CRESCENT GUNNEL

Pholis laeta Cope, 1873
(Pholidae)

Global rank GNR – suggested change to G5 (09Dec2005)
State rank S4S5 (09Dec2005)
State rank reasons
Information on abundance and trends is very limited, but this species appears to be widely distributed throughout coastal Alaska east of the Aleutians. An important forage species for marine mammals, birds, and predatory fishes. Directed fisheries for forage fishes in Alaska are prohibited. Threats are widespread but not imminent, and include habitat destruction from coastal development, pollution from oil spills, and logging and mining runoff.

Taxonomy
Formerly *Centronotus laeta*. Yatsu (1981) included this species in a new nominal genus *Allopholis*, based on differences in the number of infraorbital bones and presence or absence of a median interorbital head pore. Peden and Hughes (1984) observed overlap in the number of infraorbital bones between *Pholis* and the proposed *Allopholis* species and believed these characters were not distinct enough to support grouping in a new genus. Most authors (Robins et al. 1991, Mecklenburg et al. 2002, Mecklenburg 2003) use *Pholis laeta*. The crescent gunnel is closely related and very similar in appearance to the saddleback gunnel (*Pholis ornata*). Alaskan specimens collected in the 1990s and previously identified as *P. ornata* are now believed to be *P. laeta* (Mecklenburg et al. 2002).

General description
A small, elongate, eel-like fish. Body coloration is yellow-green to orange-brown above, with distinctive brown or blackish crescent-shaped markings enclosing a yellow or orange spot which extend the length of the dorsal surface. Immature males and females have pale coloration ventrally, but mature males are orange or reddish along cheeks, throat, pectoral fins and belly. Dorsal and anal fins are long, low, and posteriorly confluent with the rounded caudal fin; pectoral fins are well-developed, and pelvic fins are present but tiny and may not be visible without a hand lens in the field. Individuals can be up to 25 cm in length, but commonly measure half that length in Southeast Alaska (Hughes 1986, O'Clair and O'Clair 1998, Mecklenburg et al. 2002).

Length (cm) range 10-25

Reproduction
Adults attain sexual maturity at around 10 cm length (Hughes 1986, O'Clair and O'Clair 1998). Females lay egg masses (600 to 1,600 eggs) in mid-January (Patricia Bay, Vancouver Island, B.C.; Hughes 1986) or January to February (near Victoria, B.C.; O'Clair and O'Clair 1998). Eggs are demersal, adhere to one another or to the substrate, and are guarded by either parent or left unguarded. Larvae hatch after around 2 months and are planktonic (Hughes 1986). Species may delay breeding in Southeast Alaska due to colder water temperatures, but specific information is lacking (O'Clair and O'Clair 1998). Maximum lifespan is 6 years (Hughes 1986, O'Clair and O'Clair 1998).

Ecology
Forage fishes, such as the crescent gunnel, are a vital link between primary and secondary producers in marine ecosystems. This species is an important prey item for marine birds, large fishes, and mammals. Predators include Great Blue Heron (*Ardea herodias*), Pigeon Guillemot (*Cepphus columba*), river otter (*Lontra canadensis*), mink (*Mustela vison*), and subtidal fishes (Barber et al. 1995, Butler 1995, Gillespie and Westrheim 1997, Golet et al. 2000). However, Golet et al. (2000) found that crescent gunnels provided lower-lipid (hence, lower quality) food for Pigeon Guillemot chicks and as prey were not correlated with high reproductive success. Crescent gunnels hide in tidepools or tiny crevices under rocks and vegetation, or may emerge fully from water at low tide, and

apparently breathe air when out of water (Martin and Bridges 1999). Hughes (1985) suggested resource utilization differences between crescent and saddleback gunnels may be due to interspecific competition; the crescent gunnel is generally larger, and where it is common it appears to displace the saddleback gunnel from otherwise suitable nearshore habitats.

Migration
Movements are primarily related to seasonal and tidal cycles (Barber et al. 1995). At Izembek Lagoon, Bering Sea, Alaska, this species occurs in nearshore habitats only during summer and likely makes seasonal movements offshore to deeper water during winter to avoid extreme freezing water temperatures (Smith and Paulson 1977). Hughes (1985) also observed seasonal changes in the distribution of gunnels in southern B.C.; gunnels spent the summer in eelgrass beds and some were observed offshore during winter, likely in response to reduced eelgrass cover during that season.

Food
Small crustaceans and molluscs. Juveniles feed primarily on harpacticoid copepods, while adults feed on harpacticoid copepods, gammarid shrimp (such as *Hippolyte clarki*), and isopods, with additional consumption of other marine invertebrates such as mussels, and algae (Hughes 1985, O'Clair and O'Clair 1998). Hughes (1985) found gunnels had more food in the stomach when captured at midmorning than at night.

Phenology
Hughes (1985) observed significant peaks of activity at dawn and dusk under experimental conditions.

Habitat
Intertidal and shallow subtidal areas among eelgrass (*Zostera marina*), kelp (*Laminaria* spp.), other algae or rocks to a maximum recorded depth of 73 m (Murphy et al. 2000, Mecklenburg et al. 2002, Mecklenburg 2003). Often found under rocks and in tidepools at low tide, usually in areas of rocky headlands, but also on cobble beaches (O'Clair and O'Clair 1998, Mecklenburg et al. 2002).

State habitat
Crescent gunnels utilize eelgrass beds in Izembek Lagoon, Alaska, only during the summer (Smith and Paulson 1977) where salinity ranges from 26-32 pph and water temperatures from below 0°C to above 20°C (McRoy 1966). Murphy et al. (2000) compared intertidal fish assemblages in eelgrass, kelp and filamentous algae habitats in Alaska and found crescent gunnels most abundant in eelgrass habitat, and least abundant in filamentous algae habitat.

Global range
North Pacific: Aleutian Islands and east along northern Alaska Peninsula to Port Heiden, and Gulf of Alaska shores to northern California at Crescent City; Commander Islands and southeastern Kamchatka (Mecklenburg et al. 2002).

State range
From the Aleutian Islands east along northern Alaska Peninsula to Port Heiden, and Gulf of Alaska shores throughout Southeast Alaska (Mecklenburg et al. 2002).

Global abundance
Unknown.

State abundance
Unknown. Murphy et al. (2000) reported mean numbers of 11.6-42.6 crescent gunnels per seine haul near Craig, Alaska. At Chisik Island, Lower Cook Inlet, Robards et al. (1999) reported a mean CPUE of 0.37 individuals per beach seine (n = 30 sets).

Global trend
Unknown.

State trend
Unknown. Percent occurrence and CPUE increased slightly for crescent gunnels caught in beach seines in Lower Cook Inlet during 1995 and 1996 (4.9 % occurrence; 0.19 individuals per set) compared to catches in 1976 (2.3% occurrence; 0.04 individuals per set; Robards et al. 1999).

State protection
Amendments to the Bering Sea/Aleutian Islands and Gulf of Alaska Fishery Management Plans prohibit directed fisheries for any forage fish species, and place limits on bycatch and sale or processing of any species included in this group (Nelson 2003). Habitat is protected where species occurs in nearshore waters of Glacier Bay National Park, Maritime National Wildlife Refuge, Kachemak Bay National Estuarine Research Reserve and other preserves with marine

components. Protected by the Coastal Zone Management Act (CZMA; NOAA 1996, Committee on Environment and Public Works 2000a, Alaska Dept. of Natural Resources 2004). The Outer Continental Shelf Lands Act (OCSLA) mandates that development of Outer Continental Shelf resources be balanced with protection of human, marine and coastal environments and any project that could adversely impact the coastal zone is subject to federal consistency requirements under the CZMA (Committee on Environment and Public Works 2000b).

Global threats
Intertidal habitats may be threatened by pollution from timber harvest, mining, and agricultural runoff, oil and gas development, oil spills, seafood processing, beachfront development and sewage discharge (Tindall 2004). Natural perturbations such as earthquakes and scouring incurred by major storms are also potential threats. Although little understood, the effects of climate change will likely result in changes in ocean temperatures, and intertidal community structure and diversity may be affected. In California, researchers have already attributed a reduction in cold-water intertidal species to warming water temperatures (Tindall 2004).

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Oil spills are of particular concern in Alaska, where oil extraction and transportation occurs in many coastal areas. A study of the effects of the Prince William Sound *Exxon Valdez* oil spill on intertidal fishes reported an initial negative effect one year after the spill (i.e. decreased fish density and biomass at oiled sites that were cleaned compared to unoiled reference sites), but no significant difference in fish density and biomass between these sites two years after the spill (Barber et al. 1995). However, Jewett et al. (2002) found a biomarker of hydrocarbon exposure (CYP1A) present in significantly higher concentrations in the livers of crescent gunnels collected from oiled vs. unoiled intertidal sites 10 years after the spill, suggesting that petroleum pollution of intertidal habitats may have long-lasting effects.

Transportation and development associated with the Kensington Gold Mine in the Berners Bay area near Juneau poses several threats to intertidal fish habitat: potential sources of hydrocarbons to the bay include fuel spills, chronic pollution from ships, and parking lot runoff near ferry terminals (Harris 2005). Researchers have documented damage to embryos of other intertidal-spawning fishes (e.g., pink salmon and Pacific herring) resulting from concentrations of polynuclear aromatic hydrocarbons (PAHs) as low as 1 ppb in the bay (Harris 2005).

State research needs
Identify habitat/substrate requirements for spawning, rearing, and adult life stages. Study effects of increased water temperatures and climate change on intertidal communities.

State inventory needs
Obtain baseline information on populations, habitat and trends at index locations, especially outside Southeast and Southcentral Alaska, where all information is lacking. Survey the condition and status of required habitat for this species.

State conservation and management needs
Protect intertidal zones from pollution and habitat destruction by monitoring coastal development, limiting runoff from mining, logging, and agriculture, and preventing oil spills. Educate the public about the importance of forage fish in marine ecosystems and the impact of human activities on intertidal communities.

LITERATURE CITED

Alaska Department of Natural Resources. 2004. Alaska Coastal Management Program. Available online at: http://www.alaskacoast.state.ak.us. Accessed 12May2004.

Barber, W.E., L.L. McDonald, W.P. Erickson, and M. Vallarino. 1995. Effect of the *Exxon Valdez* oil spill on intertidal fish: a field study. Transactions of the American Fisheries Society 124:461-476.

Butler, R.W. 1995. The patient predator: foraging and population ecology of the Great Blue Heron *Ardea herodias* in British Columbia. Canadian Wildlife Service Occasional Paper No. 86.

Committee on Environment and Public Works. 2000a. Marine Protection, Research, and Sanctuaries Act of 1972. Available online at: http://epw.senate.gov/mprsa72.pdf. Accessed 12May2004.

Committee on Environment and Public Works. 2000b. Outer Continental Shelf Act. Available online at: http://epw.senate.gov/ocsla.pdf. Accessed 12May2004.

Gillespie, G.E. and S.J. Westrheim. 1997. Synopsis of information on marine fishes utilized as prey by marine and shoreline birds of the Queen Charlotte Islands. Pp. 36-55 in: Vermeer, K. and K.H. Morgan (Eds.). The ecology, status, and conservation of marine and shoreline birds in the Queen Charlotte Islands. Can. Wildl. Serv. Occas. Pap. No. 93.

Golet, G.H., K.J. Kuletz, D.D. Roby, and D.B. Irons. 2000. Adult prey choice affects chick growth and reproductive success in Pigeon Guillemots. The Auk 117:82-91.

Hughes, G.W. 1985. The comparative ecology and evidence for resource partitioning in two pholidid fishes (Pisces: Pholididae) from southern British Columbia eelgrass beds. Canadian Journal of Zoology 63:76-85.

Hughes, G.W. 1986. Observations on the reproductive ecology of the Crescent Gunnel, *Pholis laeta*, from marine inshore waters of southern British Columbia. Canadian Field-Naturalist 100:367-370.

Hughes, G.W. 2005. Personal communication between Grant Hughes, Royal British Columbia Museum, Victoria, B.C., and Jodi McClory, Alaska Natural Heritage Program, Anchorage, AK, October 2005.

Jewett, S.C., T.A. Dean, B.R. Woodin, M.K. Hoberg, and J.J. Stegeman. 2002. Exposure to hydrocarbons 10 years after the *Exxon Valdez* oil spill: evidence from cytochrome P4501A expression and biliary FACs in nearshore demersal fishes. Marine Environmental Research 54: 21-48.

Martin, K.L.M. and C.R. Bridges. 1999. Respiration in water and air. Chapter 4 in: Horn, M.H., K.L.M. Martin and M.A. Chotkowski. Intertidal fishes: life in two worlds. Academic Press, San Diego, CA.

McRoy, C.P. 1966. The standing stock and ecology of eelgrass (*Zostera marina* L.) in Izembek Lagoon, Alaska. M.S. thesis, University of Washington, Seattle, WA.

Mecklenburg, C.W. 2003. Family Pholidae Gill 1893. California Academy of Sciences annotated checklists of fishes, No. 9.

Mecklenburg, C.W., T.A. Mecklenburg and L.K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society. Bethesda, MD. 1,037 pp.

Murphy, M.L., S.W. Johnson, and D.J. Csepp. 2000. A comparison of fish assemblages in eelgrass and adjacent subtidal habitats near Craig, Alaska. Alaska Fishery Research Bulletin 7:11-21.

Nelson, M. 2003. Gulf of Alaska forage fish assessment, appendix A: forage fish species in the Gulf of Alaska. Available online at: http://www.afsc.noaa.gov/refm/docs/2003/GOAappendixA.pdf. Accessed 27Jul2004.

National Oceanic and Atmospheric Administration (NOAA). 1996. Coastal Zone Management Act. Available online at: http://www.ocrm.nos.noaa.gov/czm/czm_act.html. Accessed 12May2004.

O'Clair, R.M., and C.E. O'Clair. 1998. Southeast Alaska's rocky shores: animals. Plant Press, Auke Bay, AK.

Peden, A.E., and G.W. Hughes. 1984. Distribution, morphological variation, and systematic relationship of *Pholis laeta* and *P. ornata* (Pisces: Pholididae) with a description of the related form *P. nea* n. sp. Canadian Journal of Zoology 62:291-305.

Robards, M.D., J.F. Piatt, A.B. Kettle, and A.A. Abookire. 1999. Temporal and geographic variation in fish communities of lower Cook Inlet, Alaska. Fishery Bulletin 97:962-977.

Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea and W. B. Scott. 1991. Common and scientific names of fishes from the United States and Canada. American Fisheries Society, Special Publishing 20. 183 pp.

Smith, R.L. and A.C. Paulson. 1977. Osmoregulatory seasonality and freezing avoidance in some fishes from a subarctic eelgrass community. Copeia 1977:362-369.

Tindall, B. 2004. Tidal attraction. Sierra. May/June 2004: 48-55; 64.

Yatsu, A. 1981. A revision of the gunnel family Pholididae (Pisces, Blennioidei). Bull. Natn. Sci. Mus. Ser. A (Zool.), 7:165-190.

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