EXTENT AND SEVERITY OF AVIAN PREDATION AT FEDERAL FISH HATCHERIES IN THE UNITED STATES

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Abstract: A survey of Federal fish hatcheries in the United States was conducted to determine the extent and severity of avian predation on fish stocks as well as to determine which avian species were the most serious predators. A list of 58 bird species in 14 families was provided. Managers of hatcheries were asked to indicate which species or members of what family caused problems by predation in their hatcheries. They were asked to provide their estimate of the severity of the problem; i.e. severe, significant, trivial, or none. They were also asked which fish species were preyed upon and also to identify any bird predators not on the list provided. The survey elicited a 66% response from 121 managers. Of the 58 species on the survey form, 28 species in 9 families were mentioned by managers as predators visiting fish hatcheries. Additionally, 8 species from 6 other families or subfamilies were added by managers as being pests at hatcheries. Eighteen species in 8 families were mentioned as causing "severe" damage to fish stocks.

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Intensive fish culture practices commonly used at hatcheries for artificial propagation results in high densities of small fish that are confined in limited open-water areas. These abnormal concentrations of fish frequently attract birds that are piscivorous in natural environments. In addition, many species of birds that do not normally prey on fish, may feed opportunistically on the small, relatively helpless fish that are easily available at hatcheries.

Scattered references in the literature suggest that a diversity of bird species representing many families are potential predators on fish hatchery stocks (Elson 1962; Latta and Sharkey 1966; Timkin and Anderson 1969; Bennett 1970; Miller and Barclay 1973). In particular, fish-eating birds including herons, gulls, egrets, cormorants, loons, pelicans, mergansers, terns, osprey, and others are likely to cause serious problems for hatchery managers.

Before successful avian predator control techniques can be developed it is necesary to identify specific predatory birds and assess extent of their impact on hatchery ponds. Our study was designed to establish those particular avian species that prey on hatchery fish and to determine the severity of avian predation at hatcheries. The study synthesizes survey information based on the respnses of 80 Federal fish hatchery managers throughout the United States to a mailed questionnaire.

METHODS AND MATERIALS

The information used in this study was gathered as a result of a comprehensive survey into the effects, extent and severity of avian predation at Federal hatcheries in the United States. Survey questionnaires were mailed in the fall of 1977 to managers of 121 Federal fish hatcheries (as listed in U.S.D.I., Fish and Wildlife Service, 1975), which were in operation or under construction.

The questionnaire provided a list of 58 bird species in 12 families that were considered likely to prey on fish. Space was also provided to add "other" bird species not included on the list. Hatchery managers responding to the survey were requested to identify: (1) the avian species frequenting their hatcheries that were considered fish

predators, (2) the fish species cultured, (3) the annual fish production rates and, (4) the degree of avian predation on their fish stocks. Respondents were asked to evaluate qualitatively the impact of individual bird species on their hatchery stocks by ranking the effects as severe, significant, slight, or no problem. Those hatchery managers who could not accurately identify avian predators to species, were directed to use the familial levels. Identification of bird species reported on all the completed survey forms were compared to known area distribution maps of birds (Robbins et al. 1966) to eliminate any obvious misidentified species. Details on the survey technique chosen are presented in Backstrom and Hursch (1963). When survey forms were returned data were coded and sorted. Data were analyzed by hatchery in terms of severity of problems at hatcheries regardless of avian species causing the problem. Data were also analyzed by species of avian predator and severity of problems caused by that species.

RESULTS

Survey forms were completed and returned by 80 of the 121 eligible respondents. This represents a response rate of 66% which is considered high in natural resource survey research (W. D. Wellman VPI & SU, personal communication) and therefore non-response bias measurements were not made.

The results presented in this survey document, for the first time as far as we can determine, that avian predation is a relatively common problem at Federal fish hatcheries throughout the United States and that a wide range of avian species is involved. Of the 80 hatchery managers that responded, a majority (86%) indicated that avian predators were a problem at their respective hatcheries, while only 14% cited avian predation as "no problems" (Table 1). When asked to qualitatively rank the severity of avian predation approximately half (49%) of the managers reported either severe (18%) or significant (31%) bird predation problems. An additional 38% of the hatchery managers rated the problem caused by predatory birds as at least slight.

A list of the species of birds that were reported as fish predators at Federal hatcheries, accompanied by a qualitative assessment of the extent of predation attributed to each species is presented in Table 2. A total of 34 species (excluding the crow (*Corvus corax*) and the cattle egret (*Bubulcus ibis*) which caused no problems) representing 15 families or subfamilies were cited by managers as fish predators at the hatcheries. Of the avian predators observed, the herons, notably the great blue heron (*Ardea herodias*) and the green heron (*Butorides virescens*), and the belted kingfisher (*Megaceryle alcyon*) were the most frequently observed fish predators. Severe predation was caused by 18 species in 9 families. As expected, those bird species that typically prey on fish were the most often cited by hatchery managers as causing severe or significant problems. This group of predominantly piscivorous birds included the cormorants, mergansers, herons, gulls, terns, osprey (*Pandion haliaetus*), and belted kingfisher. It also included species not typically regarded as piscivorous such as blackbirds and mallard ducks (*Anas platyrhynchos*).

Table 1. Severity of avian predation at Federal fish hatcheries in the U.S.

Severity of Predation	*No.*	*Percent*
Severe	14	18
Significant	25	31
Slight	30	38
No problem	11	14

Table 2. Bird species reported as predators at federal fish hatcheries in the U.S. together with estimates of severity of predation.

Family or Subfamily[a,b]	*Species Common Name*[b]	*Species Generic Name*	*Severity of Predation (No. Reports)*				*Total No. Reports*
			Severe	*Significant*	*Slight*	*No Problem*	
Grebes			---	---	2	1	3
	Western Grebe	*Aechmophorus occidentalis*	---	---	1	---	1
	Eared Grebe	*Podiceps caspicus*	---	---	1	---	1
	Pied-billed Grebe	*Podilymbus podiceps*	---	---	3	3	6
Coromorants			---	1	---	1	2
	Double-Crested Cormorant	*Phalacrocorax auritus*	1	1	1	---	3
Anhingas							
	Anhinga	*Anhinga anhinga*	---	1	1	---	2
Duck							
	Mallard	*Anas platyrhynchos*	1	---	---	---	1
Mergansers			2				
	Common Merganser	*Mergus merganser*	1	---	3	---	4
	Red Breasted Merganser	*Mergus serrator*	1	---	---	---	1
	Hooded Merganser	*Lophodytes cucullatus*	1	1	---	---	2
Accipiters							
	Osprey	*Pandion haliaetus*	1	1	8	8	18
Herons			1	---	---	---	1
and	Great White Heron	*Ardea occidentalis*	---	---	2	1	3
Allies	Common gret	*Casmerodius albus*	1	2	2	1	6
	Snowy Egret	*Leucophoyx thula*	1	1	1	---	3
	Great Blue Heron	*Ardea herodias*	3	14	21	6	44
	Louisiana Heron	*Hydranassa tricolor*	1	1	1	---	3
	Little Blue Heron	*Florida caerulea*	1	1	1	1	4
	Green Heron	*Butorides virescens*	---	10	11	2	23
	Black Crowned Night Heron	*Nycticorax nycticorax*	---	---	3	1	4
	American Bittern	*Botaurus lentiginosas*	---	---	1	---	1
	Least Bittern	*Ixobrychus exilis*	---	---	1	---	1
	Wood Ibis	*Mycteria americana*	1	---	1	1	3
	Cattle Egret	*Bubulcus ibis*	---	---	---	1	1
Gulls			1	2	6	---	9
	Glaucous Gull	*Larus hyperboreus*	1	---	1	---	2
	Herring Gull	*Larus argentatus*	2	2	4	1	9
	California Gull	*Larus californicus*	---	1	1	---	2
	Franklin's Gull	*Larus pipixcan*	---	---	1	---	1
Terns			2	---	1	---	3
	Arctic Tern	*Sterna paradisaea*	---	---	1	---	1
	Foster's Tern	*Sterna forsteri*	1	---	---	---	1
	Black Tern	*Chlidonias niger*	---	1	---	---	1
Owls							
	Great Horned Owl	*Bubo virginianus*	---	---	2	---	2
Kingfishers							
	Belted Kingfisher	*Megaceryle alcyon*	3	13	35	10	61
Crow							
	Common Crow	*Corvus corax*	---	---	---	1	1
	Raven	*Corvus brachyrhynchos*	---	---	1	---	1
Dipper	Dipper	*Cinclus mexicanus*	---	---	4	---	4
Starling	Starling	*Sturnus vulgaris*	---	---	1	---	1
Blackbirds				3		1	4
	Common Grackle	*Quiscalus quiscula*	3	7	2	---	12

[a]Where predators were not given by species the instances are recorded by family.
[b]Family, subfamily, generic, and specific name follows use by Robbins et al. 1966.

DISCUSSION

Birds are highly mobile and resourceful predators able to rapidly exploit situations where prey species are either naturally or unnaturally concentrated. Fish hatcheries are ideal feeding areas for avian predators. They provide artificially high concentrations of relatively helpless, readily accessible prey. Weakly-swimming fry and fingerling fish confined to shallow-water hatchery pools that are devoid of escape cover are easy prey for fish-eating birds. In addition, the characteristically clear, highly-transparent water used in cold water hatcheries increases the visibility of target fishes making them more susceptible to winged predators. Clearly, fish-eating birds represent a potentially serious impact on fish production at hatcheries. Hatcheries located near bird nesting colonies or on the migratory routes of heron, gulls, terns, cormorants, and mergansers can expeience severe predation problems.

Fish eating birds tend to be voracious feeders. American mergansers consumed 18 to 27% of their mean body weights per day (Latta and Sharkey, 1966). Bennett (1970) cited evidence that cormorants eat approximately 450 g fish per day. Such levels of predation on young fish stocks can be substantial. Much less is known about the fish-eating capacity of other species of fish predators.

Fish eating was not the only problem mentioned by hatchery managers. Mention was made of the potential for disease introduction or spread by free flying birds. Gulls and kingfishers were mentioned in this context. Ancillary comments provided by 1 hatchery manager indicated that the accidental transfer of live fish from 1 pond to another by grackles catching and subsequently dropping fish may represent a more severe problem than direct predation.

In contrast, 1 hatchery manager noted beneficial effects of cattle egrets and great blue herons in removing frogs. Another obvious advantage of avian predators is their ability to cull dying and diseased stocks.

Ancillary comments by managers indicated that predation in many instances was seasonal or confined solely to holding ponds. Most predation seemed to be on small fish though ospreys were noted to take large fish. Many managers indicated that kingfishers were seldom severe predators as they did not visit hatcheries in large numbers.

The possibility of misidentification of bird species by reporting managers is worthy of comment. For instance "grackles" were mentioned in several responses. These were presumed to be common grackles (*Quiscalus quiscula*) based on hatchery locations. In the case of 2 hatcheries with grackle problems the casual species may have been boat-tailed grackles (*Cassidix mexicanus*) as this was within the range of that species. Arctic terns (*Sterna paradisaea*) were mentioned in one report. They may have been predators while migrating as most of the U.S. is outside their breeding range (Robbins et al. 1966). The species involved may have been a common tern (*Sterna hirundo*) if predation took place by a resident tern.

The survey was preliminary in nature. Follow-up work will include determination of whether predation took place in raceways or holding ponds; what control and prevention techniques, if any, were used; whether fish species were selectively useld; and an analysis of available control techniques.

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