Eiders

King Eider pairs foraged more on impoundments (32.6 ± 4.9%) than natural ponds (27.1 ± 4.8%) (Fig. 20). Pairs on ponds spent 46.5% of total foraging time diving. On impoundments only 0.1% of foraging time was spent diving; however, diving on natural ponds was almost entirely restricted to two sites—DS7a (no. 16) and DS7b (no. 18) (Appendix A). On impoundments, pairs spent 99.7% of total foraging time dabbling (surface and subsurface), while dabbling on ponds accounted for only 53.5% of total foraging time. Spectacled Eiders were observed too infrequently on natural ponds to compare behavior with birds on impoundments.

For comparison of foraging rates among King Eider pair members, we selected only those observation periods in which at least one adult was foraging at the beginning of the period. Foraging times of paired females (Fig. 21) were similar on impoundments (70.2 ± 6.6%) and ponds (68.6 ± 5.6%). However, paired males (Fig. 22) foraged more on ponds (19.2 ± 5.2%) than impoundments (14.4 ± 5.6%). Alert behavior was the primary behavior of the male while in the presence of the female.

For both sexes, diving occurred more often on ponds than impoundments (Figs. 21 and 22). On ponds, diving accounted for 40.4% and 65.1% of total foraging time for males and females, respectively. However, males and females on impoundments dove less than 1.0% of the time. Dabbling (surface and subsurface) was the most frequent foraging method on impoundments, accounting for 99.8% of female and 99.3% of male foraging time, respectively.

One observation session was conducted on a King Eider brood on 17 July at the DS7a Impoundment. The four young foraged 75.0% of the time during the 15-minute observation period. Subsurface dabbling accounted for 87.5% of total foraging time, but young also dove (11.0%) and "picked" chironomids off the water surface (1.5%). The adult female foraged 68.9% of the time, entirely by dabbling below the water surface.

Oldsquaw

Oldsquaw pairs (Fig. 23) and unpaired males (Fig. 24) foraged more on impoundments (55.2 ± 5.4% and 45.4 ± 13.6%, respectively) than natural ponds (45.1 ± 5.1% and 39.0 ± 7.0%, respectively). Oldsquaws foraged almost entirely by diving. Dives (of both sexes combined) averaged longer on ponds (23.7 ± 1.5 seconds, n = 6 ponds) than impoundments (21.4 ± 0.8 seconds, n = 6 impoundments). Average dive lengths were determined only for those water bodies where we observed a minimum of four, presumably different, birds diving at least five times each. Mean dive lengths for each bird were then combined to determine average dive length for birds at that water body.

Northern Pintail

Too few Northern Pintail pairs were observed for comparison of ponds and impoundments. However, foraging times of unpaired male Northern Pintails were similar on impoundments (54.9 ± 7.7%) and natural ponds (53.6 ± 12.2%) (Fig. 25). Percent of total foraging time spent dabbling on the surface and below the surface also was similar between ponds (18.6% and 81.4%, respectively) and impoundments (20.1% and 79.9%, respectively).

At both ponds and impoundments, adult Northern Pintails, Oldsquaws, and King Eiders periodically switched to surface feeding during or immediately following a midge emergence. Surface feeding was most commonly observed among Northern Pintails and comprised 18.6% and 20.1% of total foraging time on ponds and impoundments, respectively (Fig. 25). Although emerging chironomids are considered an important food supply for ducklings (Sugden 1973, Sjoberg and Danell 1982), too few ducklings were observed to compare foraging behavior on ponds and impoundments.

Reproductive Biology of Pacific Loons

Water Body Size

Impoundments with nests averaged larger in surface area ($\overline{X}$ = 11.76 ± 3.3 ha, n = 22) than ponds with nests ($\overline{X}$ = 2.97 ± 0.4 ha, n = 23) (Table 5). Over 40% of impoundments with nests were >10 ha in size, but all ponds with nests were <8 ha (Appendices L and M). Two loon pairs nested on one large (42.2 ha) impoundment, but there were no cases of multiple nests on ponds.

Nest Substrate

Nests on natural ponds (Table 6) were more frequently located away from the mainland shore on islands and vegetation platforms (65.2%) than nests on impoundments (57.2%), but the difference was not significant ($\chi^2 = 0.31$, 2 df, P>0.75).

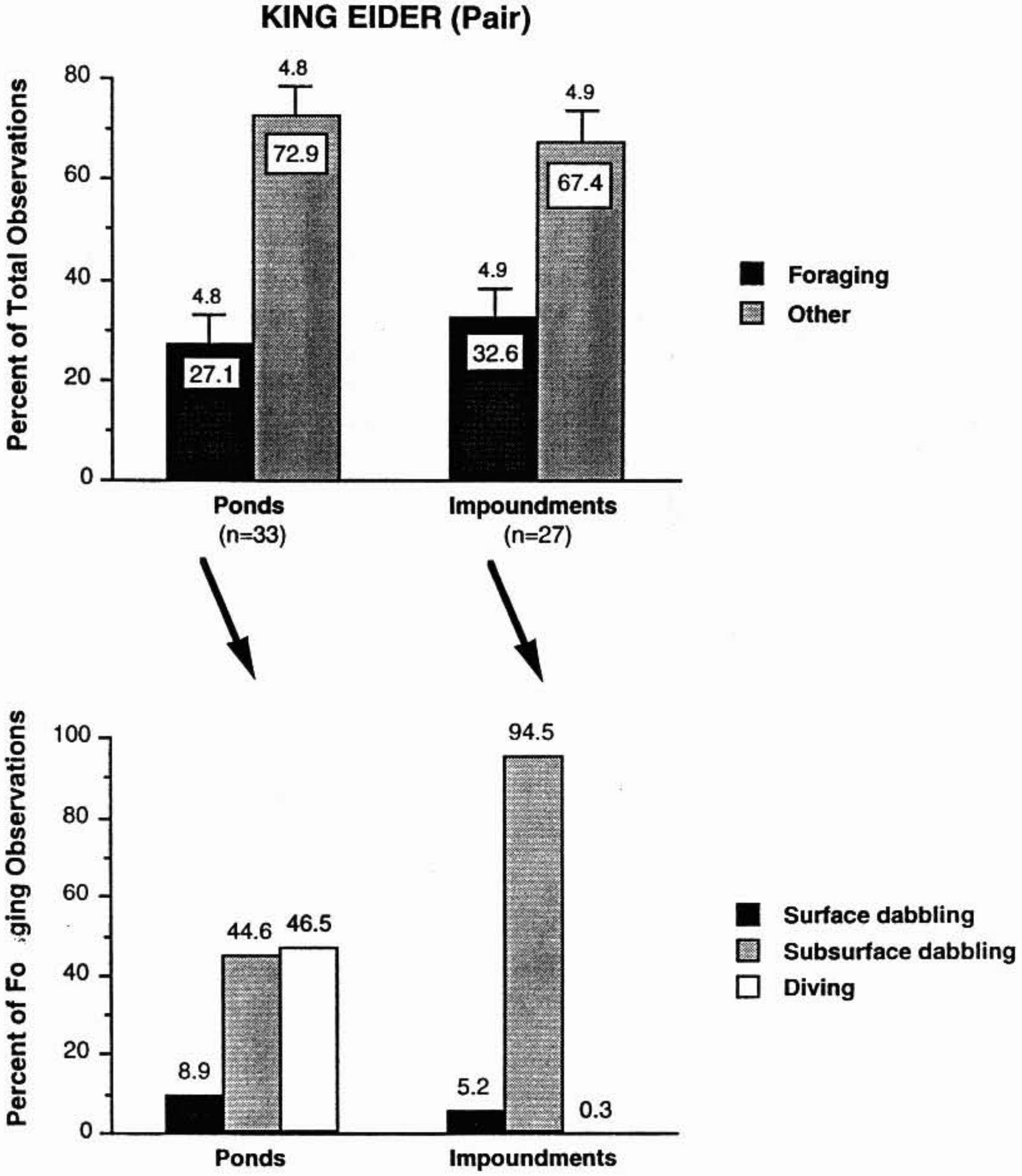

Figure 20. Comparative behavior of King Eider pairs on ponds and impoundments in 1992, Prudhoe Bay, Alaska. Because of large differences between ponds and impoundments in the number of observations per water body, sample sizes (n) represent the total number of pairs observed on ponds and impoundments rather than the number of ponds and impoundments at which behaviors were recorded. The bottom graph refers to the percent contribution of different foraging methods to total foraging time. Error bars denote SE (Standard error). Differences were not tested statistically.

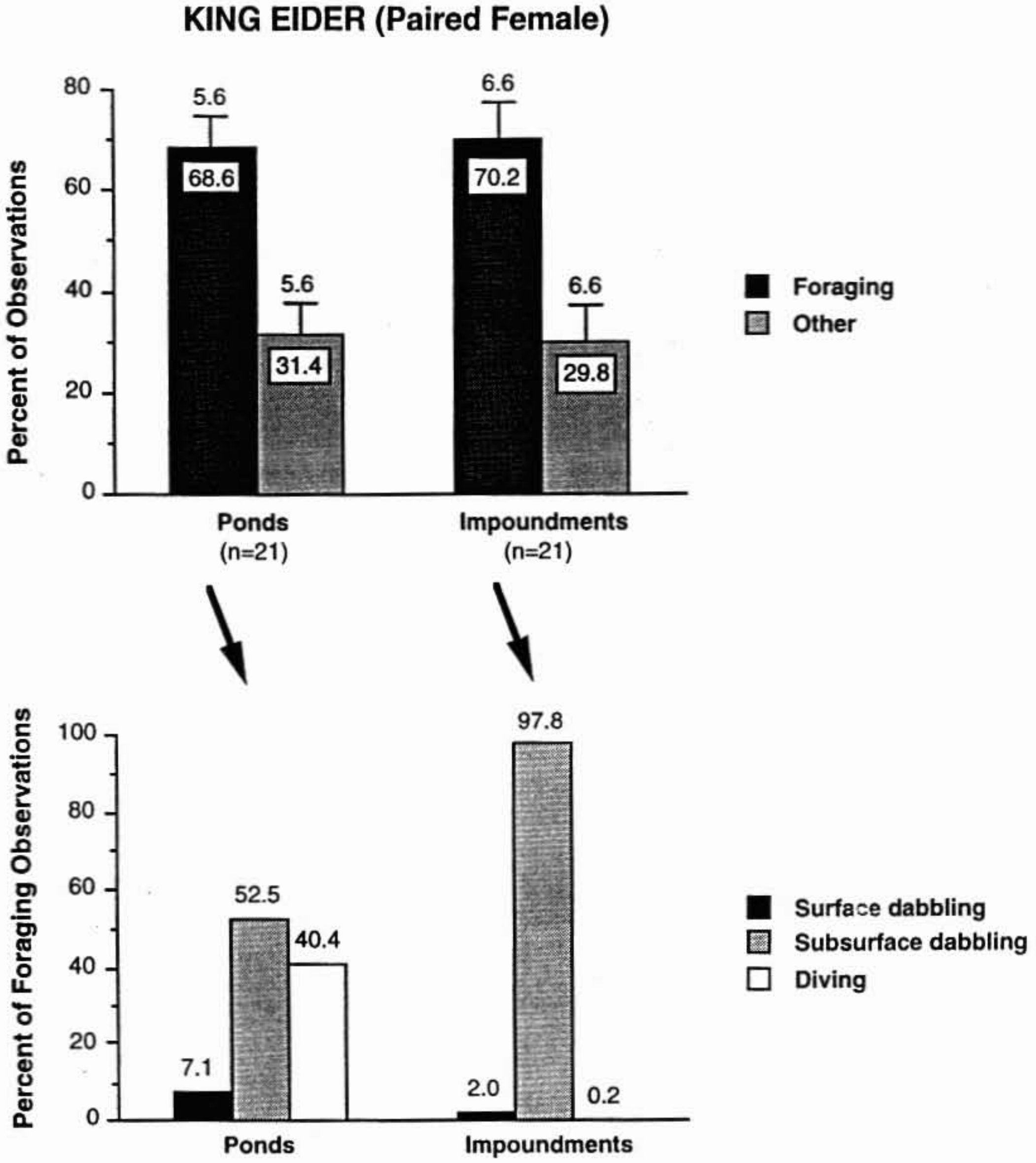

Figure 21. Comparative behavior of paired female King Eiders on ponds and impoundments in 1992, Prudhoe Bay, Alaska. Because of large differences between ponds and impoundments in the number of observations per water body, sample sizes (n) represent the total number of females observed on ponds and impoundments rather than the number of ponds and impoundments at which behaviors were recorded. The bottom graph refers to the percent contribution of different foraging methods to total foraging time. Error bars denote SE (Standard error). Differences were not tested statistically.

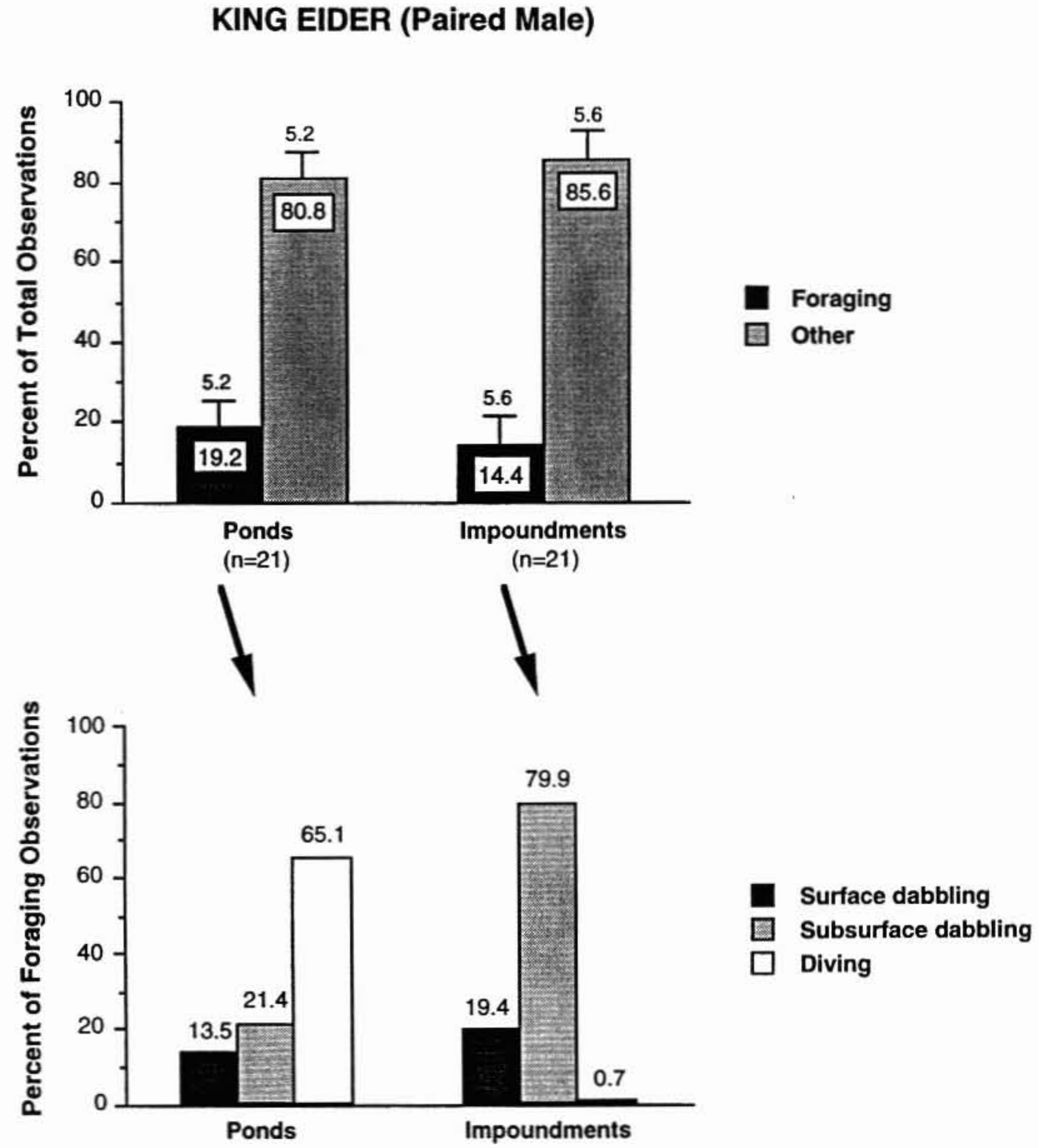

Figure 22. Comparative behavior of paired male King Eiders on ponds and impoundments in 1992, Prudhoe Bay, Alaska. Because of large differences between ponds and impoundments in the number of observations per water body, sample sizes (n) represent the total number of males observed on ponds and impoundments rather than the number of ponds and impoundments at which behaviors were recorded. The bottom graph refers to the percent contribution of different foraging methods to total foraging time. Error bars denote SE (Standard error). Differences were not tested statistically.

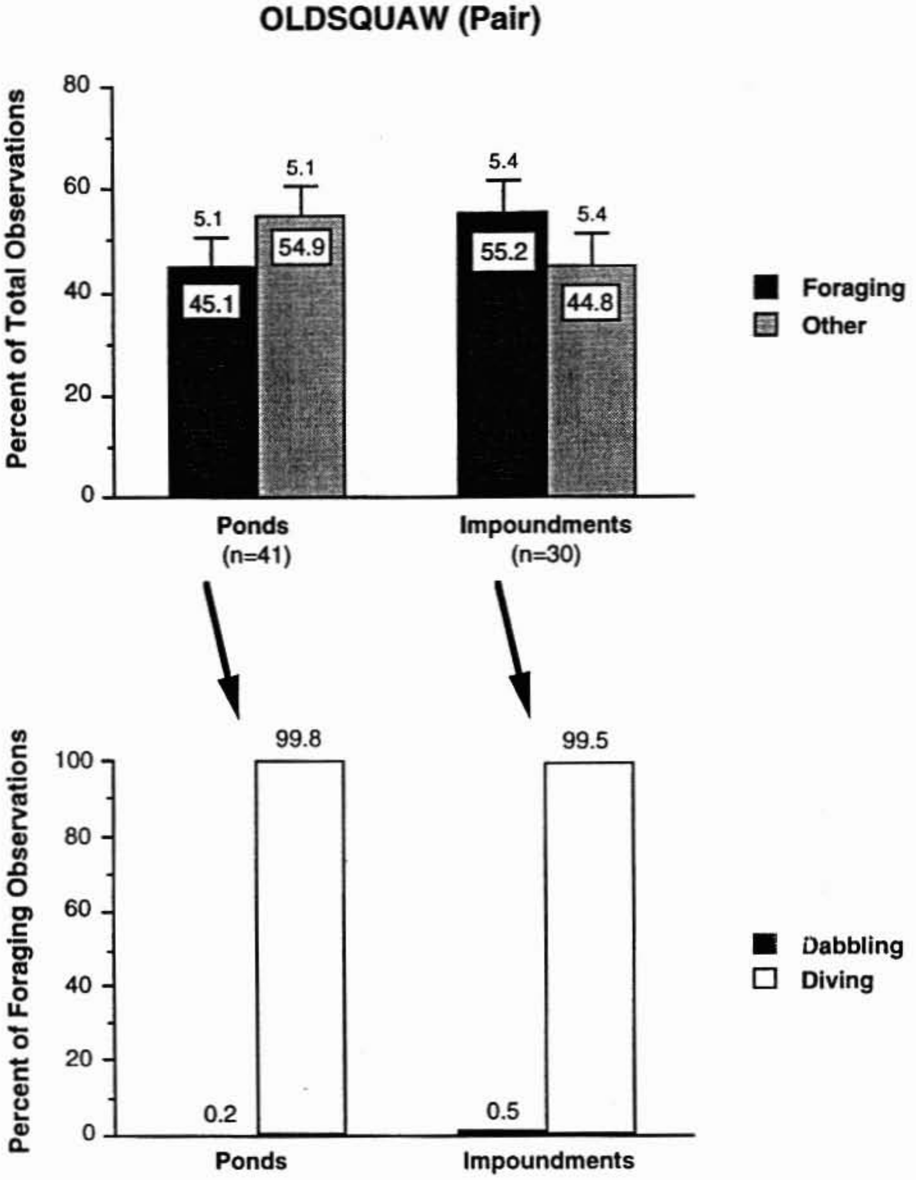

Figure 23. Comparative behavior of Oldsquaw pairs on ponds and impoundments in 1992, Prudhoe Bay, Alaska. Because of large differences between ponds and impoundments in the number of observations per water body, sample sizes (n) represent the total number of pairs observed on ponds and impoundments rather than the number of ponds and impoundments at which behaviors were recorded. The bottom graph refers to the percent contribution of different foraging methods to total foraging time. Error bars denote SE (Standard error). Differences were not tested statistically.

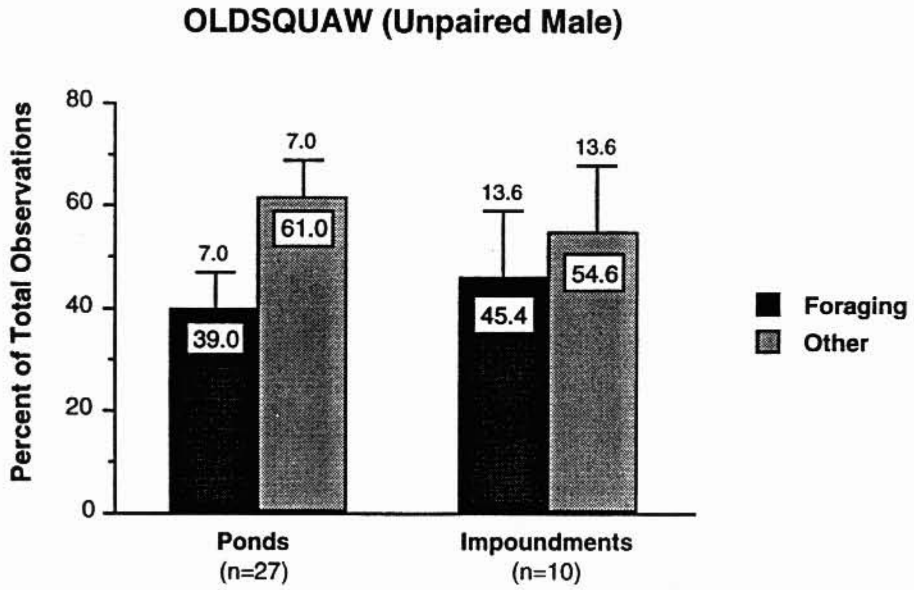

Figure 24. Comparative behavior of unpaired male Oldsquaws on ponds and impoundments in 1992, Prudhoe Bay, Alaska. Because of large differences between ponds and impoundments in the number of observations per water body, sample sizes (n) represent the total number of males observed on ponds and impoundments rather than the number of ponds and impoundments at which behaviors were recorded. The bottom graph refers to the percent contribution of different foraging methods to total foraging time. Error bars denote SE (Standard error). Differences were not tested statistically.

Nesting Chronology

We did not actively search for nests until the beginning of July when most clutches had already been initiated. Clutch initiation was observed in eight instances, and dates of clutch initiation for the majority of nests were calculated by back-dating from the date of egg-hatching.

Assuming an incubation period of about 26 days (Johnson and Herter 1989), the mean date of clutch initiation was 23 June (range 18 June–11 July) on natural ponds and 26 June (range 19 June–13 July) on impoundments (Table 7). Further assuming that clutches initiated after 10 July were re-nesting attempts, the mean date of clutch initiation for initial nesting attempts was 22 June on natural ponds and 23 June on impoundments (Table 7). From 1971 to 1973 at Point Storkersen, dates of clutch initiation on natural ponds were also between 20 and 23 June (Bergman and Derksen 1977).

Hatching was considered to have occurred on the day when at least one young was first observed. The mean date of hatch was 18 July (range 14–25 July) on

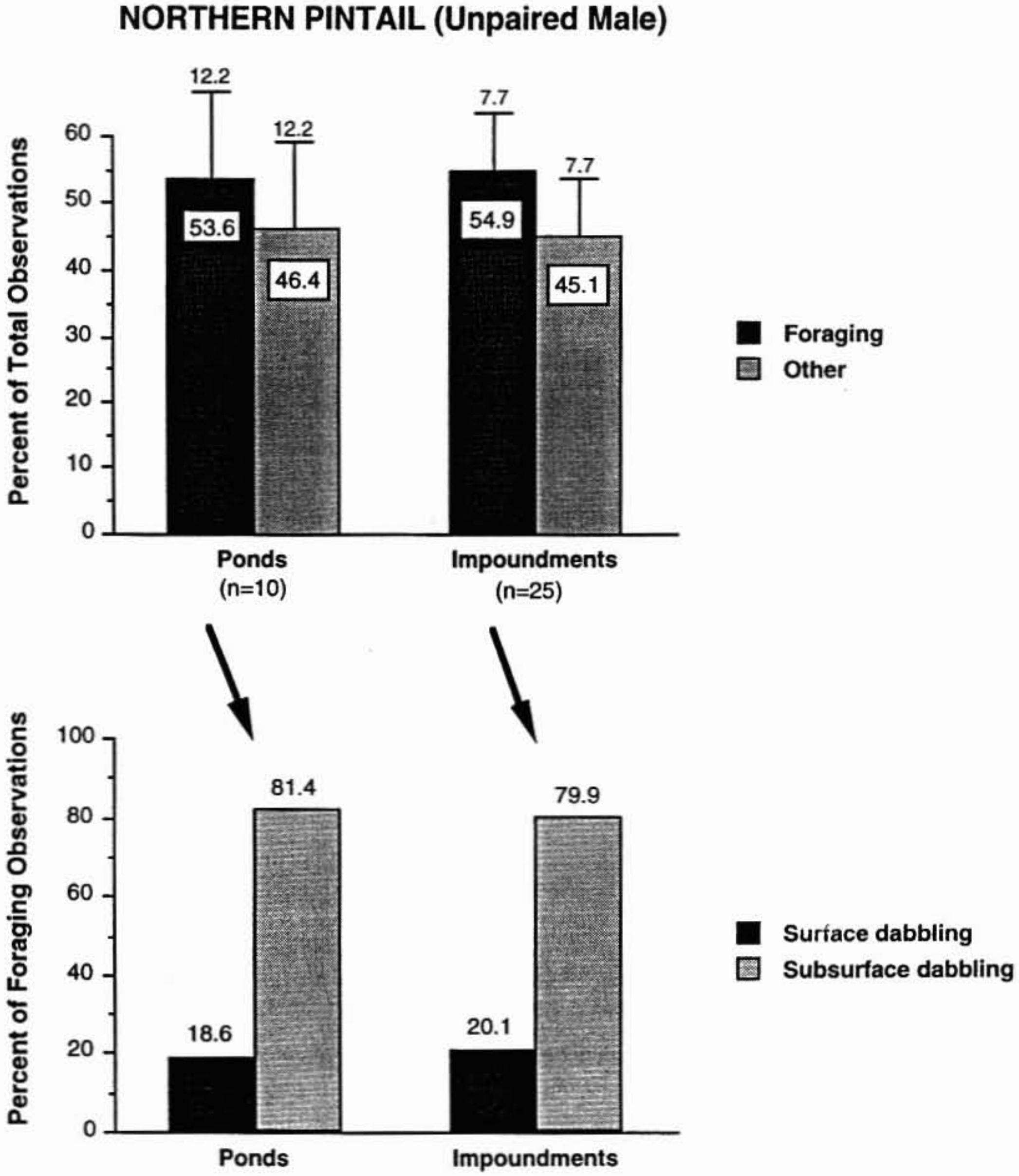

Figure 25. Comparative behavior of unpaired male Northern Pintails on ponds and impoundments in 1992, Prudhoe Bay, Alaska. Because of large differences between ponds and impoundments in the number of observations per water body, sample sizes (n) represent the total number of males observed on ponds and impoundments rather than the number of ponds and impoundments at which behaviors were recorded. The bottom graph refers to the percent contribution of different foraging methods to total foraging time. Error bars denote SE (Standard error). Differences were not tested statistically.

Table 5. Sizes of ponds and impoundments used for nesting by Pacific Loons in 1992, Prudhoe Bay, Alaska

Water Body Type	n	Mean Size (ha)	SE	Range
Pond	23	2.97	0.4	0.39–7.25
Impoundment	22	11.76	3.3	0.84–57.47

Table 6. Nest substrates used by Pacific Loons on ponds and impoundments in 1992, Prudhoe Bay, Alaska

Nest Substrate	Ponds (%)	Impoundments (%)
Natural Island	11 (47.8)	9 (42.9)
Vegetation Platform	4 (17.4)	3 (14.3)
Mainland Shore (Including Peninsula)	8 (34.8)	9 (42.8)

Table 7. Nesting chronology and dispersal of Pacific Loons on ponds and impoundments in 1992, Prudhoe Bay, Alaska

Water Body Type	Mean Clutch Initiation Date (n)	Mean Clutch Initiation Date (re-nests not included) (n)	Mean Hatch Date (n)	Active Families Remaining On The Water Body Where The Nest Was Located (n)	Days Since Hatch When Family Dispersed From Nest Site
Pond	23 June (15)	22 June (14)	18 July (13)	27.3% (11)	6.5
Imp	26 June (14)	23 June (12)	19 July (10)	75.0% (8)	6.7

Table 8. Productivity of Pacific Loons nesting on ponds and impoundments in 1992, Prudhoe Bay, Alaska

Water Body Type	Number of Nesting Pairs	Number of Successful Nests	Number of Young at Hatch	Number of Young Per Successful Nest	Number of Young Per Nesting Pair at Hatch	Number of Young in August	Number of Young Per Successful Nest in August	Number of Young Per Nesting Pair in August
Pond	24	14	20	1.43	0.83	15	1.07	0.63
Imp	22	11	16	1.45	0.73	9	0.82	0.41

natural ponds and 19 July (range 15–28 July) on impoundments (Table 7). At both water body types, hatch dates were near the lower extreme of the range of dates (16–31 July) reported by others for Pacific Loons along the Beaufort Sea coast (see Johnson and Herter 1989).

Nest Success

Fourteen of 24 nests (58.3%) on natural ponds and 11 of 22 nests (50.0%) on impoundments (Table 8) were successful (the two families found after hatch were included in overall nest success). On average, nests on ponds failed earlier (10 July) than nests on impoundments (13 July). Nests that failed were either empty of eggs and egg remains (eight ponds and eight impoundments), or were empty of eggs but contained egg remains in and/or adjacent to the nest bowl (two ponds and one impoundment). At one impoundment, the nest was empty of eggs and egg remains, but an intact egg with a fully developed fetus was found submerged in the water next to the nest site. Two failed nests were not checked because they were inaccessible.

Although predation was not directly observed, predation by Arctic fox was suspected at three of the nests with no egg remains. At two nests, fox tracks were evident leading to and from the nest site, and a musky odor was detected at the third. Arctic fox were abundant in the Prudhoe Bay oil field in 1992 and, on two occasions, were observed stealing Canada Goose eggs from nests—on 5 June from a mainland nest and on 11 June from an island nest located 10 m from shore (pers. obs.). Considering that foxes typically remove eggs from the vicinity of the nest before eating or caching them (Tinbergen 1972), it is likely that predation by foxes was the main cause for the majority of failed nests with no egg remains. However, Glaucous Gulls will occasionally fly with whole eggs before eating them (Davis 1972, Petersen 1979) and cannot be discounted as a potential source of predation.

Two impoundment nests were unsuccessful apparently because of large drops in water level. At the K-Pad Impoundment (no. 8, Appendix G), a mainland nest was stranded on land about 5 m from water following a 0.5–1.0 m drop in water level between 9 and 12 July. Total water volume dropped approximately 80% during this period, and the nest was preyed upon, or abandoned and then preyed upon. A 0.5-m drop in water level at the E-Pad Impoundment (no. 3, Appendix F) between 10–15 June exposed an island nest by providing access to the mainland; however, the loon(s) continued to incubate until the nest was preyed upon approximately three weeks later.

Hatching Success

The number of young Pacific Loons per nesting pair averaged 0.83 for ponds and 0.73 for impoundments at hatch (Table 8); however, for successful nests only, number of young at hatch was 1.43 for ponds and 1.45 for impoundments. Five of 11 nests (45.5%) on impoundments hatched two young, compared with 6 of 14 nests (42.9%) on natural ponds (Table 9). Because hatching success was based on nests found 7–10 days after clutch initiation (clutch size is two eggs, although occasionally only one egg is laid; Davis 1972), these results likely underestimate predation losses early in the incubation period before nests were found. The proportion of pairs that produced 0, 1, and 2 young was not significantly different (χ^2 test, 2 df, P>0.75) between ponds and impoundments at hatch.

Table 9. Number of Pacific Loon nests hatching one and two young in 1992, Prudhoe Bay, Alaska

Water Body Type	Number of Successful Nests	Nests Hatching 1 Young (%)	Nests Hatching 2 Young (%)
Pond	14	8 (57.1)	6 (42.9)
Imp	11	6 (54.5)	5 (45.5)

At both ponds and impoundments, nests away from shorelines (on natural islands and vegetation platforms) were more successful than nests on mainland shorelines. Nine of 15 pond nests (60%) and 7 of 12 impoundment nests (58.3%) on natural islands or vegetation platforms successfully hatched. Hatching success of nests on mainland shorelines was 50% (4 of 8) at ponds and 33.3% (3 of 9) at impoundments.

Mortality of Young

Seven of 16 young (43.8%) on impoundments (0.64 young per successful nest) and 5 of 20 young (25.0%) on natural ponds (0.36 young per successful nest) were lost before the study ended (Table 10). Three of 11 pairs that nested successfully on impoundments (27.3%) and 3 of 14 pairs that nested successfully on ponds (21.4%) suffered complete loss of young. Mortality of young occurred at an average age of 3.8 days on impoundments and 9.6 days on ponds (Table 10).

When observations ended in early August, 78.6% of pairs (11 of 14) that nested successfully on ponds and 72.7% of pairs (8 of 11) that nested successfully on impoundments were still active (Appendices L and M). Active pairs at this time averaged 1.07 young on ponds and 0.82 young on impoundments (Table 8). The number of young per nesting pair averaged 0.63 for ponds and 0.41 for impoundments in early August (Table 8). However, the proportion of pairs that produced 0, 1, and 2 young was not significantly different (χ^2 test, 2 df, P>0.25) between ponds and impoundments at the end of the study.

Dispersal from the Nest Site

Pairs that nested on natural ponds moved their young to adjacent water bodies more frequently than pairs that nested on impoundments (Table 7). Of 11 families that nested on ponds and were still active at the end of the study, only three (27.3%) remained on the water body where the nest was located. By contrast, 6 of 8 families (75%) that nested on impoundments remained on the impoundment where the young hatched. However, families that dispersed from ponds and impoundments did so when young were approximately the same age on both water body types (Table 7).

For both ponds and impoundments, families dispersed more frequently from small versus large water bodies. Average size of water bodies from which families dispersed was 4.19 ± 3.2 ha (n = 3) for impoundments and 1.72 ± 0.4 ha (n = 8) for ponds. Water bodies

Table 10. Mortality of Pacific Loon young on ponds and impoundments in 1992, Prudhoe Bay, Alaska

Water Body Type	Number of Successful Nests	Number of Young at Hatch	Number of Young Lost (%)	Number of Young Lost Per Successful Nest	Pairs Suffering Partial Loss of Brood (%)	Pairs Suffering Complete Loss of Brood (%)	Average Age of Young When Lost
Pond	14	20	5 (25.0)	0.36	1 (7.1)	3 (21.4)	9.6 Days
Imp	11	16	7 (43.8)	0.64	2 (18.2)	3 (27.3)	3.8 Days

Table 11. Foraging time and estimated prey deliveries by Pacific Loons on six ponds and six impoundments in 1992, Prudhoe Bay, Alaska

Water Body Type	n	Mean Number (±SE) of Foraging Bouts Per 4-h Period	Mean Length (±SE) of Complete Foraging Bouts Per 4-h Period	Mean Time (±SE) Adult Spent Feeding Young Per 4-h Period (% of total by 1 ad and 2 ad)	Mean Prey Deliveries (±SE) Per 10-min Period	Estimated Total Prey Deliveries (±SE) Per 4-h Period (excluding fish)
Pond	6	3.0 (±0.5)	50.8 (±13.5) min	113.9 (±13.5 min) (48.1, 51.9)	62.2 (±11.5)	665.1 (±117.8)
Imp	6	2.4 (±0.3)	78.1 (±9.8) min	129.1 (±13.5) min (62.6, 37.4)	67.8 (±13.0)	853.8 (±172.5)

at which families remained averaged 20.70 ± 7.1 ha (n = 6) in size for impoundments and 5.65 ± 1.2 ha (n = 3) in size for ponds. There were no observations of families crossing roads or pads during dispersal. Dispersal dates for families on individual ponds and impoundments are provided in Appendices L and M.

Rates of Prey Delivery

Prey deliver rates were compared only at sites with a minimum of six (10-minute) observation periods, and only for observations collected prior to dispersal from the water body on which the nest was located. Loon pairs on impoundments (n = 9) delivered an average of 73.4 ± 9.0 prey items per 10-minute period, while pairs on ponds (n = 9) delivered an average of 52.3 ± 7.1 prey items per 10-minute period. Because of high interpair variation in prey delivery rates, however, differences were not significant (Mann-Whitney *U* test, Z = -1.10, P>0.2).

Foraging Habits

During an average 4-hour period (Table 11), loon pairs on impoundments spent more time delivering prey to young (129.1 ± 13.5 minutes, n = 6) than loon pairs on natural ponds (113.9 ± 13.5 minutes, n = 6). Although percent of total time spent foraging was higher on impoundments than ponds (53.8% versus 47.5%), percent of total time spent foraging by both adults was lower (37.4% on impoundments versus 51.9% on natural ponds). Loons on impoundments engaged in fewer foraging bouts per 4-hour period (2.4 ± 0.3, n = 6) than loons on natural ponds (3.0 ± 0.5, n = 6), but complete bouts averaged longer on impoundments (78.1 ± 9.8 minutes) than ponds (50.8 ± 13.5 minutes) (Table 11).

Prey deliveries (Table 11) averaged lower for pairs on ponds (62.2 ± 11.5/10-minute period, n = 6) than pairs on impoundments (67.8 ± 13.0/10-minute period, n = 6) during 4-hour observation periods. Based on these rates and time spent foraging, estimated average total deliveries per 4-hour period (invertebrates only) were 853.8 ± 172.5 for pairs on impoundments ($n = 6$) and 665.1 ± 117.5 for pairs on natural ponds ($n = 6$). Number of foraging bouts, average length of complete bouts, total time spent foraging, and prey delivery rates for individual pairs are provided in Appendices N–Q.

Prey Selection

Although invertebrate prey items could not be distinguished in the field, they often could be categorized according to relative size. Large prey items either drooped from the adult's bill or caused a visible gap between the upper and lower mandible of the adult. Among potential small prey, probably only fairy shrimp (Order Anostraca) and cladocerans occur at densities high enough to explain the high rate of prey delivery (up to 320 prey deliveries per 10-minute period) observed in open water at some ponds and impoundments. Fairy shrimp are often mentioned as prey of Pacific Loons (e.g., see Davis 1972), but cladocerans are not. Although the majority of cladocerans collected during invertebrate sampling were small (<2 mm long), larger cladocerans (*Eurycerus lamellatus*, ~4 mm long) were also collected (during August from the Gasline Pond [~50/sample] and Gasline Impoundment [~5/sample]) and may serve as a potential food source for loons with young.

DISCUSSION

Invertebrate Production

Results from this study show that some impoundments in the Prudhoe Bay oil field are highly productive. However, results also show that there was high variability in invertebrate production among water bodies for both ponds and impoundments. This variability may have resulted from a variety of factors, the most important of which were probably water chemistry, water body surface area and depth, hydrology, and amount of emergent vegetation. Given the apparent influence of these factors on productivity in individual water bodies, results of this study should be applied to measured sites only and not used to suggest that impoundments in general are more productive than natural ponds.

Reasons for high invertebrate production in some impoundments may have been related to impoundment age, as has been found elsewhere (Whitman 1976, Kaminski and Prince 1981, Danell and Sjoberg 1982). Newly created impoundments in temperate regions often proceed through a fairly predictable sequence, including an initial rapid increase in available nutrients, which results in increased productivity of zoobenthic organisms (Rosenberg et al. 1986). High secondary productivity of some arctic impoundments is also probably related to the increased thawing of nutrient-rich soils that occurs because inundation of tundra reduces surface albedo in summer (Truett and Kertell 1992). This results in a basic sequence of changes similar to that observed for temperate impoundments (Fig. 26). Increases in thaw depth cause increased rates of organic matter decomposition and increased nutrient availability for plants. Thus, plant productivity per unit area is often enhanced by the formation of impoundments (Alexander and Miller 1977, Hobbie 1984, Walker et al. 1987). Plants provide not only food for invertebrates but also habitat structure important for overall invertebrate productivity (Wetzel 1983, Weller 1990).

Invertebrate production in temperate impoundments reaches a peak 3–4 years after initial flooding and then declines (Whitman 1976, Danell and Sjoberg 1982). In eastern Canada, the magnitude of the decline in invertebrate numbers was attributable to a decline in chironomids (Whitman 1976). Chironomids are often the first and most abundant colonizers of new impoundments (Rosenberg et al. 1986). Danell and Sjoberg (1982) found that chironomid larval biomass decreased from 55 g/m^2 to less than 10 g/m^2 between the third and eighth year in an artificial lake in northern Sweden. They also reported a decrease in mean individual larval weight during this period. In Manitoba, Kaminski and Prince (1981) found that abundance and biomass of invertebrates were much reduced in older impoundments.

Whether impoundment productivity declines with impoundment age in arctic areas is unknown. Although impoundments sampled in this study ranged in age from 10 to 20 years, invertebrate productivity was relatively high on average compared with natural ponds. In the Arctic, organic matter decomposition is slow due to cold soil temperatures (Bliss 1986, Johnson 1987), and thaw depth may increase for one to several decades before a new thermal equilibrium is established (MacKay 1970, Lawson 1986). Thus, nutrients may be released more slowly and for a longer period of time than in temperate impoundments.

Another major difference between natural ponds and impoundments in the Arctic that may affect long-

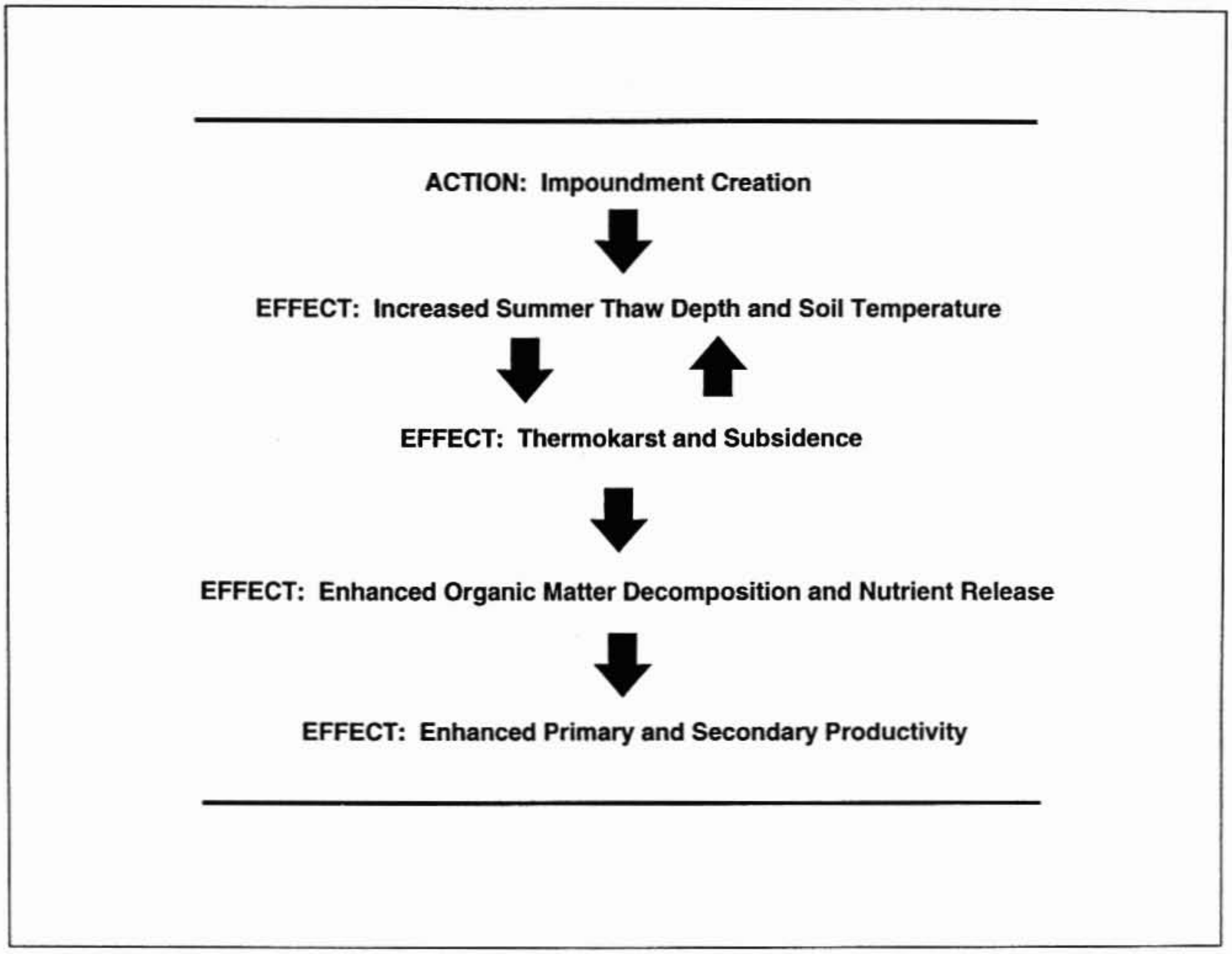

Figure 26. Chain of physical and biological changes induced by impoundment creation in tundra landscapes. Adapted from Truett and Kertell (1992).

term differences in invertebrate productivity is the timing and extent of water-level change. Water regime is considered the dominant factor controlling wetland ecosystem structure and function (Mitsch and Gosselink 1986, Conner and Day 1992). Water levels in natural arctic wetlands tend to be relatively stable and predictable (Hohman et al. 1992), but impoundment water regimes often are not (Truett and Kertell 1992). In this study, for example, water-level drawdowns at some impoundments were extensive, rapid, and unpredictable depending on the placement of culverts and the timing of their thaw. At other impoundments, where culverts were absent or ineffective, water levels remained relatively constant, fluctuating with yearly rainfall cycles in a manner similar to natural ponds.

In temperate regions, water-level drawdowns initiate a sequence of changes that affect growth of emergent vegetation and invertebrate productivity (Fig. 27). These changes also affect the foraging efficiencies and reproductive success of waterbirds (Weller 1990, Payne 1992). Drawdowns encourage expansion of emergent vegetation through germination of seeds and regrowth of perennials as temperatures increase in shallow water and through the release of nutrients as dead emergent and other plants decompose. However, impoundments with large spring drawdowns may be unavailable as nesting and brood habitat (Payne 1992). Constant water levels or excessively deep water will eliminate most emergents (Kadlec and Smith 1992), resulting in low invertebrate productivity (Payne 1992); and openings unprotected from wind action by vegetation are characterized by low invertebrate abundance and survival (Nelson and Kadlec 1984). How-

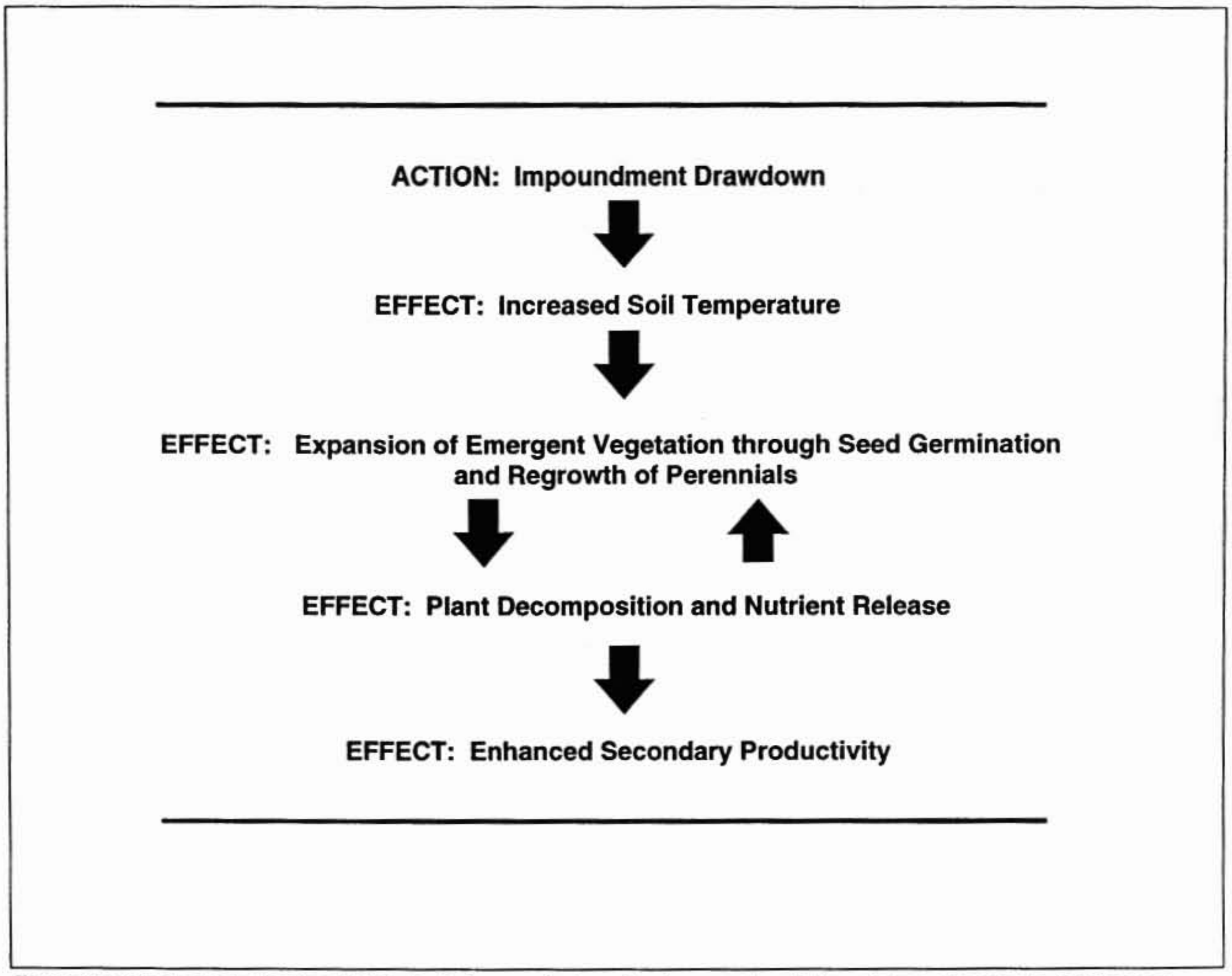

Figure 27. Chain of physical and biological changes induced by impoundment drawdown in temperate landscapes.

ever, stable water levels prevent loss of breeding tradition developed by waterfowl for specific pools (Payne 1992).

Shallow-*Carex *versus Shallow-*Arctophila *Water Bodies

Greater production of trichopterans and plecopterans in Shallow-*Arctophila* versus Shallow-*Carex* water bodies may have resulted from differences in water chemistry due to soil type. The Shallow-*Arctophila* water bodies we sampled (Gasline and WBS) were located in acidic soils, whereas the Shallow-*Carex* water bodies (GC2 and P-Pad) were located in alkaline soils (based on soils map in Walker et al. 1980). In 1991, the pH values recorded at GC2 and P-Pad were within the range expected for water bodies in alkaline soil (Kertell and Howard 1992). Although pH values were not recorded in 1992, the Gasline and West Beach State water bodies were in an area where pH was previously measured at 5.9 ± 0.8 by Walker et al. (1980). According to M. Butler (North Dakota State University, pers. comm. 1991), who sampled chironomid larvae at a variety of Prudhoe Bay locations, only in the more acidic, peat-rich soils near the western edge of Prudhoe Bay (where the Gasline and West Beach State sites were located) did chironomid larvae reach high densities. Results of this study suggest that trichopteran and plecopteran abundances followed the same pattern. Reasons are unclear for relatively high gastropod productivity in Shallow-*Carex* versus Shallow-*Arctophila* impoundments and the reverse in natural ponds.