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Roinn na Mara

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ASPECTS OF THE LIMNOLOGY OF LOUGH GUR, CO. LIMERICK

by

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ABSTRACT

A survey of Lough Gur, a 76 ha lowland lake in Co. Limerick, was carried out between December 1988 and October 1989. The lake is a hardwater, eutrophic system with consistently elevated levels of total phosphorus. Large algal crops were produced in spring, dominated by the diatom *Asterionella formosa* Hass. and in the autumn, dominated by *Chlamydomonas* - type biflagellates. A large crop of the floating macrophyte, *Ceratophyllum demersum* L., persisted throughout the year. *Asellus* and Chironomid larvae were the principal invertbrates recorded. The fish stock was dominated by rudd, *Scardinius erythrophthalmus* L. In addition pike, *Esox lucius* L. and eel, *Anguilla anguilla* (L.) were encountered.

INTRODUCTION

Lough Gur is a lake of 76 ha surface area in the lowlands of County Limerick. Successive human settlements have occurred in the surroundings of the lake throughout pre-historic and historically recorded time as evidenced in the rich archaeological remains uncovered or extant. These include crannógs (lake dwellings), standing stones, "giants' graves", numerous stone circles, the lines of ancient roads, causeways and castles (O'Kelly and O'Kelly 1978, Ordnance Survey 6" Sheet No. 32 of Limerick 1927).

The lake (Fig. 1) has been purchased by Limerick Co. Council and a visitor centre detailing the pre-history of the area has been constructed close to the shore. In addition, the site lies in a scenic location with attractive walks and hill climbs. Much of the area has been designated as a wildlife sanctuary.

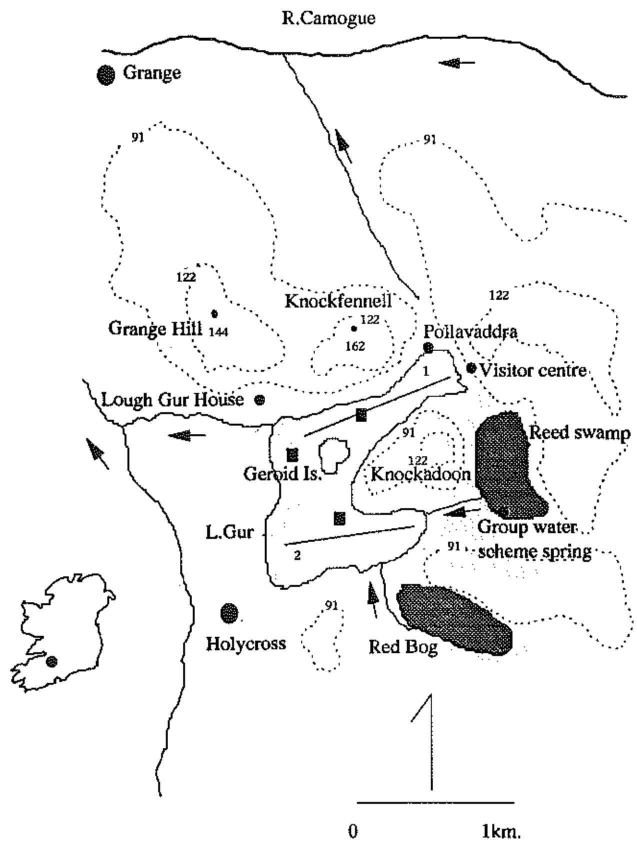

Figure 1. Lough Gur and surface features of catchment. Dotted lines indicate surface contours (m); ■ = location of gill net sets. Lines 1 and 2 indicate transects of depth soundings.

The level of the lake was lowered in the 19th century by the construction of a channel running west near Lough Gur House and opening to a series of drains and channels which discharge to the R. Camogue. The opening of this channel lowered the surface level of the lake and may have been designed to drain the reed-swamp area immediately to the east. This area may have been part of an earlier, larger L. Gur (see Praeger 1900). O'Kelly and O'Kelly (1978) refer to a map of 1687 showing the lake completely surrounding the hill of Knockadoon, embracing the current lake and reed-swamp zone. The presence of a causeway between the two areas would also support the idea of their having been joined by a more substantial band of water than the current small drain. No drainage works in the 20th century in the catchment have impacted on the water levels in L. Gur. Channels draining from the lake were specifically excluded by the Office of Public Works from the Maigue Catchment Drainage Scheme (1973-1986).

Since the visit of Praeger (1900), the flora around the lake shore and in adjoining reed-swamp and bog areas has been examined on several occasions and extensive species lists compiled (Curtis and McGeogh 1978, S. Reynolds unpublished data, T. Harrington unpublished data). The submerged flora of the lake was examined in specific locations in 1977 (Heuff 1984). The first Irish record of the flatworm *Bdellocephala punctata* (Pallas) was reported from L. Gur (McCarthy 1973) and appears to be confined to this locality (McCarthy pers. comm.). A fish stock survey was carried out by the Inland Fisheries Trust (precursor of Central Fisheries Board) on the lake in March 1978 (IFT unpublished data).

In 1988 the Central Fisheries Board (CFB) was commissioned by Shannon Development (SFADCO) to carry out a survey of Lough Gur, with particular regard to its leisure fishery potential. This paper presents data on the lake's bathymetry, water chemistry, flora and fauna with particular reference to that component of the fish stock accessible to gill-net sampling.

STUDY SITE

The lake has a horse-shoe shape and is separated into two parts by Geroid Island (Fig. 1). It lies within the catchment of the R. Camogue which drains to the R. Maigue. The lake itself has a small catchment (538 ha.) with two small inflowing streams. The original outflow, which still discharges, is by way of a swallow hole, Pollavaddra, at the north eastern end of the lake. This subterranean discharge emerges to the north of Knockfennel (O'Kelly and O'Kelly 1978).

A summary of the major physical features of L. Gur is presented in Table 1. The surface of the lake is 61m above sea level. It is surrounded by hills to north, west and east. The highest of these is Knockfennel, rising to 154m (Fig. 1). The high ground rises from the shoreline as grassy slopes with limestone outcrops.

The surface catchment of the lake lies entirely on limestone. The principal soil association in the catchment is composed of minimal grey-brown podzolics (70%), gleys (20%) and brown earths (10%) (Gardiner and Radford 1980). The soils of this association are deep and free-draining with good moisture holding capacity and support excellent grassland. Grazing of sheep is carried out on the high ground surrounding the lake.

METHODS

Survey work was carried out between December 1988 and October 1989. Water samples were collected on eight occasions in that period. Initially, sampling in the lake was carried out at a number of open-water stations. This was reduced to two open-water, mid-basin sites, one to the north-east and one to the south of Geroid Island, after initial results indicated a well-mixed water body. Water clarity, as Secchi Disc reading, was measured at each sampling site. As part of the lake sampling programme, the main surface water inflows and outflows were sampled when they carried flowing water. Samples from lake and flowing water were analysed for a range of conservative characters and nutrients (see Tables 2 and 3).

Phytoplankton crop size and composition were monitored by measuring the chlorophyll content in known volumes of samples and by estimation of biomass (assuming unit density of cells, after Bostrom and Pettersson 1977) from quantitative phytoplankton lists compiled from selected open water stations. Composite water column samples were obtained (after Lund, Kipling and Le Cren, 1958) and phytoplankton estimation followed the method of Edmondson (1969). The phytoplankton analysis was usually carried out on water from the northern part of the lake. On two occasions the material from the southern end was used.

The lake was surveyed in detail by boat over a five-day period in June 1989 when bathymetry, flora, invertebrate fauna and fish stock were examined. A graduated plumb line was used to record water depth along two specific transects, one across the south side of the lake and one along the long axis of the northern part of the lake.

The emergent, floating leaved and submerged macrophytes in the lake were examined and the principal species identified. An Eckman grab was used to collect samples of lake sediment. A qualitative examination of the principal invertebrate groupings in both sediment and vegetation samples was carried out.

A fish stock survey was carried out using standard gill net sets in randomly pre-selected areas of the lake following the method of O'Grady (1981). This involved fishing with sets of nets, each 210m in length, each set containing seven panels of equal length, each panel being of a specific mesh size increasing by 1.25cm increment from 5 to 12.75cm. A sheet of 17.75cm mesh size was also attached to each net gang to enable the capture of deep-bodied cyprinids of large size (>1kg) if such were present. Three sets of nets were fished for one twenty-four hour period.

RESULTS

Lake bathymetry

The depth soundings taken on 28 June 1989 along specific transects showed the lake to be a shallow water body with maximum depth of 3.75m in the northern basin and 2.1m in the southern basin. Results from 55 soundings taken along transect 1 (Fig. 1) showed an extensive area of uniform depth (1.5m) between Geroid Island and Lough Gur House. Along the northern axis of the lake, the bed sloped gradually to a maximum depth of 3.75m before rising gradually to 1.25m close to the visitor centre on the north shore. The southern basin (transect 2) was more shallow. A total of 21 soundings were taken. Depth ranged from 1.5m to 2.1m.

The depth sounding results indicated that the entire lake bed was a shallow littoral zone, more than 90% being shallower than 3m. An estimated value of 1.5m for mean depth was extrapolated from the maximum recorded depth of 3.75m, from the extent of lake bed deeper than 1m and from the range of depth readings taken in both transects. This mean was used to calculate lake volume. (The value obtained was similar to that of Layden (1993) compiled using a detailed bathymetric map and AUTOCAD computer software). The shoreline development attribute, a ratio of the length of shoreline to the length of the circumference of a circle of equal area to that of the lake (Hutchinson 1957), had a value of 1.72. This is a low value reflecting a limited degree of indentation and bay formation along the lake perimeter.

Water chemistry, and physical measurements

Lake Samples: Water chemistry data were compiled over the period December 1988 to October 1989 for both basins. Results were very similar from both sampling stations for all variables measured and the results from the northern basin, only, are presented in Table 2. The pH values recorded over the study period all lay within the narrow range of 8.0 - 8.2 Values of the three conservative characters conductivity, alkalinity and total hardness showed a trend of rising values in winter with a February maximum. All three showed a subsequent fall in value through the spring and summer with minimum values recorded in October.

Of the two forms of phosphorus measured, total phosphorus (TP) remained high, without major fluctuations, throughout the study period. The level of biologically available phosphorus (MRP) fluctuated during the December-October period. The fall in levels recorded in the February-March period was related to the dramatic chlorophyll peak and algal crop recorded in March. The level of MRP fell even further in the late June and October sampling periods when high chlorophyll levels, an indication of algal crop size, were recorded.

Total nitrogen is a measure of bound forms of N along with the more labile ammonia. Levels showed a decline in the February-June period but the levels recorded in October had returned to those recorded the previous December and January. The soluble nitrite and nitrate forms of nitrogen are readily assimilable by phytoplankton. Concentrations rose over the winter period but fell dramatically to trace level during the spring algal peak in March. Similar trace levels were recorded in May. With surface inflows dried up or stagnant, no surface water supply of nitrate was available to replenish the depleted levels in the lakes. These showed a slight increase in the June - October period but were, at that time, very significantly lower than the winter levels. Some degree of recycling from algal decomposition may have occurred in the May - October period after the spring algal peak.

Water clarity, as Secchi Disc reading, fluctuated widely, considering the very shallow nature of the lake. The lowest reading, 0.75m was recorded during the spring diatom peak. Temperature fluctuated slightly in the January-March period. A notable feature was the rapid warming in June with temperature rising from 14 to 18°C over a three-week period. Oxygen saturation levels remained high at all times with slight supersaturation recorded in late June.

Stream Sampling Programme: Sampling was carried out on the two inflowing channels and on the surface outflow when these channels contained flowing water. The inflow from Red Bog was dry subsequent to the March sampling while the inflow from the extensive reed swamp area had little flow and a heavy cover of *Lemna* sp. in June. Both inflowing channels had a low volume discharge on all sampling occasions. Values for conductivity, alkalinity and total hardness were higher in the Red Bog stream than in the reed swamp channel (Table 3). The nutrient regime was more notably different with values for both phosphorus forms being circa two-fold higher in the Red Bog stream. The MRP was a major component of the TP on both occasions. Levels of nitrite/nitrate were higher by a factor of twenty in this channel compared to the reed swamp outflow.

The similarity in results between the two groundwater samples from the spring supplying the local group water scheme, taken three months apart, suggest a very uniform chemical regime. Values for pH and conductivity were very similar to the springtime values recorded in the Red Bog inflow. Nitrite/nitrate levels were notably high and, again, of similar magnitude to the spring values from the Red Bog stream.

Comparison of the groundwater samples (Table 3) with the open lake samples (Table 2) of the same date indicate that total phosphorus levels were lower in the groundwater but that nitrite/nitrate levels were circa two orders of magnitude higher from this source.

The water chemistry of the outflow channel reflected that of the associated open water samples. No flow was recorded in the June-October period.

Phytoplankton

Pigment levels were low in the winter period but peaked dramatically in March (Table 2) with a large crop of the diatom *Asterionella*. Pigment levels had fallen sharply by May but high values were again recorded in late June and in October. The values obtained in the latter sampling varied widely between the northern and southern basins.

The algal crop showed a low species diversity over the sampling period. *Anabaena* was recorded in most months and together with *Aphanizomenon* in late June formed the entire crop in the sample examined (Table 4). *Asterionella* and large centric diatoms were the only true planktonic diatoms recorded. Given the shallow nature of the lake and the extensive in-lake macrophyte flora a greater presence of epiphytic and epipelic forms, such as *Gyrosigma*, might have been expected in the crop. Seven genera of green algae were recorded, always in small amounts except for the very large crop of small *Chlamydomonas*-type biflagellates recorded in October. This form, along with the large centric diatom, dominated the October crop and both were responsible for the high chlorophyll content (54 mg/m^3) in the sample examined. The small *Cryptomonas* was recorded from December 1988 to March 1989.

Macrophytes

The principal emergent, floating-leaved and submerged macrophytes recorded in L. Gur are listed in Table 5. The emergent vegetation formed large reed-swamp areas along much of the shoreline, composed of the tall *Schoenoplectus* and *Typha*, frequently with an understorey of *Equisetum*, *Hippuris* and *Menyanthes*. The lower growing plants frequently grew on the landward and lakeward sides of the tall plants. Particularly large stands of *Schoenoplectus* and *Typha* were developed along the southern shore of the lake.

The floating-leaved *Polygonum amphibium* L. was recorded in several locations in sheltered areas of the southern part of the lake fringing the lakeward side of *Schoenoplectus /Typha* stands.

The open-water flora was dominated by *Ceratophyllum*. Areas up to 1ha in extent had 100% cover of this plant with dense mats in some places caused by wind drift and accumulation. Apart from the very shallow area to the east of Geroid Island, *Ceratophyllum* was ubiquitous. Of the two *Potamogeton* species recorded *P. pectinatus* was by far the more common. It was most prominent in the open water fronting Lough Gur House and in the southern bay of the lake. The Potamogetons grew with and under the *Ceratophyllum* at many sites and occasionally grew in water free of the floating vegetation. Two species of *Chara* were recorded locally to the south and east of Geroid Island.

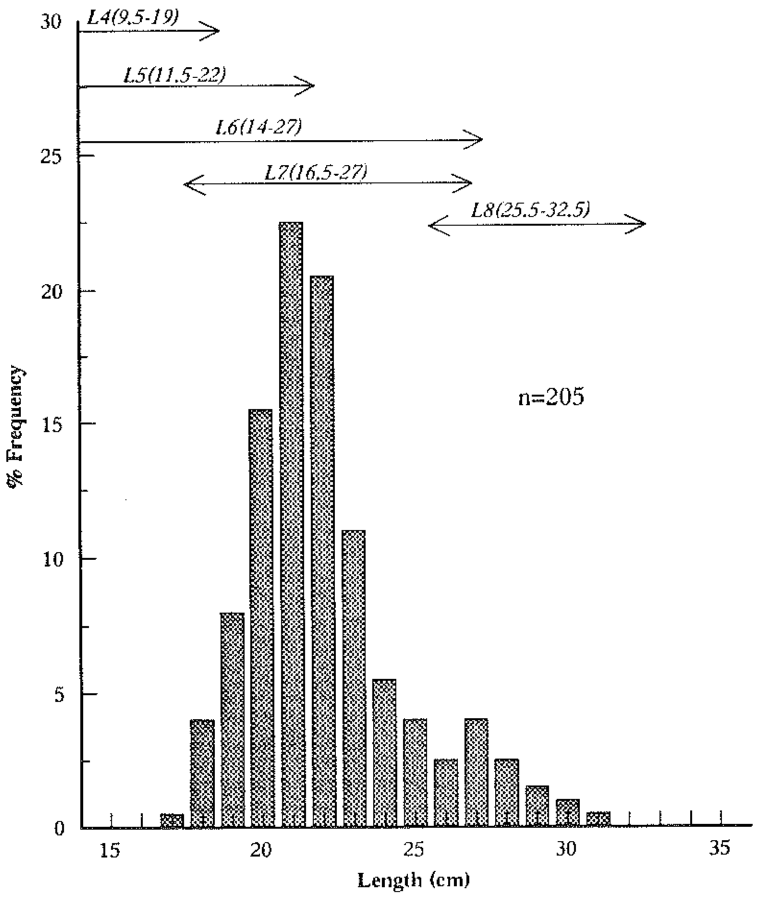

Figure 2. Length Frequency of rudd and range of length-at-age, June 1989.

Invertebrates

Samples of vegetation and dredge samples of bottom sediment were examined for invertebrates. Most samples did not contain large numbers of organisms. The fauna examined were not identified to species level.

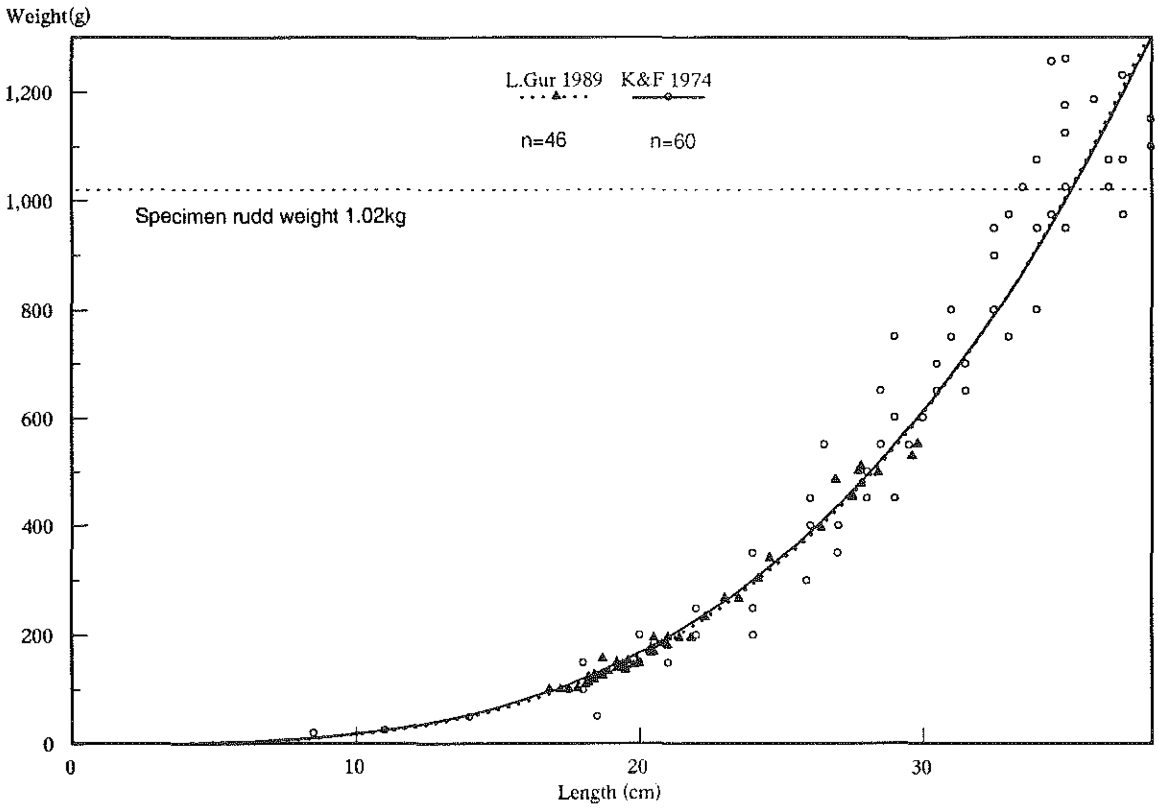

Figure 3. Fork length-weight relationship in rudd from L. Gur 1989, and from waters studied by Kennedy and Fitzmaurice (1974).

The principal items found were red chironomid larvae, the snail *Bithynia* and the water louse *Asellus*. Samples between Geroid Island and the lake outflow held large numbers of red and apple-green chironomid larvae. Samples in the shallow water east of the island produced trichopteran larvae (mostly Leptocerid spp.) in cases of fine sediment particles and good numbers of the water shrimp *Gammarus* under stones at the island. Sweep samples at the fringes of the reed-swamp vegetation were more productive and yielded planorbid snails, adult corixids, and large numbers of *Asellus*. Chironomids and *Bithynia* were also recorded here.

The lake bed consisted of soft, fine sediments of mud and marl with quantities of shell material. In sheltered areas close to the reed-swamp vegetation the sediment was much blacker in colour, possibly due to a high organic content derived from decomposed vegetation.

Fish Stocks

The fish samples were dominated by rudd (*Scardinius erythropthalamus* L.). A total of 804 rudd , 6 pike *Esox lucius* L. and 1 eel *Anguilla anguilla* L. were captured in the three sets of nets fished overnight on 26/27 June 1989. The sample of rudd captured was dominated by fish in the length range 20cm to 24cm. Scale analysis indicated that this dominant group was composed of three year-classes, 5, 6 and 7 year-old fish (Fig. 2). While the survey was in progress the authors noted substantial shoals of juvenile rudd which were too small to be retained in the gill nets. Many of the rudd examined had spawned and microscopic examination showed evidence of new growth on their scales. The length: weight relationship for rudd from L. Gur is presented in Fig. 3 in conjunction with the length: weight data of Kennedy and Fitzmaurice (1974) from all Irish waters examined by them. In neither case were the sexes separated. Data for mean growth rate of rudd from L. Gur (Fig. 4) were computed by back-calculation of length-at-age from 55 sets of scales.

The pike captured were extremely thin and in poor condition. Even allowing for the rigours of spawning in March-April, fish from other systems examined have normally recovered condition by June. The pike may have spawned late, possibly in late May or early June. The three female pike examined were 'spent' rather than displaying post-spawning recovery of gonadial tissue normal for pike at that time of year. Mean growth was computed (Fig. 5) from the limited set of scales available.

DISCUSSION

The chemistry of the springwater samples is considered to be representative of the groundwater chemistry regime underlying L. Gur due to the relatively wide area of aquifer from which the spring (group water supply) would be drawing (D. Daly pers. comm.). The high nitrate, low total phosphorus status of the groundwater is the direct opposite of the nutrient status in the open lake. This suggests, firstly, that groundwater is not contributing to the phosphorus-rich status of L. Gur and secondly, that groundwater may not contribute significantly to the volume of the water body. The limited

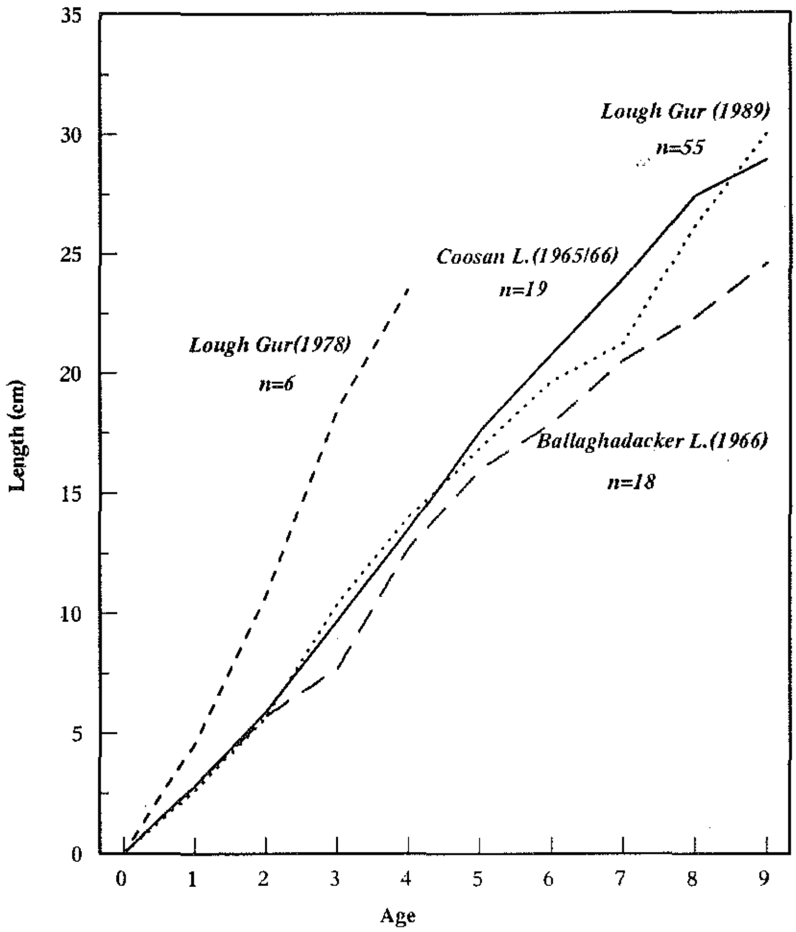

Figure 4. Calculated mean growth of rudd from L. Gur and from selected Irish waters (after Kennedy and Fitzmaurice 1974).

volume discharge to the lake and the high proportion of MRP in the in-lake total phosphorus levels may indicate that the lake is functioning as a concentration basin with continuous recycling of nutrient inputs and limited outputs for much of the year. Such internal loading is contributed to in shallow water sediments by mixing processes at the sediment - water interface in both oxic and anoxic conditions and by wind induced mixing in shallow lakes (Anon, 1982). A sequence of stratification onset and breakdown, in relation to oxygen, was recorded in the July-August period in Lough Gur (Layden 1993), leading to elevated phosphorus levels in water overlying the sediments. The frequency of onset and breakdown is related to atmospheric factors of alternating calm weather with windy conditions, characteristic of the changeable Irish climate. The impact of wind, in a shallow lake such as Lough Gur, may be modified by a stilling effect created by the dense macrophyte cover in the water column (Blindow 1992).

A wide range of variables has been used to assess the degree of enrichment or trophic status of a lake. The classification scheme devised by the OECD (Anon, 1982) incorporated data on total phosphorus, pigment levels and water clarity. That report counsels caution in the use of its loading formulae for prediction in shallow macrophyte-dominated lakes. However, simple comparison of the L. Gur data with the OECD categories (Table 6) shows the lake to be a highly eutrophic system. The 1982 data for L Sheelin, when that lake was at its most eutrophic (Champ 1993), show similarities in total phosphorus levels and water clarity (Table 6). Lough Sheelin was, however, hypereutrophic in relation to chlorophyll content. It would appear that, while elevated plankton levels do occur in L. Gur, much of the primary production is manifested in terms of macrophyte biomass. The assemblage of submerged macrophytes in L. Gur, composed primarily of *Ceratophyllum* and *Potamogeton pectinatus* is indicative of nutrient-enriched waters (Ozimek 1978). The severe contraction of the submerged *Chara*-dominated flora in Irish hard-water trout lakes, caused by nutrient enrichment and its impact in enhancing plankton production and depressing water clarity (John, Champ and Moore 1982), did not occur in L Gur. However, the poor status of *Chara* material collected in L Gur indicated that these plants were at a competitive disadvantage, possibly due to limited light penetration. *Chara delicatula* was notably more prominent in 1977 in L. Gur (Heuff 1984) than in the present study. Studies on L Krankesjon, of similar morphometry and water chemistry to L Gur, indicated initial colonisation by angiosperms, including *Ceratophyllum* and *Potamogeton pectinatus* after catastrophic events such as drying out and refilling of the lake or high water levels creating high turbidity or severe ice damage in low-water conditions (Blindow 1992). These were replaced by species of *Chara*, primarily *C. tomentosa* as water clarity improved. The charophyte expansion may have contributed further to enhanced water clarity. Blindow considered that charophytes have a competitive advantage over angiosperms in moderately eutrophic, wind-exposed marl-type lakes. The advantage may shift to the floating *Ceratophyllum* and *Potamogeton pectinatus*, with its trailing form reaching to the water surface, in conditions of long term moderate turbidity and water clarity, as recorded in L Gur. In the uniform shallow (>3m) limestone basin of lower L. Corrib the *Chara* meadows on the clear-water, west side are completely replaced by *Potamogeton pectinatus* in the enriched, frequently turbid waters of the east side (Krause and King 1994).

Rudd are known to favour relatively shallow well-vegetated water where they can feed on invertebrate and plant material. Such conditions are found on L. Gur. Rudd normally spawn in the June-July period in Ireland, laying their eggs on the leaves and stems of aquatic plants (Kennedy and Fitzmaurice, 1974). Observed spawnings and collections of ova or larvae by those authors indicate a spawning period extending from late May to mid-July. They recorded a temperature range of 17.2-26.6°C at rudd spawning sites. They also quoted spawning temperatures of 16° (minimum) in spring in France and 20.2°C in late June in Sweden. Daytime water temperature of 18°C was recorded in L. Gur in June during the netting survey, having risen from 14°C in early June (Table 2). A similar dramatic rise, from 11 to 19°C over a fourteen day period in May 1992 (Layden 1993), indicated the rapid response of the lake to rising air temperatures.

Kennedy and Fitzmaurice (op. cit.) considered Irish rudd to be slow-growing and long lived. They found that large rudd tended to occur in waters of high alkalinity and reasonable size (i.e. in lakes rather than ponds). Some of the largest rudd were recorded by these authors in L. Coosan which has very similar values for area and alkalinity (81 ha, 180mg/l $CaCo^3$) to those recorded for L. Gur (78 ha, 200mg/lCa/Co^3). Comparison of growth rates (Fig. 4) for L. Gur (1989) and Coosan Lake, a well known specimen rudd lake in the River Shannon catchment, indicated similar growth pattern and rate in each water. The very rapidly rising curve in Fig. 4 refers to rudd taken in L. Gur in 1978. Sample size was small on that occasion and the scales examined belonged to large fish only. Nevertheless, the growth rate was exceptionally fast and a rudd of specimen size was taken. The specimen weigh for angler caught rudd is set at 1.02kg (Anon 1991).

Based on the length: weight data compiled by Kennedy and Fitzmaurice (op. cit.), with which the current L. Gur data conform, the smallest Irish rudd to attain specimen weight was 32cm fork length. The majority of specimen fish were in the 34-38cm length range (Fig. 3). Fish from Coosan Lake would attain this length range at 11-13 years of age. The oldest rudd recorded in L. Gur in this study were eight years of age.

The small number of pike captured for the netting effort involved suggests the presence of a limited stock of this species despite the presence of a substantial food supply in the form of rudd. The surprisingly poor pike population may be a consequence of the exceptionally dense vegetation regime in the fishery which could, at times, limit the movements of larger pike. From the limited data available growth rate of the L. Gur pike was similar to that from other Irish limestone lakes (Fig. 5).

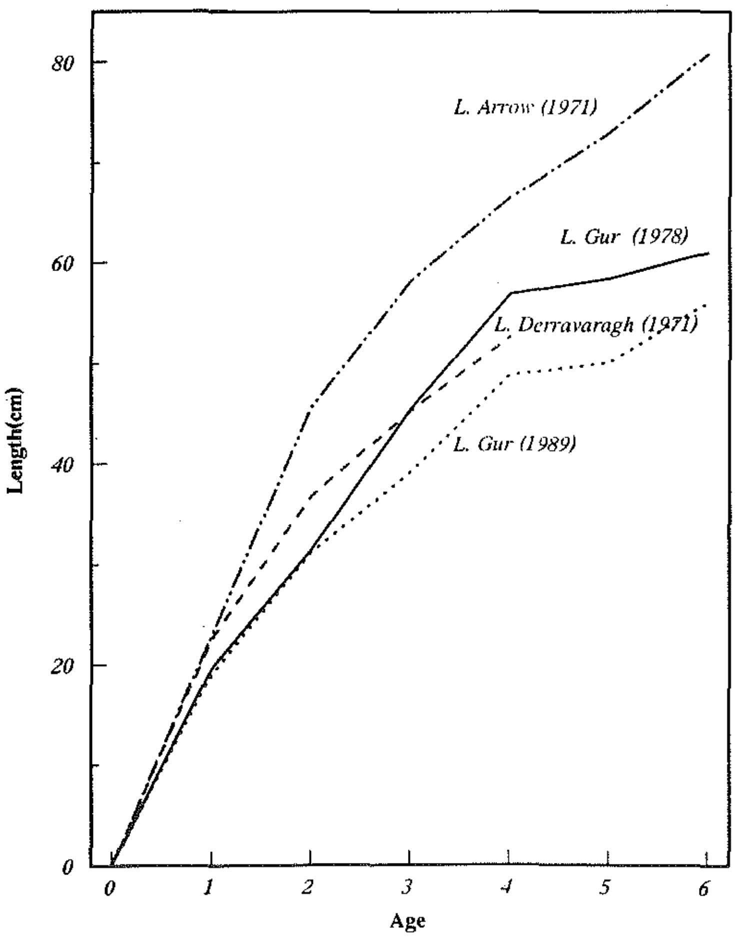

Figure 5. Calculated mean growth of pike from L. Gur and from selected Irish waters (after Bracken and Champ, 1971).

Direct comparison of fish stock results from the 1978 and 1989 surveys is not possible due to differences in time of year (March 1978 as against June 1989), differences in the net mesh composition in the sets used and a greater fishing effort (8 sets overnight in 1978 as against 3 in 1989) used. Length of set used was similar in each year. Bearing these constraints in mind dramatic differences in stock structures are suggested in a comparison of the results (Table 7). The 1978 survey yielded a total of 68 pike, as against 3 in 1989. A wide range of sizes was obtained with fish ranging from 1 year old to adults in excess of 4.5kg. The heaviest pike taken weighed 6.3kg. The heaviest pike taken in 1989 weighed less than 2kg. In contrast, 69 rudd were taken in 1978 compared to 801 in 1989. Several large rudd were taken in the former, including fish of 0.91kg and 1.01kg which would be close to the 'specimen weight' as set by the Irish Specimen Fish Committee. The heaviest rudd taken in 1989 weighed 0.55kg. Examination of the results of the two fish stock surveys suggest a shift in the predator-prey relationship of pike and rudd and also a shift in the population structure of the rudd. The 1 : 1 predator : prey ratio shown in 1978 would not be sustainable and should lead to a decline in stocks of both predator and prey until a balance was created. The 1 : 133 ratio shown in 1989 also indicates an imbalance with a small poorly-conditioned predator stock. Kennedy & Fitzmaurice (op.cit.) reported an inverse relationship between stock density and growth of rudd. An enriched system such as L. Gur with a large stock of forage fish (rudd) for predation should be capable of supporting a larger predator stock. Historically, the lake has produced large pike, with documented evidence of a 56lb (25kg) fish caught in 1909 and a 39 lb (18 kg) fish taken in 1898 (see Losinski 1987). Winter shore angling, a popular pursuit among local anglers, may function to a limited extent in maintaining a low pike stock. An enhanced pike stock might function in regulating the rudd, producing fewer but larger rudd to the rod. At present, the leisure angling potential of the rudd fishery is not exploited to any degree.

Lough Gur is unusual in possessing a large rudd stock, isolated from other cyprinid species. The eutrophic, macrophyte-dominated status of the lake is also rare in Ireland. The authors believe that a number of valuable limnological studies could be carried out on the lake. A more intensive monitoring programme, monthly for a two-year period, might elucidate the sources of nutrient enrichment and the fate of nutrients entering the system. Palaeolimnological coring of the bed would be of value in indicating the rate of sedimentation and might indicate the chronology of eutrophication onset.

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Table 1. Physical features of L.Gur and its catchment.

National Grid Reference.		R64 41
Volume m^3		$1.14*10^6$
Altitude m		616
Lake catchment area ha (exc. lake surface area)		538
Lake surface area ha		78
Shoreline length km		5.3
Shoreline development		1.72
Maximum length km		1.67
Maximum width km		0.93
Mean depth m (extrapolated)		1.5
Maximum depth recorded m		3.75
Proportion (%) of lake bed:	0-3m	>90
	3-3.75m	<10

Table 2: Summary physico-chemical data from L.Gur (mid-lake, north basin), December 1988-October 1989. Biologically-available phosphorus as MRP.

Date	1.12.88	9.1.89	6.2.89	29.3.89	18.5.89	8.6.89	27.6.89	2.10.89
pH	8.1	8	8	8.2	8.1	8.1	8.2	8.2
Conductivity (μS/cm 20C)	377	386	401	384	348	322	318	256
Alkalinity (mg/l $CaCo_3$)	180	190	210	190	190	180	150	125
Total Hardness (mg/l $CaCO_3$)	172	192	196	186	186	176	144	120
Colour (Hazen units)	12.5	5	17.5	20	25	25	25	25
Turbidity (mg/l SiO_2)	4	5.5	5.5	10	5.5	7	9.5	6
Total Phosphorus (mg/m^3 P)	76	53	45	57	57	87	97	50
M.R.P. (mg/m^3 P)	33	35	16	14	14	28	2	1
Total Nitrogen (mg/m^3 N)	1069	1120	663	712	526	678	891	1144
Nitrite + Nitrate (mg/m^3 N)	410	778	797	1	1	27	47	56
Chlorophyll (mg/m^3)	3.7	2.1	6.8	38.6	12.2	13.9	73.2	54.2
Secchi Disc (m)	2	3.2	1.8	0.75	N.A.	1	0.9	N.A.
Temperature (°C)	6	8	9	8	14	14	18	N.A.
% Oxygen saturation	85	92	85	95	95	95	105	N.A.

Table 3: Water chemistry data in 1989 for two streams discharging to L. Gur and for the spring supplying the local water scheme. No flowing water recorded after the dates shown. Biologically-available phosphous as MRP.

	Red Bog Stream		Stream from reed swamp area				Spring	
	6.2.89	29.3.89	6.2.89	29.3.89	18.5.89	8.6.89	29.6.89	2.10.89
pH	7.2	7.2	7.8	7.8	7.5	7.6	7	6.9
Conductivity (µS/cm 20°C)	715	755	528	475	437	447	645	644
Alkalinity (mg/l $CaCo_3$)	390	380	200	240	250	220	315	315
Total Hardness (mg/l $CaCO_3$)	428	432	292	244	248	224	332	328
Colour (Hazen units)	12.5	5	30	35	45	45	5	5
Turbidity (mg/l SiO_3)	7.0	2.5	6	7	8	22	2	4
Total Phosphorus (mg/m^3 P)	130	94	60	42	75	77	20	23
M.R.P. (mg/m^3 P)	93	91	34	5	20	3	99	16
Total Nitrogen (mg/m^3 N)	473	274	570	508	861	1255	77	140
Nitrite + Nitrate (mg/m^3 N)	6016	5133	375	288	258	188	4129	3775

Table 4: Percentage composition and total phytoplankton biomass from L. Gur, Dec. 1988 – Oct. 1989.

	1.12.88	9.1.89	6.2.89	29.3.89	18.5.89	8.6.89	27.6.89	2.10.89
MYXOPHYCEAE								
Anabaena cf. flos-aquae		17	14	1.1	23	71.8	9.9	
Aphanizomenon flos-aquae							90	
BACILLARIOPHYCEAE								
Asterionella formosa			37.5	93	66.9			
Centric diatoms 75µ								31.3
Pinnularia type						1.9		
Cymatopleura			2.5					
Pennate diatom			37.9					
Gyrosigma				5.6				
CHLOROPHYCEAE								
Ankistrodesmus						<1		
Scenedesmus								<1
Oocystis						1.9		
Pediastrum oryranum			1.9		1.6			
Dictyosphaerium				<1		13.6		
Small biflagellates						7.7		68.6
Staurastrum					5.9			
CHRYSOPHYCEAE								
Dinobryon					2.2			
CRYPTOPHYCEAE								
Cryptomonas	100	82	6	<1				
Total biomass (mg/l)	.068	.017	.414	9.63	.503	.103	.424	2.533

Table 5. Principal macrophytes recorded in L. Gur, June 1989.

Emergent	Floating-leaved	Submerged
Typha latifolia L.	*Polygonum amphibium* L.	*Ceratophyllum demersum* L.
Schoenoplectus lacustris L. Palla		*Potamogeton pectinatus* L.
Equisetum		*P. friesii* Rupr.
Menyanthes trifoliata L.		*Lemna trisulca* L.
Carex		*Chara delicatula* C.A.A.G.
Iris pseudacorus L.		*C. contraria* A.Br. ex Kutz

Table 6. OECD (1982) boundary values for higher trophic categories and data for L. Gur (1988-89) and L. Sheelin (1982).

	Total Phosphorus	Chlorophyll		Secchi Disc	
Trophic Category	mean mg/m^3	mean mg/m^3	max mg/m^3	mean m	min. m
Eutrophic	35-100	8-25	25-75	3-1.5	0.5-0.7
Hypertrophic	>100	>25	>75	<1.5	<0.5
Lough Gur	60	21.6	73.2	1.53	0.76
Lough Sheelin	57	60	110.8	1.16	0.75

Table 7. Catch per unit effort (one set of gill nets) in 1978 and 1989.

		Pike		Rudd	
	Effort	Number	Wt.(kg)	Number	Wt.(kg)
1978	8	8.5	11.5	8.6	1.8
1989	3	2	2	267	62.7

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