fish. As the samples analysed were collected during the day, the abundances obtained for Chaoboridae may not give a clear indication of their true numbers.

The powan consumes zooplankton as the main part of its diet between May and October (Pomeroy, 1994). Pomeroy (1994) showed that powan selectively ingest large cladoceran species and *Chaoborus*. Based on these findings it is likely that predation by powan is responsible for the low abundances of large sized zooplankton in the samples analysed. Powan do consume both *B. longimanus* and *L. kindtii* in Loch Lomond (Pomeroy, 1994) and they may have been responsible for maintaining these species at relatively low abundances and possible minimising their predatory impact small sized zooplankton.

Rotifers are often present in large numbers in freshwater lake systems. These species must be sampled using a small mesh size (Likens and Gilbert, 1970); a mesh size of approximately 40 µm is often used, however depending on the species expected smaller mesh sizes can be used. It is therefore difficult to comment on the variation in rotifer abundance observed as biases in the sampling method used may be present, however, the data collected is useful in making qualitative determinations of the species of rotifera present within Loch Lomond.

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APPENDIX – ABUNDANCE DATA

N.B. Blue numbers indicate estimates, as individuals were too numerous to count on these dates. This applies only to rotifers and only on three dates.

Date	Site	*Bythotrephes longimanus* (small)	*Bythotrephes longimanus* (large)	*Leptodora kindtii* (medium)	*Leptodora kindtii* (large)	*Bosmina coregoni* var *longirostris* (small)	*Bosmina coregoni* var *longirostris* (medium)	*Bosmina coregoni* var *obtusirostris* (small)	*Bosmina coregoni* var *obtusirostris* (medium)	*Chydorus* sp. (small)	*Daphnia hyalina* (small)	*Daphnia hyalina* (medium)	*Daphnia hyalina* (large)	*Daphnia longispina* (medium)	*Diaptomus* sp. (small)	Calanoida (small)	Calanoida (medium)	Calanoida (large)	Cyclopoida (small)	Cyclopoida (medium)	Cyclopoida (large)	nauplii	unidentified Rotifera	*Asplanchna* sp.	*Branchionus* sp.	*Kellicotia* sp.	*Keratella* sp.	Chaoboridae (small)	Chaoboridae (large)
23/10/01	Creinch										2829	4301				1698	2264		1245			2150							
23/04/02	Creinch		113					1132							113	5772	2264		5432			3169							
30/05/02	Creinch							5517	424			2546				5234	6649		10327	2405		9337							
30/07/02	Creinch		113									340	1698				792		453	453		340		1924		7243			
20/08/02	Creinch		85									170	764			2037	1273		2971	1613		594			1783	1188	340		
24/09/02	Creinch							85		85	170	679				1783	1103		5348	764		1528		2122					
24/10/02	Creinch							57	113		453	1924					1188		2886	1132			2603						
05/12/02	Creinch							594								594	1981		934	255		424							
06/04/03	Creinch					85	85					85				4584	1358		1698			6706							
29/05/03	Creinch							453								4527	7922		1924	1019		1132	282942						
25/06/03	Creinch		226		113							1358	1584			2150	6564		12789	3056						4188			
05/08/03	Creinch				396							283	849			1641	2660		2716	2999	396	1698				1528			
26/08/03	Creinch		28		57							283	368			424	877		3084	3254	85	113			255				
17/10/03	Creinch							1358	226		453	1019				1358	1471		1924	2829		453			679				
24/11/03	Creinch							5659			792	679					679		792	1924		1019							
20/04/04	Creinch							4669								2405	6508		424	2829		849	13723						
11/05/04	Creinch											453				5432	6225		792	3622		340	27955						
31/05/04	Creinch							2546			1698	1415				3395	10186		4810	2264		1981			13581	3112			
27/07/04	Creinch	113										566	113			5319	1584		5659	1245	340	340			3622				
10/08/04	Creinch			85	85											934	170		9846	4499		1103							
31/08/04	Creinch											679	340			1358	2971		849	8743	679	3565		509	1103	1443			
26/10/04	Creinch											622					905	283	962	1302	113	1415							
23/10/01	Cailness										226			340		4753	2490		2943			566		226					
23/04/02	Cailness							1132				226				5319	3282		1584			9281							
30/05/02	Cailness		141									707	424			15845	6083		7356			2264			84883	8064			
30/07/02	Cailness		340									226	453			4301	5885		4527	1245		5772		679		3735			
20/08/02	Cailness		85	85												3141	1698		1019	340		1443		255		1528			85
24/09/02	Cailness										1952	594	85			3989	2801		4584	679			2462						
24/10/02	Cailness											453				1245	226		1924			1471							
05/12/02	Cailness							14			156	57				212	453		255			764							
06/04/03	Cailness							736				170				2886	3622		1754	679		19410							
29/05/03	Cailness							340	113		226	566				11091	9507		7130	8036		1358	16977						
25/06/03	Cailness				340						226	679				1698	2943			1245		1584	5546						
05/08/03	Cailness		85		28							28				707	396		368	424		481		340					28
26/08/03	Cailness		28									170	85			1188	1075		2433	1839	255	905		311					
17/10/03	Cailness											453				1132	1811		1811	2150		1924		453					
24/11/03	Cailness							113			226	566				1471	2037		2377	1811		5206							
20/04/04	Cailness							651								821	1613			424		3622							
11/05/04	Cailness							3282								679	2377			1358		21164	9507						
31/05/04	Cailness		283					283				1698	566			6791	21504		4244	2829		283							
27/07/04	Cailness	170										226	283			2716	2320		1811	962		283	1302	1415		962		57	57
10/08/04	Cailness		283					57			226					622	509		1019	1132		1245		396				113	
31/08/04	Cailness											170	113			1358	2207		2264	1867	113	1075							
26/10/04	Cailness											141				226	764		283	1160		424							
27/04/05	Cailness					5829						396				4188	2546		113	453		3735	3282						
Instances encountered		**2**	**12**	**2**	**6**	**2**	**1**	**19**	**4**	**1**	**13**	**35**	**14**	**1**	**1**	**41**	**45**	**1**	**42**	**37**	**7**	**42**	**10**	**11**	**7**	**10**	**1**	**2**	**3**